North Shore of Long Island, Asharoken, Suffolk County, New York

Coastal Storm Risk Management Feasibility Study

Feasibility Report

November 2015

New York State
Department of
Environmental Conservation

U.S. Army Corps of Engineers
North Atlantic Division
New York District

EXECUTIVE SUMMARY

The Coastal Storm Risk Management Feasibility Study for Asharoken, Suffolk County, New York is in the feasibility phase. A focused array of alternatives has been evaluated, and the Tentatively Selected Plan (TSP) is presented in this document for consideration. The Tentatively Selected Plan is subject to change based on public and agency review of this report.

The Village of Asharoken is a narrow isthmus connecting the Village of Northport on the 'mainland' of Long Island to the hamlet of Eatons Neck. The village is bordered by Huntington Bay, Northport Bay, and Eatons Neck. The eastern coast of the village fronts Long Island Sound.

The study area experiences moderate to severe beach erosion on the areas fronting Long Island Sound. This erosion is caused by storm-induced waves and wave run-up from hurricanes and nor'easters. The northeast facing shoreline is directly exposed to surges and waves from Long Island Sound generated from coastal storms. Homes, bulkheads, and Asharoken Avenue are susceptible to storm damage. The village has experienced damages from multiple storm events, most recently Hurricane Sandy in October 2012.

The project area extends the 2.4 miles of Asharoken Beach that is most susceptible to storm-induced damages. The southern end of the project area is the western groin of the Long Island Power Authority (LIPA) Northport Power Station. The northern end of the project area boundary is just north of the intersection of Eatons Neck Road and Bevin Road, where an existing Section 103 shoreline protection project is located. This Continuing Authorities Program (CAP) Sec 103 project was designed and constructed in 1996 to reduce damages to this critical road section, until a more comprehensive plan could be implemented through this feasibility study.

Asharoken Avenue provides the only land access to Eatons Neck and the western parts of the Village of Asharoken. As the traffic artery becomes impassible, any evacuation of Eatons Neck is required to be performed by boat or helicopter. Disruption of the road isolates the population of Eatons Neck and Asharoken and impacts the ability of residents to commute to and from work and school. This disrupts electrical service and communications. Disruption of the road cuts off residents from medical services, law enforcement, and food distribution.

The TSP includes 2.4 miles of 50ft wide beach berm with a 3 rock groin field in the vicinity of the erosion surrounding the section 103 project. Of the alternatives considered, it provides the most efficient coastal storm risk management; increased CSRM at the northwest steel bulkhead seawall; reduced erosion rate, nourishment frequency, and quantity at the critical erosion reaches. The estimated total first cost for project implementation is $23,665,000 (October 2014 Price Level), to be cost shared 65% Federal and 35% non-Federal. Annual net benefits are in the amount of $2,570,900 and the benefit-to-cost ratio is 1.4.

The non-Federal sponsor for the study is the New York State Department of Environmental Conservation (NYSDEC). The Village of Asharoken is a local sponsor to NYSDEC.

PERTINENT DATA

DESCRIPTION
The TSP for the US Army Corps of Engineers (USACE) Coastal Storm Risk Management (CSRM) feasibility study for the North Shore of Long Island, Asharoken, Suffolk County, New York consists of 2.4 miles of 50ft wide beach berm with a 3 rock groin field in the vicinity of Bevin Rd. that tapers into existing coastal beach features. The initial fill volume is 600,000 cy with a proposed nourishment cycle of 80,000 cy every 5 years during the 50 year period of analysis (2019-2069).

LOCATION
The Village of Asharoken is located in Suffolk County, NY, within the town of Huntington along the North Shore of Long Island facing the Long Island Sound.

FEATURES
The project spans a geographic distance of approximately 12,400 linear feet and a total area of 75 acres along the coast of Asharoken Beach.

Project Feature	Area
Beach fill:	74.0 acre;
Groin Field:	00.6 acre (within beach fill footprint);
Borrow Area:	55.0 acre/370 acre in Borrow Area A

REAL ESTATE REQUIREMENTS
The project will require temporary and permanent easements. The cost for lands, easements, relocation and disposal (LERRD) is $5,872,000 (October 2014 price level).

Real Estate Requirement	Area (approx.)
Easements	87.0 acres
Fee Simple Purchase	00.7 acres
Total	**88.0 acres**

PROJECT COSTS (Discount Rate 3.375%; October 2014 price levels)	
Initial Project First Cost	$23,665,000
Annualized Initial Constr.	$806,000
Annual Nourishment Cost	$883,000
Annualized Monitoring Cost	$50,000
Annual OMRR&R Cost	$156,000

ECONOMICS (October 2014 price levels)	
Annual Project Cost (Discounted at 3.375% over a 50-year period)	$1,914,000
Average Annual Benefits (Discounted at 3.375% over a 50-year period)	$2,571,000
Average Annual Net Benefits	$657,000
Benefit Cost Ratio	**1.4**

COST APPORTIONMENT (October 2014 price levels)

Initial Project Cost	
Federal (65%)	$15,382,300
Non-Federal (35%)	$8,283,000
Total	$23,665,000
Renourishment Cost	
Federal (50%)	$28,883,000
Non-Federal (50%)	$28,883,000
Total	$57,765,000

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Cover Image: Aerial view of the Village of Asharoken looking north. (Shoreline Photography)

1.0 INTRODUCTION

1.1 STUDY PURPOSE AND SCOPE

The U.S. Army Corps of Engineers (USACE) North Atlantic Division (NAD), New York District (NAN) prepared this feasibility report for the North Shore of Long Island, Asharoken, New York (Asharoken) coastal storm risk management study. It includes input from the non-Federal study sponsor, local governments, natural resource agencies, non-governmental organizations, and the public. This report presents the Tentatively Selected Plan for managing coastal storm risk in the incorporated Village of Asharoken in the Town of Huntington, Suffolk County, New York (Figure 1).

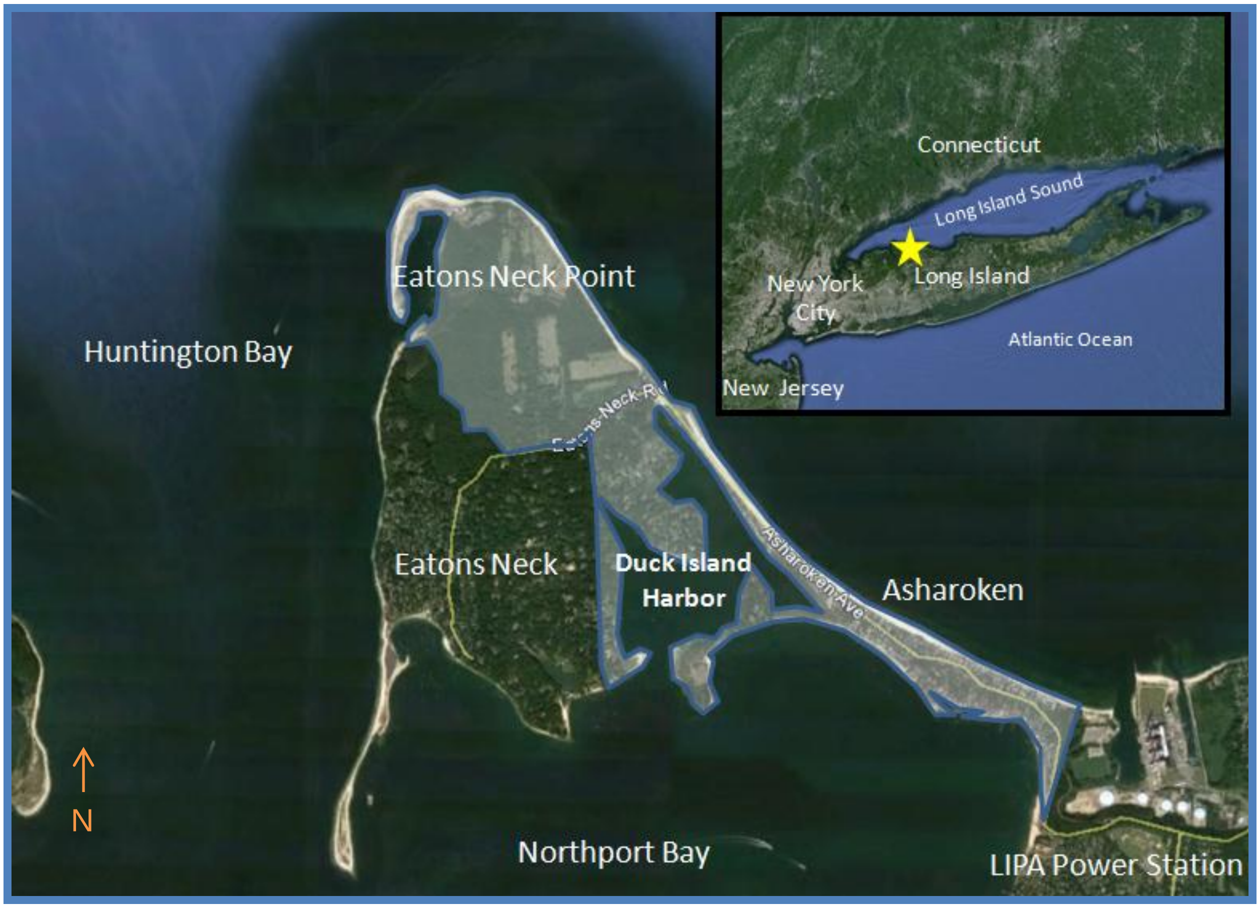


Figure 1: Village of Asharoken, Suffolk County, New York.

The Federal objective of water resource project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements (P&G, 1983). Water resource project plans are formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. Pursuant to this, this feasibility report will: (1) summarize the current and potential water resource problems, needs, and opportunities for coastal storm risk management in the Village of Asharoken; (2) present and discuss the results of the plan formulation for water resource management solutions; (3) identify specific details of the selected plan, including inherent risks and (4) determine the extent of Federal interest and local support for the plan.

Figure 2: Homes on Asharoken Avenue fronting Duck Island Harbor. Long Island Sound is east.

1.2 NEED FOR ACTION

The Village of Asharoken is located on the north shore of Long Island approximately 25 miles east of New York City. The village experiences moderate to severe beach erosion on the Long Island Sound shore. This erosion is caused by storm-induced waves and wave run-up from hurricanes and nor'easters. The shoreline faces north and northeast, so it is directly exposed to surges and waves from Long Island Sound generated from coastal storms. Homes, bulkheads and Asharoken Avenue are all susceptible to storm damage. The village has experienced damages from multiple storm events, most recently Hurricane Sandy in October 2012.

Most development in the village is located on the narrow section of land between Long Island Sound, and Northport Bay and Duck Island Harbor. The narrowest part of this area is approximately 230 feet, expanding to 1,000 feet (one fifth of a mile) to the south (Figure 2). Asharoken Avenue, the only access road to interior portions of the village and Eatons Neck, follows the isthmus. Beaches and structures in this area are subject to severe erosion caused by hurricanes and nor'easters. Recent storms that have impacted Asharoken include Hurricane Sandy (2012), Hurricane Irene (2011), Hurricane Ernesto (2006), and nor'easters in 2010, 2009, 1996, and 1992. Storms events resulted in prolonged Asharoken Ave disruption, compromised utilities and access due to severe erosion, overtopping and damage to infrastructure and homes.

During the most recent storms, the northern area of Asharoken beach experienced storm surge and wave attack that has caused overtopping of the dune system and erosion of the beach. This overtopping has deposited sand and debris on Asharoken Avenue, causing the road to be impassible for days (Figure 3). The overtopping also caused damage to utilities and the road bed. Asharoken Avenue was closed for days immediately after Hurricane Sandy and Hurricane Irene, making emergency response very difficult and travel for residents impossible. During the March 2010 nor'easter Asharoken Avenue's roadbed was damaged enough that fiber optic cables were exposed.

Closure of Asharoken Avenue disrupts access for the residents of Eatons Neck. The loss of access creates a safety hazard when Eatons Neck is cut off from emergency services including fire, police, and ambulance. Although there is a volunteer fire department in Eatons Neck, no additional resources are available to fight a large fire when the road is impassable. During the March 1993 nor'easter, fire fighters were unable to reach a burning residence due to flooding on Asharoken Avenue. While Asharoken Avenue was blocked during a December 1992 storm, two residents of Eatons Neck had to be evacuated by helicopter for medical treatment. Continued erosion has left additional sections of the road exposed to a potential for catastrophic failure that could require emergency evacuation of the isolated community of Eatons Neck.

There is a severe storm-induced erosion problem along the southeastern portion of Asharoken Beach. The beach is narrow and low, and residents have constructed a nearly continuous line of private bulkheads to protect their homes. These bulkheads vary in height, construction material, and condition. Consequently, the level of performance provided by these structures is inconsistent and uncertain. Failure of these bulkheads would result severe damages to infrastructure along this portion of the Asharoken isthmus, including Asharoken Ave and approximately 70 year-round residences. During the December 1992 nor'easter most residential structures along the Long Island Sound were not directly damaged by erosion, but the privately constructed bulkheads were damaged due to erosion and wave attack. During Hurricane Sandy, waves overtopped the bulkheads resulting in localized failure and caused surface erosion and flooding of structures.

Jetties by the Northport Basin located in the Long Island Power Authority (LIPA) Northport Power Station have contributed to the long-term erosion problems west of the west jetty, although coastal effects from Long Island Sound dominate the erosion processes along the entire downdrift coastline. Since the original construction of the jetties in 1932, the shoreline just east of the jetties has experienced accretion, while the shores to the west and northwest (Asharoken Beach) have experienced continued erosion. Analysis of sediment transport around the effluent pipes and the jetties indicate that an effective littoral block is formed near the outfall. This littoral block effectively limits sediment movement from the east to west. The only sand that is currently being bypassed around the jetties is the inlet dredge material that is placed on the beach just west of the west jetty as part of the power plant operation.

Figure 3: Residents observe flooding on Asharoken Avenue following Hurricane Irene (2011).

1.3 STUDY AUTHORIZATION

The North Shore of Long Island, New York study was authorized by the Committee of Public Works and Transportation, United States House of Representatives, adopted May 19, 1993. The study was called for after multiple storms caused significant flooding and erosion on the north shore of Long Island.

> *The Secretary of the Army, acting through the Chief of Engineers, is requested to review the report of the Chief of Engineers on the North Shore of Long Island, Suffolk, County, New York, published as House Document 198, Ninety-second Congress, Second Session, and other pertinent reports to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of beach erosion control, storm damage reduction and related purposes, on the North Shore of Long Island, New York, particularly in and adjacent to the communities.*

In response to extensive regional storm damage in the aftermath of Hurricane Sandy, Congress passed the Disaster Relief Appropriations Act of 2013 (Public Law [P.L.] 113-2). The Asharoken study was identified in the May 2013 Second Interim Report to Congress as a feasibility study to be completed at 100% Federal expense. This report responds to this authorization.

1.4 NON-FEDERAL SPONSOR

The non-Federal sponsor for the study is the New York State Department of Environmental Conservation. The Federal Cost Sharing Agreement (FCSA) of 2001 granted this feasibility study to be completed at a 50%/50% cost-share. Following the FCSA amendment in 2013, the study is being completed at full Federal expense using funds from the Disaster Relief Appropriations Act of 2013 (PL113-2).

1.5 PRIOR STUDIES AND REPORTS

The USACE has investigated potential solutions for coastal storm risk management and beach erosion in the study area since the 1960s.

i. The **Beach Erosion Control and Interim Hurricane Study** was completed in June 1969. The final report detailed a possible plan that would include the construction of floodwalls, dunes and barrier structures. The plan was found not to be economically feasible.
ii. A **Continuing Authorities Program (CAP) Section 14 Initial Appraisal Report** was completed in June 1986. It stated that no critical public facilities (roads, utilities, and government buildings) were being imminently threatened by erosion.
iii. A **CAP Section 103 Reconnaissance Report** was completed in November 1988). It stated that there was no justification for Federal participation in a project.
iv. A **CAP Section 14 Initial Appraisal Report** was completed in November 1993 in response to the December 1992 Nor'easter It stated that an emergency situation existed along Asharoken Avenue and that Federal interest in a project was warranted. A project was constructed in 1996-1997 under Section 103 of the River and Harbor Act of 1962.
v. A **Reconnaissance Report of the North Shore of Long Island** was completed in 1995. It identified a potential Federal interest in pursuing a feasibility study for the Asharoken Beach shoreline (2.4 miles) and other north shore problem areas.

1.6 EXISTING WATER PROJECTS

A number of protection measures have been constructed on Asharoken Beach, only one of which is a Federal project. They are described below from west to east.

i. An emergency shoreline stabilization project for the northwestern 900 linear feet of Asharoken Avenue near Bevin Road was completed in 1997 by the USACE in partnership with the New York State Department of Environmental Conservation (NYSDEC) under the authority of CAP Section 103 (Figure 4). Following the Dec. 1992 Nor'easter, this project was evaluated as a Section 14 project, and ultimately constructed as a Sec. 103 project, as a programmatic decision. The project design consisted of a reinforced dune, including a 10-foot tall steel sheet pile (top elevation of + 12.5 feet National Geodetic Vertical Datum (NGVD29†) of 1929) with a tie-back concrete wall, fronted with riprap toe protection on the exposed (Long Island Sound) side, and sand backfill on the landside. A 20-foot wide artificial dune behind the wall was stabilized with geotextile matting and planted with dune grass.

Figure 4: USACE Section 103 project repaired after a storm (Picture taken June 2011). Timber caps were replaced with bent steel caps after Hurricane Sandy (2012).

The project has generally performed as expected, and reduced damages to Asharoken Avenue. The performance of the project has been affected by changed conditions since initial construction, including the erosion of the beach in front of the project. The project was also designed with a relatively low-level of design, since it was intended as a stop-gap measure until a larger project could be constructed. The low-level of design, and the erosion in front of the project have resulted in storms that damaged the structure which required repairs. Tropical Depression Ernesto in September 2006 damaged the Section 103 project, and emergency repairs were made in two phases in 2007; the NorIda coastal storm in November 2009 and a nor'easter in March 2010 again damaged the project and a short length of the roadbed of Asharoken Avenue, and emergency repairs were again made; and, finally, the

† Current USACE Policy requires studies to use the North American Vertical Datum (NAVD88) of 1988. Since a significant amount of work on this study was completed using the National Geodetic Vertical Datum (NGVD29) of 1929 the data has been presented in NGVD29. NAVD88 is 1.1 ft higher than NGVD29 in the study area.

project was again damaged during Hurricane Irene in August 2011 and Hurricane Sandy in October 2012, and the project was yet again repaired.

With these repairs, the project continues to provide a low level of risk reduction (approximately a 10% annual chance of exceedance). It is expected that the project will be maintained in the future, but that the project will continue to be damaged by storm events and require repairs in the future. The effectiveness of the project will also continue to diminish in the future with continued long-term erosion in front of the project.

ii. A stone groin was constructed at the northwest portion of the shoreline in 1952, in the vicinity of where Asharoken Ave. & Bevin Rd. interact. This existing stone groin is located at the southeast end of the existing Section 103 Project and is acting as a terminal structure, trapping a significant quantity of longshore material and essentially holding the beach to the southeast in place in its current configuration. The exact condition and level of protection of the structure is undetermined.

Figure 5: Stone groin and non-engineered minor groins at eastern extent of project area.

iii. Three non-engineered groins constructed to the northwest (downdrift) of the stone groin were identified in front of the Section 103 seawall. Details of the three groins design, material, date of construction are unknown, however, they are likely composed of concrete cube armor blocks during the same time period with the stone groin. Although partially damaged, the three groins appeared to maintain a basic downdrift shoreline with dune and beach until damaged by the 1996 northeaster and several storms that followed.

Additional groins are evident along Asharoken beach. The groins are visible along the shoreline in front of the residential bulkheads on the southeastern portion of the project area. These interlocking groins appear to have been constructed along the eroding stretch of shoreline by New York State Department of Public Works in 1956 with the intention of stabilizing the critical erosion shoreline. Several of these groins are exposed just above the MLW line.

Figure 6: Exposed minor interlocking groin

iv. The southwestern portion of the project shoreline is populated with residential development with year-round houses built to the edge of water. Typical beach profiles in this study reach include residential properties extending landward from privately built bulkheads. These mixed timber, concrete and sheetwall bulkheads along the eroding stretch were constructed and are maintained by the property owners themselves. The average height of the bulkheads and ground elevation behind the bulkheads is approximately +13 ft NGVD.

Figure 7: Residential Bulkheads fronting eroded shoreline and submerged minor groins.

v. The 1962 Ash Wednesday storm was uniquely characterized by five successive storm-induced high tides, which resulted in severe erosion within Asharoken. To repair this damage, about 840,000 cy of sand (640,000 by New York State and 200,000 by the Village of Asharoken) were placed on the beach in the Village of Asharoken. The sand was taken from an offshore borrow area close to the beach, which is still visible in the current bathymetry. This placed sand has largely eroded in the past 50 years.

vi. In 1929 Metropolitan Sand and Gravel Co. filed with Corps of Engineers for a permit to construct two jetties into Long Island Sound at the western corner of their property located east of the Village border. The jetties were constructed between 1931 and 1932 with a lagoon (a.k.a. Northport Basin) and inlet channel dredged shortly thereafter. In March 1968, Long Island Lighting Company (LILCO) purchased the property and requested a change in the permit to construct a power plant adjacent to Northport Basin. As part of LILCO's plant construction, the existing barge jetties were rehabilitated into permanent quarry stone and concrete riprap jetties, and LILCO received a change of permit for permanent maintenance of the jetties (LILCO, September 1977).

The jetties now protect the inlet to the cooling water intake lagoon just west of the power plant. Tugs and other vessels use the basin and the channel between the jetties to service a fuel platform located two miles offshore where 50,000 Displaced Weight Tons (DWT) tankers dock to unload oil for the power plant. Recreational boaters and some commercial fisherman also use the Basin to launch their vessels. Since its construction, the power plant has bypassed material dredged from the channel serving the cooling water intake lagoon and deposited the material on the beach west of the jetties. The power plant's permit requires bypassing of sand equivalent to the amount that is captured in the littoral system. The powerplant has recently been bypassing sand on a 3 year cycle with the placement of 15,000 CY of sand per year, consisting of 10,000 CY of sand from Northport Basin, and 5,000 CY of sand that is trucked in. It is expected that the without–project future bypassing by the power plant would be 15,000cy/yr.

Figure 8: LIPA power plant jetties at western extent of project area.

1.7 STUDY AREA

The study area encompasses the Village of Asharoken (see Figure 1). It is a narrow isthmus connecting the Village of Northport on the 'mainland' of Long Island to the hamlet of Eatons Neck. The village is bordered to the west by Huntington Bay, Northport Bay, and Eatons Neck. The eastern coast of the village fronts Long Island Sound. Asharoken Avenue, which runs along the isthmus, provides the only land access to Eatons Neck and the western parts of the village. The LIPA Northport Power Station is located just south of the village boundary. The communities of Northport, Centerport, and Huntington Bay are located further south.

The village is mostly residential. There were 654 residents residing in 302 households in 2010 (U.S. Census, 2010). Residents are served by the Asharoken Police Department, which is currently operating out of a temporary trailer shared with Village Hall (Figure 9). The hall was flooded by Hurricane Sandy and is currently being rebuilt.

Figure 9: Asharoken Village Hall and Police Department are currently operating out of a temporary trailer. Village Hall was flooded by Hurricane Sandy (2012).

Eatons Neck Point located in the northernmost portion of the village is sparsely developed, and predominantly residential. A U.S. Coast Guard (USCG) station is located on the northern tip of Eatons Neck Point. The station is responsible for National maritime safety in the middle portion of Long Island Sound from New York City to Port Jefferson, New York/Bridgeport, Connecticut. The historic Eatons Neck lighthouse, the sixth oldest in the Nation, is located on the USCG station.

1.8 PROJECT AREA

The project area is the location of proposed work, and extends the 2.4 miles of Asharoken Beach. It includes the area where the homes and road are susceptible to storm-induced erosion and overtopping. The northern end of the project area boundary is just north of the intersection of Eatons Neck Road and Bevin Road near the Section 103 shoreline project. The project area extends south to the western groin of the Power Station.

The project area has been subdivided into two primary reaches (study evaluation sections) along the Long Island Sound shorefront, with each being sub-divided into two sub reaches (Figure 10). The purpose of these designations is for engineering and economic analysis.

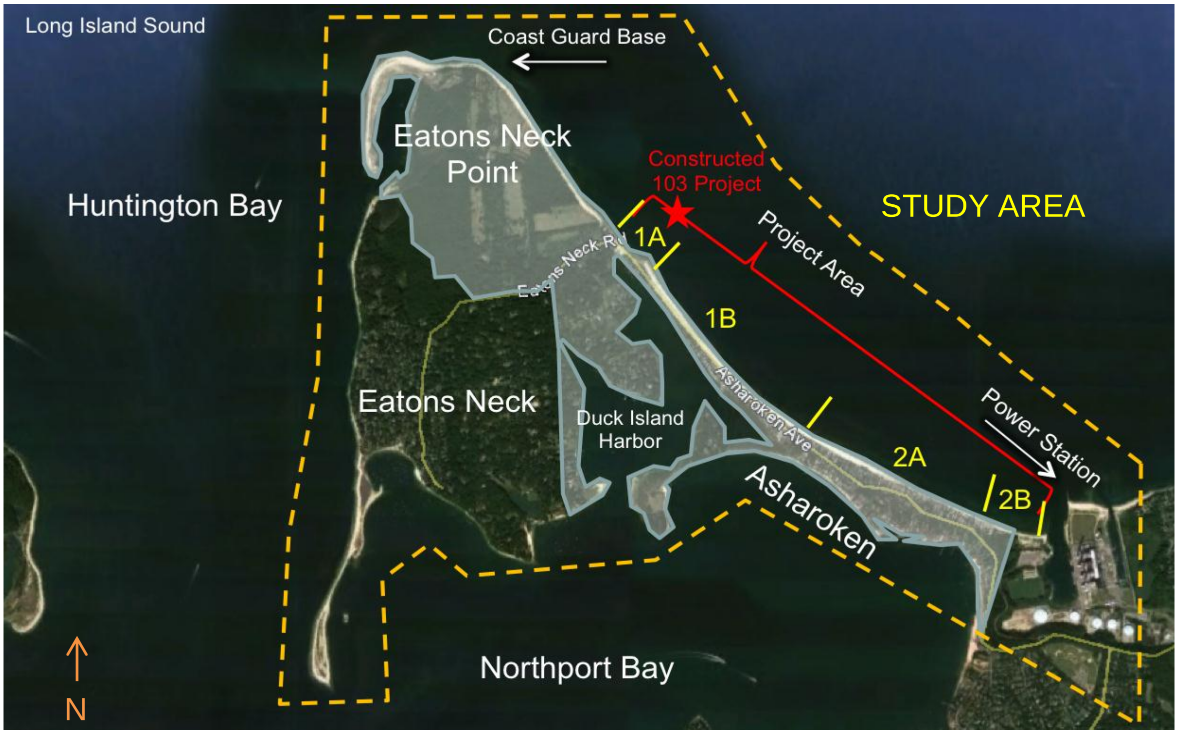


Figure 10: Project area. Reaches are located between the yellow lines.

1.8.1 Reach 1A

Reach 1A extends about 900 feet from the vicinity of Bevin Road east to the existing stone groin. It includes the USACE Section 103 bulkhead and dune project, as described in section 1.6. The temporary bulkhead and dune project was constructed by the USACE from 1996 to 1997 and repaired in 2007, 2010, and 2013. The project was designed to reduce the threat of compromising Asharoken Avenue until a more comprehensive solution could be developed. The constructed project is assumed to be in-place in the without project condition and maintained to function as designed. Because of continued erosion in front of the existing project, the Section 103 project is expected to provide a 10-year level of risk reduction (provide risk reduction for a storm with a 10% chance of occurring in any given year). The road elevation in this reach is approximately +7-9 ft NGVD29. The beach profile in this reach is characterized by a steep foreshore slope and a narrow, almost nonexistent berm in front of the steel bulkhead, and toe stone. Beach widths above 0 NGVD in this reach range from 0ft to 20ft

1.8.2 Reach 1B

This 5,300-foot long reach extends from the stone groin southeast to near Duck Island Lane. The shoreline in this area is narrow and has only a remnant dune, most recently destroyed by Hurricane Sandy and repaired with trucked in sand. This reach contains a dune and beach area with a dune crest of +15 ft NGVD29, a sloping berm, a steep foreshore slope, and a mild offshore slope. Asharoken Avenue lies just landward of the narrow dunes with residential structures located further landward. Some of the dunes in this reach are no more than steeply sloped fill material placed just seaward of the road. Moving from northwest to southeast the dunes become more natural and wider and have considerable vegetation. The average ground elevation behind the dune is approximately +8 to +10ft NGVD29. The average beach width is approximately 100 feet. The 50-foot wide sloping berm changes from +12 ft NGVD29 at the toe of the dune down to +5 ft NGVD29. The foreshore slope is about 1 ft vertical to 8 ft horizontal.

1.8.3 Reach 2A

This 5,000-foot reach extending from Duck Island Lane southeast to the last residential structure on the waterfront is characterized by waterfront properties protected by timber bulkheads at an average crest elevation of +14 ft NGVD29. The bulkheads were constructed by individual property owners who are also responsible for any maintenance they may require.

The average ground elevation behind the bulkhead is +13 ft NGVD29. There is a stretch 800-1000 feet long of shoreline within the reach without bulkheads that have dunes with a crest elevation averaging +15.5 NGVD29. Some bulkheads have riprap toe stone protection. The beach width ranges between 0 ft and 120 ft above 0 ft NGVD. The beach berm has a maximum elevation of +12 ft NGVD29 which gently slopes down to an average berm height of +4NGVD29.

1.8.4 Reach 2B

This reach is 1,200 feet long extending from the last shorefront resident to the west jetty at the power plant. This shoreline is undeveloped with a large dune system having a +17 feet NGVD29 dune crest and a sloping berm down to -2 ft NGVD29 and a mild offshore slope of 1 ft vertical on 100 ft horizontal. The average ground elevation behind the dunes is approximately +14 ft NGVD29. The average beach width is between 40 and 60 feet.

2.0 EXISTING CONDITIONS

Existing conditions, which serve as the basis for the characterization of problem identification and projection of future without project conditions, are described in this section. Existing conditions are described through the environmental setting, the built environment, and the human environment.

2.1 PHYSICAL SETTING

2.1.1 Surface Waters

Tides are semidiurnal (twice daily) with a mean tide range of 7.1 feet and spring range of 8.2 feet on Asharoken Beach (Long Island Sound). In Northport Bay these ranges are 7.2 feet and 8.1 feet, respectively. At Eatons Neck, the average maximum strength of current is 2.4 feet per second (fps) for both flood and ebb tides. The tidal current velocity at Asharoken Beach is expected to range from 0.3 to 0.8 fps along the study shoreline. The north shore wave regime is dominated by wind-generated waves across Long Island Sound. For Asharoken Beach, only waves from the northwest clockwise to the east-southeast will reach the near shore area.

Tidal inundation in the study area is caused by the combination of storm-induced water level change and astronomical tides. The storm-induced water level change has several causes: 1) storm winds that exert shearing forces on the water surface; 2) decreased atmospheric pressure; and 3) storm waves that raise the water level along the shore. The combination of the first two effects is defined as storm surge and, when added to the astronomical tide (or normal tide), is called the total stage. The third effect is called wave setup. It is the total stage levels with wave setup that are used for analyses in this report. Stage frequency curves, which relate storm water elevations to the expected risk of occurrence, were developed for Long Island Sound and Northport Bay based on the calculated water elevations for the range of storm return periods (Table 1). A storm having a return period of 100 years is calculated to have an associated water level elevation of +14.25 feet NGVD29 with wave set up on Long Island Sound, and 12.16 feet NGVD29 on Northport Bay.

Table 1: Asharoken Stage Frequency(NGVD29)

(Elevation in ft NGVD; entire storm population included)					
Return Period (Years)	Asharoken Sound Side (w/o wave setup)	Asharoken Sound Side (w/wave setup)	Northport Bay/Asharoken Back Bay	Recon. Report (for Reference Only)	North Atlantic Comprehensive Study (NACCS) (Mean Values)
5	7.47	9.16	7.23	8.4	9.40
10	8.79	10.81	8.57	9	10.25
15	9.42	11.59	9.18		
20	9.84	12.04	9.57		11.01
25	10.12	12.36	9.87	9.5	
44	10.9	13.1	10.7		
50	11.09	13.24	10.93	10.4	12.02
73	11.7	13.77	11.6		
100	12.21	14.25	12.16	11.5	12.91
150	12.92	14.94	13.05		
200	13.44	15.45	13.63	12.6	14.16
500	14.99	17.04	15.53		15.93
Note: NAVD datum is 1.0 ft above NGVD datum					

Table 2: Asharoken Stage Frequency (NAVD88)

(Elevation in ft NAVD; entire storm population included)					
Return Period (Years)	Asharoken Sound Side (w/o wave setup)	Asharoken Sound Side (w/wave setup)	Northport Bay/Asharoken Back Bay	Recon. Report (for Reference Only)	North Atlantic Comprehensive Study (NACCS) (Mean Values)
5	6.47	8.16	6.23	7.4	8.40
10	7.79	9.81	7.57	8	9.25
15	8.42	10.59	8.18		
20	8.84	11.04	8.57		10.01
25	9.12	11.36	8.87	8.5	
44	9.9	12.1	9.7		
50	10.09	12.24	9.93	9.4	11.02
73	10.7	12.77	10.6		
100	11.21	13.25	11.16	10.5	11.91
150	11.92	13.94	12.05		
200	12.44	14.45	12.63	11.6	13.16
500	13.99	16.04	14.53		14.93
Note: NAVD datum is 1.0 ft above NGVD datum					

2.1.2 Relative Sea-Level Change

Relative or “local” sea level change (RSLC) is the locally observed change in sea level relative to a fixed point. It is the additive effect of global or “eustatic” sea level rise of 1.7 millimeters (mm) per year, and the subsidence or uplift rate at a fixed point. RSLC considers the effects of (1) the eustatic, or global, average of the annual increase in water surface elevation due to the global warming trend, and (2) the “regional” rate of vertical land movement (VLM) that can result from localized geological processes, including the shifting of tectonic plates, the rebounding of the Earth’s crust in locations previously covered by glaciers, the compaction of sedimentary strata and the withdrawal of subsurface fluids. USACE projects must consider sea level change when planning and designing projects, per Engineering Regulation (ER) 1100-2-8162 and ETL 1100-2-1 (Dec.2014).

The future SLC for the project area is estimated based on the National Research Council (NRC) and Intergovernmental Panel for Climate Change (IPCC) estimates of eustatic SLC and corrected to include the local land subsidence. Both the historic SLC trend and the future accelerated rate are identified and used for planning, design, sensitivity and risk & uncertainty analysis. The recommendations are summarized as follows:

i. An extrapolation of the historic rate of local mean-sea-level rise shall be used as the low rate of sea level change for analysis, design, and evaluation;
ii. The intermediate rate of local mean sea-level change uses the modified NRC Curve I and NRC equations 2 and 3, and adds the local rate of vertical land movement.

iii. An upper (high) rate of local sea level change is estimated by considering the modified NRC Curve III value, and combining these numbers with the local rate of vertical land movement. This scenario of high rate of local mean sea level rise exceeds the upper bounds of the IPCC estimates from both the 2001 and 2007 and also includes additional sea-level rise to accommodate the potential for rapid loss of ice from Antarctica and Greenland;

The local RSLC chart and curves for both USACE and NOAA rates for year 2016 to 2116 in 5-year interval are shown in the following table and chart. Further details on the development of these curves are contained in the Engineering Appendix.

For project development purposes, the historic rate of RSLC equal to +0.4 ft over 50 years is used for project planning, design, and analysis. Sensitivity, Risk and Uncertainty analyses will be conducted on the selected plan to determine how sensitive the recommended design is to the various rates of SLC, how RSLC affects calculated risk, and what design or operations and maintenance measures can be implemented to minimize adverse consequences of accelerated RSLC. Both the USACE intermediate and high rates in future 50 and 100 years will be used for sensitivity, risk & uncertainty analysis.

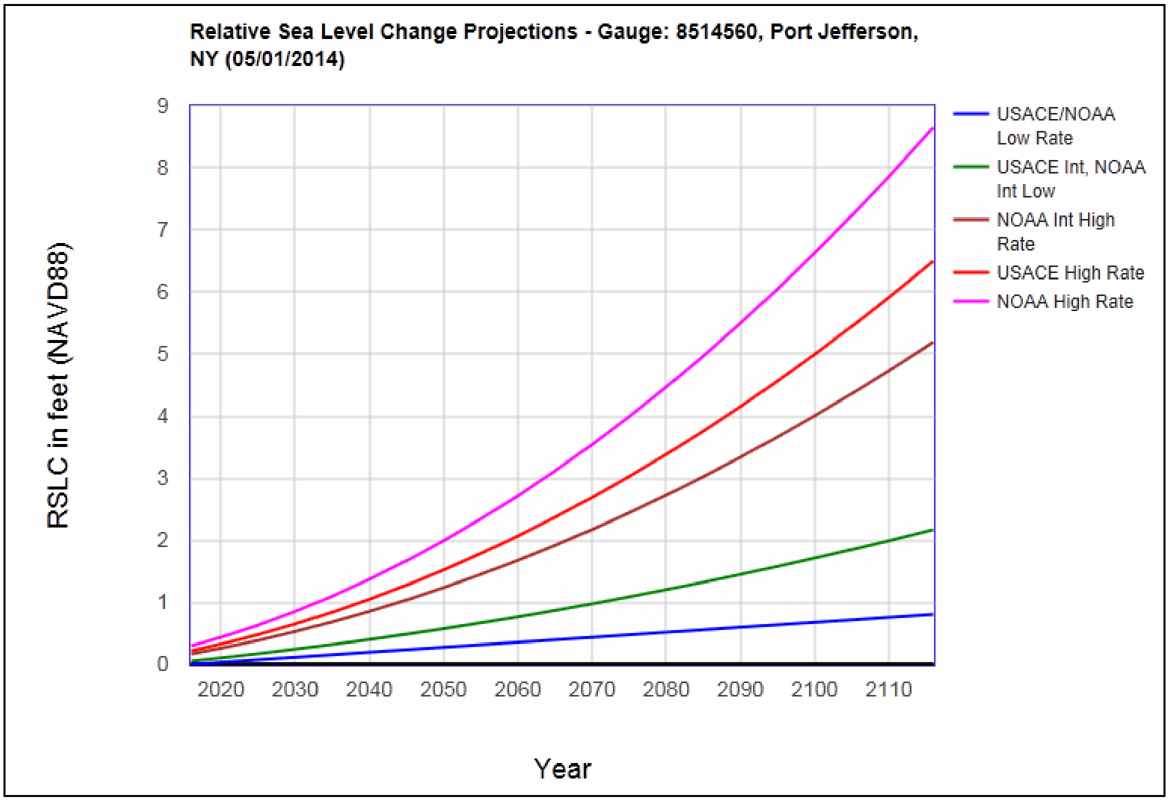


Figure 11: Relative Sea Level Change Projections – Port Jefferson, NY

2.1.3 Storm Event History

Storms and erosion have played a large role in the history of Asharoken. The Asharoken area is subject to damages from hurricanes and from extratropical cyclones known as nor'easters. Hurricanes typically strike the area from June through November; Nor'easters are most likely to occur from October through March. Table 3 is a list of storms that have affected the Asharoken area. Historically, nor'easters with northeasterly winds produce large waves and wave setup along the north shore of Long Island. Such winds that persist through numerous tidal cycles have caused the greatest amount of wave and erosion damages along the study area. The December 1992 nor'easter and March 1962 nor'easter are two such events that impacted Asharoken even more severely than Hurricane Sandy.

Table 3: Historical Storms Impacting New York Area

Hurricane			
Date	Name	Date	Name
14-Sep-04	-	19-Aug-91	Bob
8-Sep-34	-	8-Oct-96	Josephine
21-Sep-38	-	7-Sep-99	Floyd
14-Sep-44	-	1-Sep-06	Ernesto
31-Aug-54	Carol	28-Aug-11	Irene
2-Sep-54	Edna	29-Oct-12	Sandy
5-Oct-54	Hazel		
3-Aug-55	Connie		
12-Sep-60	Donna		
10-Sep-61	Esther		
20-Aug-71	Doria		
14-Jun-72	Agnes		
6-Aug-76	Belle		
27-Sep-85	Gloria		
3-Mar-31	-	30-Oct-91	-
17-Nov-35	-	1-Jan-92	-
25-Nov-50	-	11-Dec-92	-
6-Nov-53	-	2-Mar-93	-
11-Oct-55	-	12-Mar-93	-
25-Sep-56	-	28-Feb-94	-
6-Mar-62	-	21-Dec-94	-
5-Nov-77	-	5-Jan-96	-
17-Jan-78	-	6-Oct-96	-
6-Feb-78	-	2-Feb-98	-
22-Jan-79	-	14-Apr-07	-
22-Oct-80	-	15-Nov-09	Nor'Ida
28-Mar-84	-	13-Mar-10	-
9-Feb-85	-	17-Apr-11	-

2.1.4 Hurricane Sandy Damage

Hurricane Sandy passed over Asharoken in the period from late October to early November 2012 for duration of three days. The storm track traveled through New York Bight and inflicted heavy damage to the northern New Jersey and western Long Island Atlantic shoreline with combined storm surge and wave forces. However, along the North Shore of Long Island, the peak of Hurricane Sandy coincided with low tide. As a result, the effects to the Asharoken shoreline were not as significant. Based on USGS data collection after the storm, the high water marks along both LI Sound and Bay shoreline were approximately +11 ft NGVD29. Although Hurricane Sandy impacted at low tide, the effects were still felt along the Asharoken shoreline. In Reach 2 homeowners experienced damage to their existing bulkheads, overtopping of the structures, flooding, and erosion of the shoreline fronting their homes. Along Reach 1 large stretches of the dunes along Asharoken Avenue were flattened, and erosion of the beach significantly lowered the beach height. The existing Section 103 Project was significantly overtopped, was damaged and required repairs to be made. Asharoken Avenue was closed for days until the roadway could be reestablished. The consequences of Hurricane Sandy could have been far greater if the storm coincided with high tide in the Study Area.

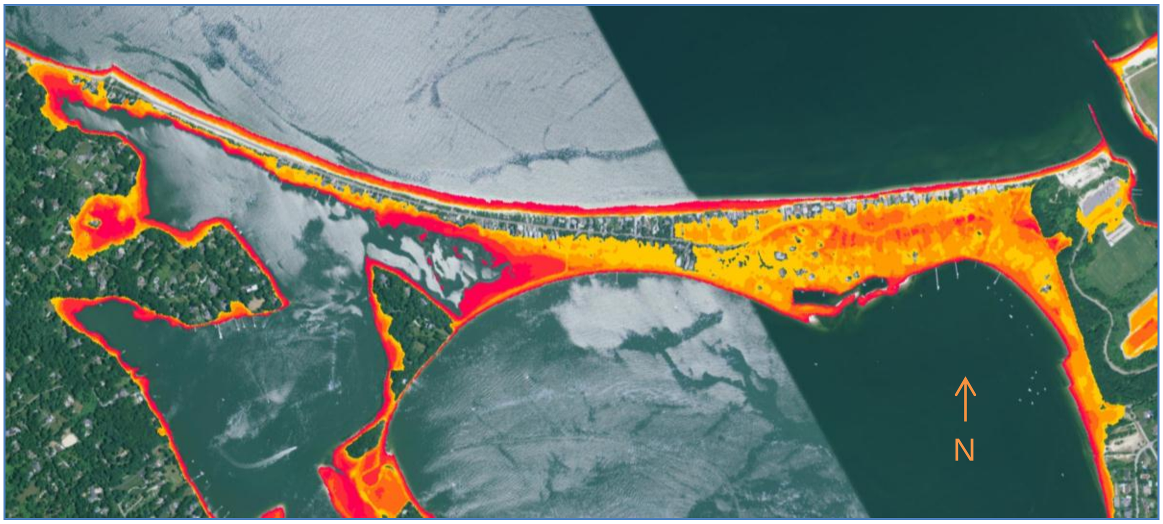


Figure 12: Hurricane Sandy Flooding

2.1.5 Geology

Long Island is part of the inner part of the Atlantic Coastal Plain. Parts of the deposits of the island are true coastal plain deposits, whereas the greater portion of both the surficial and underlying materials are Pleistocene and represent morainal and outwash accumulations associated with the continental glaciers. The extensive unconsolidated sediments underlying the study area range from fine silts and clays to sands and coarse gravel.

In the late 18th century a shoal began to form between Long Island and Eatons Neck Island, gradually becoming navigable at high tide only. As a result of longshore sediment transport predominantly from the east, accretion of the shoal continued, eventually joining Eatons Neck with Long Island, and forming the Asharoken Isthmus.

The nearby study shoreline vicinity is highly irregular, indented by several deep harbors and bays. The narrow beaches of the necks are backed mostly by bluffs in the vicinity of 30 feet high with some parts of Eatons Neck over 75 feet high. Material eroded from the necks, headlands and offshore islands have been deposited as spits, baymouth bars and isthmus.

2.1.6 Shoreline Characteristics

The Asharoken shore faces northeast on Long Island Sound located between the Eatons Neck Point bluffs to the northwest and the power plant to the southeast. Elevations decrease easterly from Eatons Neck Point to generally 10-15 feet NGVD29 from the vicinity of Bevin Road to the west jetty of the power plant cooling water intake lagoon. The northwestern half of Asharoken Beach (Reach 1) is backed by the upper limit of Duck Island Harbor and a row of residences located at the bay side or landward side of Asharoken Avenue. Seaward of Asharoken Avenue is an eroded dune area fronted by a beach berm sloping to the Long Island Sound. The southeastern half of the 2.4-mile stretch (that is, Reach 2) consists of a setback section of Asharoken Avenue, thence seaward a single row of residential structures most of which are perched near a bulkhead line of protection overlooking a low sloping beach about 100-150 feet wide.

2.1.7 Littoral Materials

Asharoken Beach was formed and is sustained by littoral sediment from the east because the predominant sediment forcing wave action is from the northeast. Littoral materials also come from the west as the Eatons Neck bluffs erode providing sediment driven eastward by waves from the northwest. The net volume of littoral material contributed to Asharoken Beach is naturally supplied from the east. The jetties and lagoon at the east end of Asharoken Beach originally constructed in 1931-1932 as part of a sand mining operation altered the previous natural pattern of littoral movement producing an effect that continues today. Since the construction of the jetties and lagoon with the navigation entrance channel, the shoreline east of the basin has accreted, while the shoreline west of the jetties recessed from its natural position. Based on dredging records from the power company, the average bypassing rate in the period 1962-2001 is approximately 10,000 cubic yards/year from the intake channel deposited on the beach just northwest of the west jetty. In recent years the powerplant has bypassed 15,000 CY/year. Even with the 840,000 cubic yards of material in the 1960's and the bypassing of channel dredged material, the immediate downdrift shore continued to erode.

Since the construction of the jetties by the sand mining operation and the subsequent rehabilitation by LILCO, the composition of the beach has changed. Before 1930, the mean grain size of the sand on the beach was about 0.3 mm; currently the mean grain size is about 0.9 mm. The median grain size changed over time because the beach was not receiving a continuous supply of new sand from the east and the storm actions washed away the fine-grained sand. As a consequence, the sand that is currently being trapped east of the jetties is finer than that on the beach.

2.1.8 Sediment Budget

In order to forecast the potential future condition of Asharoken Beach and to determine the volumes of beach fill material that would be needed for an alternative to protect the community and stabilize the shore, a detailed sediment transport study was undertaken (see the Engineering Appendix). A coastal planning and engineering tool known as a sediment budget was developed to quantify baseline and existing transport rates for the region between Crab Meadow to the east and Eatons Neck to the west for the overlapping periods 1962 to 2001 and 1976 to 2001. Ten sediment budget cells were established at coastal structure boundaries and where shoreline orientation changes are significant as shown in Figure 13.

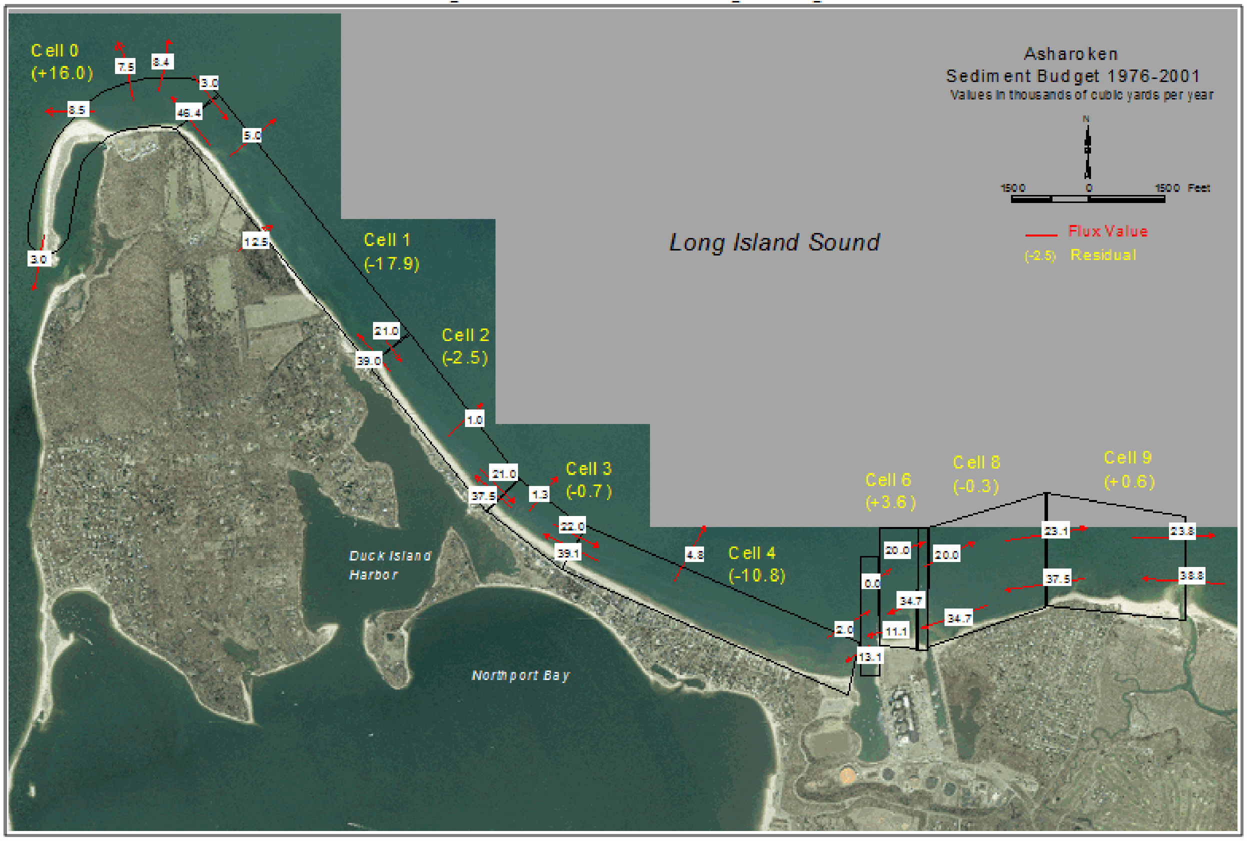


Figure 13: Sediment Budget Diagram

The 1976-2001 sediment budget excludes the effect of the beachfill in the mid-1960's but includes the current and ongoing sand bypassing by the power plant. This sediment budget provides several useful key erosion and transport rates summarized as follows (note that all rates are rounded to thousands to reflect the degree of confidence):

i. Based on the 1976-2001 sediment budget, the erosion rate on the eastern shoreline immediately west of the jetties (Cell 4) is eroding at approximately 10,000 cy/year after the 10,000 cy/year bypassed from upstream by the power plant, a total erosion rate of 20,000 cy/year;

ii. The shoreline in the middle of Asharoken Beach (Cells 3 and 2) are more stable, experiencing minor shore erosion at approximately 4,000 cy/year;

iii. Beach erosion increases along the western shoreline (Cell 1) at approximately 18,000 cy/year. The 900 ft Section 103 Project shoreline experiences higher erosion due to interruption of sediment supply by a stone groin located just east of this section;

iv. The sand spit just west of Eatons Neck Point (Cell 0) is growing at a rate of 16,000 cy/year, representing net sediment transport into this cell less sediment lost offshore;

v. The sediment supply from upstream shoreline is approximately 15,000 cy/year (Cell 8 to Cell6). 15,000 cy/year is currently being placed on the beach downstream (Cell 4) by the powerplant from bypassing via dredging and from trucking from upland sources.

2.2 EXISTING SOCIOECONOMIC CONDITIONS

2.2.1 Demographics

Population in the study area has been used to identify the impact of road closures and transportation disruption. Detailed studies of future population growth and other projections have not been undertaken. Modest population growth is projected over Suffolk County as a whole for the next 25 years, recent data indicates that the study area experienced an increase in population of 4.6% from 2000 to 2010.

From 1990 to 2000, within Asharoken itself, there was an overall decline in population. The decrease in population in Asharoken was assumed by the Village Master Plan to result from several factors: Many of the children of families that moved to the area in the 80s and 90s had matured and moved away to college or were employed elsewhere and, because of the high cost of property, homes that were coming onto the market tended to be purchased by older people whose children no longer lived at home. The 2010 census data for Asharoken shows a 51.5% decrease in population for children under age 5, a 31% increase for 5 to 19 and 20 to 64 age groups and a 27% increase in the over age 64 . The population of Eatons Neck declined at a slower rate than Asharoken between 1990 and 2000. There was a decrease in people under 45 and an increase in people of retirement age during this time. From 2000 to 2010 the population of Eatons Neck increased by 1.3%. The overall increase included a 40.6% reduction in children under age 5 and 6.5% reduction in ages 20-64 along with a 21.1% increase in ages 5 to 19 and 28.4% increase over the age of 64. In light of this data which shows a demographic trend toward an older community, and probable resistance of the local community to significant further development, the study has not used projected future population levels in the analysis and has assumed 0% population growth over the period of analysis.

The study also collected data relating to pet ownership and people with disabilities: emergency shelters and hotels are unlikely to accommodate residents' pets, and the cost of ensuring their suitable accommodation is not insignificant. Data from the Humane Society of the USA indicates that more than 800 cats and dogs may be resident in the study area. Census data indicates that more than 150 residents have disability status, and in the event of evacuation, special treatment for such people may tend to increase evacuation costs. However, due to the lack of precise data regarding the nature of these disabilities and the difficulty in quantifying the cost of special evacuation treatment, this data has not been included in the analysis.

2.2.2 Commuters

In the sense that anyone who travels to a place away from their residence for a particular purpose on a daily/regular basis can be considered a commuter, commuters may include both those who travel to their place of work and those who travel to a place of education. This data forms the basis for estimating the number of residents (approx.

1700) who may be cut off from critical essential services or their homes by a significant storm event and who will require temporary accommodation. Economic losses also result from delays to commuters' work journeys. Census data records the use by residents of private and public transport: public transport is assumed to include railroad and bus services, and since the peninsula is not served by any scheduled public transport links, this study assumes that public transport refers to the bulk of the journey to the workplace and does not include journeys by other means (mostly by car) to reach transport nodes such as the Long Island Railroad Station in Northport. Since no schools exist on the peninsula, all residents in education are at risk from being cut off from their homes and may require temporary accommodation, hence their inclusion in the commuter data. Since residents must also leave the peninsula for all services and shopping, the number of people affected by blockage or severance of the isthmus road may be assumed to be more than just those who leave for work and school.

2.2.3 Income/Employment

Comparisons with local (County) and State statistics for household income and the value of owner-occupied housing units tend to suggest that the peninsula is a relatively affluent area, with median household incomes in the study area 50% higher than in the County as a whole, and median house values 2-3 times greater than the County median. The 2000 census also reported that only 8 families in the study area were living below the designated poverty level, and that unemployment in the study area was greater than the County figure but lower than the State average.

Due to the fact that the 2010 census data used was available for discrete communities, an adjustment factor has been applied to raw data for Asharoken Village to determine the population and other socioeconomic data applicable to Northern Asharoken, assuming that socioeconomic factors such as household size and income are evenly distributed across the community. Table 4 presents key socioeconomic base data, which incorporates an adjustment factor to derive figures applicable to the study area, which was discussed in sections 2.21 to 2.23.

Table 4: Key Socioeconomic Data

Socioeconomic Criteria	Asharoken	Northern Asharoken*	Eatons Neck	Peninsula*
Total Population	654	281	1,406	1,687
Under 5 years	16	7	57	64
5-19 years	114	49	304	353
20-64 years	380	163	783	946
Over 64 years	144	62	262	324
Number of households	255	110	519	629
Number of families	199	86	412	498
Families with children <18	59	25	179	204
Housing Occupancy				
Total Housing Units	302	130	575	705
Owner Occupied	227	98	488	586
Renter Occupied	28	12	31	43
Seasonal/Occasional	36	16	41	56
Vacant	47	20	56	76
Household size (Owner Occ.)	2.59	2.59	2.75	2.72
Household size (Renter Occ.)	2.39	2.39	2.0	2.07
Pet Ownership (cats & dogs)	396	170	753	924
Employment				
Population over16 years	549	361	1,038	1,399
In Labor Force	296	127	625	752
Employed	281	121	578	699
Unemployed	15	6	47	53
Unemployed, %	2.7	2.7	4.5	4.17
Total Commuters	275	118	578	696
Motor vehicle (driver)	202	87	415	502
Motor vehicle (passenger)	6	3	50	53
Public transport	41	18	46	64
Pedestrian	0	0	21	21
Mean travel time (mins)	47.7	47.7	45	45.5
School enrollment Total	157	68	361	429
Preschool/kindergarten	16	7	13	20
Elementary school	83	36	238	274
High school	40	17	60	77
College/graduate school	18	8	50	58
Disability Status Total	71	30	123	153
5-20 years	10	4	7	11
21-64 years	31	13	83	96
Over 64 years	30	13	33	46
"go-outside-home" disability	22	9	16	25
Median Household Income	$131,563		$124,167	
Median Family Income	$173,611		$133,158	

*Peninsula: the study area, covering Eatons Neck and Northern Asharoken (assuming 43% of residences in Asharoken Village are in Northern Asharoken, hence located on the peninsula). – Sources: Census 2010, US Census Bureau (except for disability – Census 2000), and The Humane Society.

2.2.4 Study Reaches and Their Structures

It has been assumed that if current conditions remain unchanged, the shorefront (Reach 1) will continue to experience increased storm-induced erosion of beach material, requiring increased periodic repairs to the coastal protection features, and rehabilitation work to maintain the existing Asharoken Avenue and utilities. Such work may include complete reconstruction and replacement of all assets and infrastructure in the event of a catastrophic storm-induced breach of the area. Inundation of structures is considered to be a lesser problem in this area, as there are fewer than 100 residential properties with relatively minor flooding problems. The major concerns of this study are both the vulnerability of the road and the utilities that accompany it across the isthmus and the maintenance of safe access to and from the peninsula for local residents.

For the area from Duck Island Lane southeast to Northport basin (Reach 2), the 70 houses fronting Long Island Sound are vulnerable to erosion and storm damages. The erosion and storm surge and wave attack experiences forced nearly all residents directly on the Long Island Sound to build bulkheads. The cost of maintaining the bulkheads is ongoing and expected to increase. In view of the variable bulkhead designs and conditions, failures will occur leading to rapid erosion of the retained soils from wave runup.

2.2.5 Access

The Village is reached from local roads in Northport which in turn are connected to Route 25A, the northern most east-west artery along the north shore of Long Island. As discussed above, all traffic into and out of the Village and Eatons Neck must pass over Asharoken Avenue.

2.2.6 Land Use

The land use in Asharoken and Eatons Neck is predominately single-family housing. Of the 1500 acres in the Village of Asharoken, fewer than 500 acres are vacant. Within the incorporated Village of Asharoken and the Unincorporated section of Eatons Neck there are four institutional uses: The Village Hall and Police Station, the US Coast Guard Station, the Eatons Neck Firehouse, and the Town of Huntington Beach House. The power plant is located within the study area but is not within the Village of Asharoken.

2.3 EXISTING ENVIRONMENTAL CONDITIONS

The study area encompasses a dynamic marine environment with coastal beach, dune, estuarine marsh, maritime scrub-shrub, and maritime woodland habitats. The northern shore of Long Island has changed over time, not only due to impacts by man but also due to natural processes of erosion and deposition of sediment material. The material of necks and bluffs of the area has been deposited as spits (e.g. West Beach on Eatons Neck), baymouth bars, and isthmuss (sand bars like Asharoken beach) (Davies et al. 1972).

2.3.1 Vegetation

A coastal vegetation survey of the Asharoken study area was conducted by the USACE in September 2001 (USACE-NYD, 2002). The study area encompasses a dynamic marine environment with coastal beach, dune, estuarine marsh, maritime scrub-shrub, and maritime woodland habitats. The beach and frontal dune plant community consists mainly of American beach grass (*Ammophila breviligulata*) and seaside goldenrod (*Solidago sempervirens*). Smaller numbers of seaside spurge (*Chamaesyce polygonifolia*), sea rocket (*Cakile edentula*), common saltwort (*Salsola kali*), and halberd-leaved orach (*Atriplex patula*) were also observed. Scattered patches of American Beach Grass, sea rocket, beach pea, and sea chickweed (*Honckenya peploides*) occur along the northern reach of Asharoken Beach (Eaton's Neck) (USACE-NYD, 2002).

Backdune and roadside areas contain a mix of native and non-native species including: Virginia creeper (*Parthenocissus quinquefolia*), water dock (Rumex orbiculatus), prickly pear (*Opuntia drummondii*), yucca (*Yucca aloifolia*), woolly mullein (*Verbascum thapsus*), ragweed (*Ambrosia artemisiifolia*), common cocklebur (*Xanthium strumarium*), Japanese knotweed (*Polygonum cuspidatum*), Aster spp., field pepperweed (*Lepidium campestre*), pitch pine (*Pinus rigida*), American beach grass, and seaside goldenrod (USACE-NYD, 2002).

Habitat type fluctuates with the change in sediment transport, beach elevation, and erosion. Sand or other substrate lost from one beach is transported through the Long Island Sound system to another beach or to offshore areas. As sand is eroded, maritime woodland acreage is lost on the northeast side of Eatons Neck, the beach profile changes, and sand is transported somewhere else within the Sound's ecosystem. Different plant communities establish as substrate conditions change. For example, pioneer plant species, such as seaside spurge (*Chamaesyce polygonifolia*), sea rocket (*Cakile edentula*), and common saltwort (*Salsola kali*), have adaptations to grow in the extreme high salinity and high wind environment of the beachfront and are the first plants to be seen on a sandy beach with recent deposits of material. Each plant community and habitat type supports a unique assemblage of invertebrates and other wildlife.

2.3.2 Aquatic Resources

The study area and surrounding waters support diverse assemblages of marine biota. A Nearshore Investigation (USACE-NYD, 2005) gathered baseline biological information near Asharoken and Bayville, New York, from fall 2003 through summer 2004. Sampling activities included beach seining to characterize fish assemblages, beach cores to characterize benthic macroinvertebrate communities, and water quality measurements. A concurrent Borrow Area Investigation characterized fish and benthic macroinvertebrates at Borrow Areas A and B from 2003 to 2004.

A Biological Assessment (BA) was submitted to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) by the District as part of the formal consultation process under Section 7 of the Endangered Species Act (ESA), as amended November 10, 1978 (Appendix B). The purpose of this BA is to: 1) address potential impacts to the Atlantic sturgeon, which was recently listed under the ESA (Federal Register Vol 77, No. 24, Monday February 6, 2012; 50 CFR Part 224); and 2)to update the existing beach nourishment consultation to include the Asharoken project for listed sea turtles and whales, including the change to the listing of loggerhead sea turtles (see Appendix B, sub-Appendix C).

Finfish

Nearshore waters are recognized as an important habitat for numerous fish species. Seasonally many individuals in the surf zone are small (e.g., anchovies or silversides) or juvenile stages of larger species. Nearshore and intertidal shallows are considered to be important pathways for juveniles moving in and out of estuarine nursery areas, as well as for adult fish migrating along the coast (Layman 2000). Fish which occupy the surf zone are typically small species or juveniles taking advantage of the shallow water refuge, tending to be opportunistic feeders and will change their dietary preferences according to season and prey availability. The USACE's Nearshore Aquatic Resources Investigation along Asharoken Beach in 2003–2004, resulted in the collection of 6,407 fish and macroinvertebrates representing a total of 20 species.

The NMFS has determined that Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) is comprised of five distinct population segments (DPSs) that qualify as listed species under the ESA: Gulf of Maine (GOM), NY Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic. The Northeast Region of NMFS has listed the GOM DPS as threatened, and the NYB and CB DPSs as endangered. The proposed CSRM project covered by the BA falls within the boundaries of the NYB population, although the marine range for all DPSs extends from Canada to Florida and it is therefore possible that any DPS may be present in/around the project area

Benthic Invertebrates

Nearshore Benthic (Infauna) Invertebrates: USACE-NYD conducted a Nearshore Aquatic Resources Investigation at Asharoken Beach in in LIS during 2003-2004. This sampling program included characterization of shallow water and intertidal benthic infaunal invertebrates along nearshore transects at Asharoken Beach as well as in the bay (back-barrier) side of Eaton's Neck (USACE-NYD 2005). A total of 8 phyla consisting of 47 taxa were collected and identified throughout the study period.

Offshore Benthic Invertebrates

Concurrent with the Nearshore Investigation, a Borrow Area Investigation monitored the biological resources at Borrow Areas A and B, located offshore of Asharoken during 2003-2004 (USACE-NYD 2007, Appendix D). Infaunal invertebrates were sampled at the two borrow areas during fall (2003) and spring (2004). The benthic sampling design allocated a greater number of grab samples at Borrow Area A than at Borrow Area B (35 vs. 15) during both seasonal sampling events. The disproportionate sampling effort due to the size of the borrow areas, Borrow Area A being larger, probably influenced the observed higher taxonomic richness/diversity in Borrow Area A.

During fall 2003, a total of 86 macroinvertebrate taxa, represented by >26,700 individuals was collected in both borrow areas. Taxa richness was considerably higher in Borrow Area A (83 taxa) than in Borrow Area B (51 taxa). Nematodes, annelids, and oligochaetes were abundant at both borrow areas. Representative polychaete taxa included Ampharete spp., Ampharete lindstroemi, Cossura longocirrata, Cirratulidae spp., Nephtys spp., Scalibregma inflatum, and Polydora cornuta. Molluscs and arthropods were consistently present in both borrow areas, but were markedly less abundant than annelids.

2.3.3 Terrestrial Wildlife

Reptiles and Amphibians

Marine reptiles that may potentially occur seasonally within the study area include the green sea turtle (Chelonia mydas), loggerhead sea turtle (Caretta caretta), leatherback sea turtle (Dermochelys coriacea), Kemp's ridley sea turtle (Lepidochelys kempii). Of these species the green and the leatherback are the least likely to occur in the western Sound. In addition, the northern diamondback terrapin (Malaclemys terrapin, a brackish water species) may be found in the project area (USACE-NYD, 2004).

Most of the sea turtles that have been observed in Long Island Sound have been juveniles, which have migrated north during the summer to take advantage of the abundant food resources offered by inland embayments. Green sea turtles feed primarily on vegetation and may be the least likely of the turtles to be seen in the Sound due to the relative paucity of sea grasses found in the Sound. Ridelys and loggerhead turtles prey largely on marcro-crustateans and bivalves, which are found in abundance in nearshore areas. The leatherback turtle's diet consists largely of jellyfish. The leatherback turtle is a highly pelagic fast swimming open water animal and not an expected visitor to the western Sound. Marine turtles do not nest further north than Delaware.

Mammals

The maritime scrub-shrub, meadow and woodland landscapes in the vicinity of the study area provide habitat for a variety of terrestrial mammals including: common rat (Rattus norvegicus), eastern cottontail (Sylvilagus floridanus), white-footed mouse (Peromyscus leucopus), white-tailed deer (Odocoileus virginianus), gray squirrel (Sciurus carolinensis), eastern chipmunk (Tamias striatus), northern short-tailed shrew (Blarina brevidauda), meadow vole (Microtus pennsylvanicus), little brown bat (Myotis lucifugus), red fox (Vulpes vulpes), opossum (Didelphis virginiana), and raccoon (Procyon lotor) (Springer-Rushia and Stewart 1996) as well as the possibility of fereal cats and dogs.

Several species of marine mammals have been documented offshore of Asharoken Beach, including gray seal (Halichoerus grypus) and harbor seal (Phoca vitulina). These two species are increasing in southern New England (including Long Island Sound) and may be present in the project area from late fall to April. Sightings of harp seals (Phoca groenlandic) and hooded seals (Cystophora cristata) have increased in

Long Island Sound in recent years. Bottlenose dolphin (Tursiops truncatus) are periodically observed offshore of the study area (USACE-NYD 2002; NOAA, 2009).

<u>Birds</u>
A variety of avian species use habitats in Asharoken Beach as a breeding area. Confirmed breeding species include: piping plover (Charadrius melodus), barn swallow (Hirundo rustica), black-capped chickadee (Parus atricapillus), eastern tufted titmouse (Parus bicolor), Carolina wren (Thryothorus ludovicianus), American robin (Turdus migratorius), gray catbird (Dumetella carolinensis), European starling (Sturnus vulgaris), yellow warbler (Dendroica petechia), northern cardinal (Cardinalis cardinalis), common grackle (Quiscalus quiscula), brown-headed cowbird (Quiscalus major), and house sparrow (Passer domesticus) (USACE-NYD 2002, NYSDEC 2008).

Avian species observed feeding along Asharoken beach include: Laughing gulls (Larus atricilla), herring gulls (Larus argentatus), ring-billed gulls (Larus delawarensis), great black-backed gulls (Larus marinus), double-crested cormorants (Phalacrocorax auritus) and sanderlings (Calidris alba) (USACE-NYD 2002). In addition, an osprey (Pandion haliaetus) nest was observed across from the beach on Asharoken Avenue during a field visit on 30 December 2013 (Appendix B).

Of special consideration is the use of Asharoken beach by the piping plover (*Charadrius melodus*), a species listed by the federal government as threatened and state listed as endangered. As the foredune and beachfront area would be eroded with the projected loss of sediment material without federal action, there would be a reduction in the available habitat for plover nesting. If the beachfront were to decrease, there may also be an increased overlap of bird nesting areas and recreational areas of beachgoers, potentially causing greater disturbance to nesting birds without management measures such as restricting beach use by the local community during nesting and brood rearing periods. The available beach habitat for other foraging or migrating shorebirds, such as gulls (*Larus sp.)* and sanderlings (*Calidris alba*), would also be reduced with continual erosion of sediment material.

2.3.4 Hazardous, Toxic and Radioactive Waste

The District conducted a Hazardous, Toxic, and Radioactive Waste (HTRW) assessment for the Asharoken Study Area. This assessment consisted of a regulatory agency file review and a site survey. The file review involved Federal and state database searches that included regulated sites located within the project corridor and within a 0.5-mile area from the project corridor. A site survey was conducted to verify the database information and to identify potential sites of concern that were not included in the database report.

The Northport Power Station is the largest oil-burning power plant in the northeast. This facility houses various storage tanks for petroleum products and is listed in the Leaking Underground Storage Tanks database. The power station is a small quantity generator Resource Conservation and Recovery Act site, has an active water discharge permit, and has an emission permit under the Clean Air Act. At present, the operation of the

Northport Power Station does not directly impact any of the proposed project elements by virtue of the distance of the station from the designated project areas; either along the Asharoken Beach shoreline or at the offshore borrow areas within Long Island Sound.

To confirm the absence of any HTRW concerns, databases maintained by the State of New York Department of Environmental Conservation (NYSDEC) and the US Environmental Protection Agency (EPA) were reviewed. EPA data bases reviewed were National Priorities List (NPL), Resource Conservation and Recovery Information System (RCRIS), Toxic Release Inventory System (TRIS) and Comprehensive, Environmental Response, Compensation and Liability Information System (CERCLIS). Review of these databases showed no sites in proximity of the project area.

Review of NYSDEC databases for Spills, Brown Fields and State Superfund sites showed no incidents/locations in the proposed project area. Review of EPA and DEC data bases showed the power plant (located outside the project area) is in compliance in water, air and solid waste discharges and management.

2.3.5 Air Quality

As required by the Clean Air Act of 1970, National Ambient Air Quality Standards (NAAQS) have been established for six major air pollutants identified by the United States Environmental Protection Agency (USEPA) as being of nationwide concern: carbon monoxide (CO), nitrogen oxides (NOx), ozone (O3), particulates (PM), sulfur oxides (SOx), and lead (Pb).

In the Asharoken study area, ambient concentrations of CO, O3, and Pb are predominantly influenced by vehicle emissions; NOx and particulates are emitted from both motor vehicle and stationary sources (i.e., power generation), and emissions of SOx and sulfates are mainly from stationary sources. The location of the study area next to Northport Power Plant, the largest oil-burning power plant in the northeast, may result in abnormally high levels of criteria pollutants produced by fossil fuel combustion, such as CO, NOx, PM, and SO2. However, the coastal location of the study area, with prevailing northeasterly winds, may reduce the direct impact of emissions from the Northport Power Plant. A project-specific Record of Non-Applicability (RONA) Air Conformity Statement was prepared by the District and is provided in sub-appendix H of the Environmental Assessment (Appendix B).

2.3.6 Noise

Noise is defined as any sound that is undesirable because it interferes with communication, is intense enough to damage hearing, or is otherwise annoying. Noise can be intermittent or continuous, steady or impulsive, and can involve any number of sources and frequencies.

Existing sound sources in the project area include sounds originating from natural sources such as waves, wind, vegetation, birds, and other sources. These may have a substantial effect on the existing sound environment but under normal conditions would not be interpreted as noise. Noise would come from traffic, air traffic, boat usage, residential including power and lawn tools, and barking dogs. Transportation sounds are also potentially important noise sources. Sensitive sound receptors in the vicinity of the study area include residences and natural receptors, such as osprey and other nearby fauna.

2.4 EXISTING CULTURAL RESOURCES

The Area of Potential Effect (APE) for this project includes the project area as identified in section 1.7, the near shore area and the proposed borrow area. Although there are no confirmed prehistoric sites within the limits of the shoreline areas of the APE, a total of 17 previously documented prehistoric sites lie within a 1-mile radius of the project corridor (USACE-NYD, 2004). However, due to land use actions and shoreline erosion within the project area, there is a low probability that any remains of the incidental use of the shoreline by Native Americans have been preserved (USACE-NYD, 2004).

In 1646, Theophilus Eaton, Governor of New Haven, acquired what is now Eaton's Neck from the Matinnecocks. During the 19th century, a number of sand and gravel mining industries were situated in Eaton's Neck and Asharoken. Mining facilities were located: on the West Beach spit in southwestern Eaton's Neck; on Eaton's Neck Beach, where Asharoken Beach joins the mainland; and near the Coast Guard Station and lighthouse, constructed in 1849. The Coast Guard Station is the oldest such facility in New York State (USACE-NYD, 2002).

There are four sites listed on the National Register of Historic Places for Eaton's Neck and Asharoken Village, just outside the APE: the Delameter-Bevin Mansion on Bevin Lane, the New Jersey Felix House on the west side of Asharoken Avenue in Asharoken, the Harry E. Donnell House on Locust Lane, and Eaton's Neck Lighthouse. The latter property is the second oldest lighthouse on Long Island, first lit in 1799 (USACE-NYD, 2002). There are four potential National Register of Historic Places-eligible architectural resources identified: the Chesebrough House, the Chesebrough Servants House, the Laura S. Stewart House, and the Rube Goldberg House (USACE-NYD, 2004).

A Remote Sensing Survey was conducted along Asharoken Beach in 2003 to determine the presence or absence of submerged or shoreline cultural resources that may be eligible for inclusion in the National Register of Historic Places within the nearshore and offshore areas that might be affected by the proposed alternatives. Comprehensive magnetic, acoustic, and bathymetric remote sensing and hydrographic surveys were conducted within the nearshore sand placement area, as well as within two proposed offshore sand borrow areas. The magnetic survey of the tidal zone identified a total of 28 magnetic targets within the study area, seven of which had signatures potentially consistent with a buried shipwreck or shipwreck-related debris. The remote sensing survey of the nearshore area identified one side-scan sonar target, which was evaluated as not being potentially significant. No targets were identified within the offshore survey areas (USACE-NYD, 2004).

3.0 PROBLEMS AND OPPORTUNITIES

3.1 PROBLEM STATEMENT

Problem definition is the detailed description of a problem. It begins with a **problem statement**, a simple assertion of what the basic problem is. The problems in the study area are:

i. Damage to structures (including buildings, and existing coastal structures) caused by storm-induced wave attack, erosion, and flooding due to storms and high tides.
ii. Disruption to Asharoken Avenue due to storm-induced wave attack, erosion, and flooding, closing the only route to and from the Village of Asharoken and Eatons Neck.

3.2 FUTURE WITHOUT PROJECT CONDITIONS

In the absence of a CSRM project coastal forces will continue to cause narrowing and lowering of the study area beaches thereby reducing the protection currently afforded to the Village residents and causing more frequent interruptions of access to Eatons Neck via Asharoken Avenue. Those coastal forces include long-term erosion, storm recession and wave attack (including run up and overtopping of dunes and bulkheads), and storm surge inundation (Long Island Sound and Northport Bay). In the expected without project future conditions residents of Asharoken and Eatons Neck would experience increasing economic losses from storm damages. For project evaluation purposes the potential project area has been delineated into the four reaches briefly described in Section 1.5 of this report.

It is assumed that the current coastal features (jetties, groins, Section 103 project, bulkheads, etc) remain in place or are repaired as necessary. It is also assumed that the power plant will continue to operate much as it has with periodic intake channel dredged material placed on the immediate downdrift (west) shore. The average yearly quantity of dredged material will be 15,000 cy/yr as in the recent historic records.

3.2.1 Reach 1A

The primary factor affecting the future conditions and likely damages in this reach is the assumption of the future condition of the existing Section 103 Project. Over the next 50 years it is assumed that this project will be in place, and will be maintained and repaired as needed. The Section 103 project has reduced damages to Asharoken Avenue for over 15 years, but without a regular supply of littoral material, which is partially blocked by the adjacent groin, the beach has almost disappeared and even moderately high tides and waves pound on the bulkhead and the toe stone. The small remaining beach will continue to recede increasing the probability of structure failure. Increasing frequent storms will result in storm-induced overtopping, structure failure, impacts to Asharoken Avenue and damage to the road itself interrupting access to Eatons Neck. With the existing project in place, the road is subject to damages due a storm with a 10% annual chance of occurrence (10 year event), and with continued erosion would be subject to damages due to a storm with a 20% annual chance of occurring (5 year event).

3.2.2 Reach 1B

The long-term erosion rate in Reach 1B is approximately 1 ft/year. Moderate to severe storms would cause dune failure due to wave attack, particularly wave overtopping and overwash. Dune lowering would initially deposit sand on the road and nearby landward property but would also lead to road damage and potentially damage to the structures behind the road. The existing dune is subject to damages from storms with a 5 to 15 year return period. The surge and waves from both Hurricane Sandy in October 2012 and Hurricane Irene in October 2011, which essentially destroyed the dunes along the majority of the reach. In both cases, sand was scraped from the road and trucked in to rebuild a narrow triangular shaped dune immediately seaward of Asharoken Avenue.

3.2.3 Reach 2A

The long-term erosion rate in this reach is approximately 1 foot/year. The existing bulkheads and dunes would eventually exhibit failure due to toe scour and wave overtopping forces. It is estimated that a storm with a 20% annual chance of occurrence up to a 7% annual chance of occurrence (a storm event of a 5-year return period up to a 15 year return period) would initiate bulkhead failures and a rapid loss of inland material leading to damage to any of the residential structures located near the bulkheads.

In the without project condition it is expected that residents would repair their bulkheads and try to prevent undermining of their homes by backfilling material behind the bulkheads. These repairs are assumed to be replacement in-kind with a single row of timber bulkhead with limited rock armor toe protection; placement of sand fill on the nearby foreshore and landward slides of the bulkhead as well as repairs to the residential structures.

3.2.4 Reach 2B

Erosion in this reach is estimated at 5 ft/year. Dune overwash and overtopping from waves is considered to be minimal in this reach due to the high dune elevations, and limited development located landward of the shoreline. Erosion is partially offset by the periodic placement of material dredged from the power plant cooling water intake channel.

3.3 ECONOMIC AND SOCIAL WITHOUT PROJECT CONDITIONS

Two communities considered in the economic and social analysis. The non-incorporated community of Eatons Neck lies wholly on the peninsula, and the incorporated Village of Asharoken is divided between the peninsula, the isthmus, and the mainland of Long Island. The portion of Asharoken Village within the project area is Northern Asharoken, which lies to the north of the most vulnerable section of the isthmus, and is impacted by disruptions to Asharoken Avenue.

Apart from at its narrowest sections, the isthmus is heavily developed with residential properties, the great majority of which are inhabited throughout the year. The peninsula is comparatively sparsely developed, with heavily wooded parcels of undeveloped land rising to elevations of up to 150 feet. There is no commercial or other non-residential land use evident on the peninsula or the isthmus, apart from the Eatons Neck Fire Department and a US Coast Guard station on the northern tip of the peninsula.

Since Asharoken Avenue is the only link to Eatons Neck, it is expected to be maintained by the Village of Asharoken in the future regardless of whether or not a Federal project is constructed. If no comprehensive erosion CSRM measures are implemented, it is expected that the Village will continue to spend resources in repairing the road and clearing it from overwashes. In the past the Village and utility companies have expended between $21,000-$129,000 (FY15 price level) after a storm even to repair utility lines and dunes and clearing as well as repairing the road.

In the future there would also be increased emergency costs incurred by the Village of Asharoken and the Town of Huntington. In the event of a major storm event, it would mean calling in all available police officers for emergency duty. This emergency duty would be performed by officers being paid overtime and would greatly increase the emergency budget for the Village. Increased emergency costs would result from having to borrow extra equipment from other municipalities to respond to fires or other emergencies and for extra resources to be put in place. Special vehicles to transport residents would have to be leased from outside the Village if Asharoken Avenue is damaged but still passable to access Eatons Neck. If Asharoken Avenue were impassible, any evacuation of Eatons Neck would have to be done by boat or helicopter, and such an evacuation would be difficult until storm conditions subside. A closure of the road would isolate the population of Eatons Neck from essential emergency services and other utilities such as medical services, law enforcement, food distribution, disaster relief, sanitation services, etc.

There will be continued threat of damage to structures abutting Northport Bay and Long Island Sound that will also increase over time. The increase will be the result of reduced protection from diminishing beach berms that are eroding over time and the expected change in sea level. As the beach front for the impacted 2.4 miles of shoreline is eroded, wave impact damages to the bulkheads, the road, and the structures will increase in severity and frequency.

3.4 ENVIRONMENTAL WITHOUT PROJECT CONDITIONS

From an environmental perspective, it is expected that without any CSRM action in the study area, erosion would continue along Eatons Neck and along other sections of the Asharoken beach. Maritime woodland coverage may be lost on Eatons Neck as the bluff is eroded, and beachfront may be converted to submerged tidal surf zone or shallow depth marine habitat that would support marine benthos, invertebrates, and fisheries. Dune or back dune habitat could be converted to beachfront in areas that still exist in a natural state (not yet bulkheaded), however, due to the built environment along the beachfront of the southeastern end of the beach along Asharoken Avenue, a significant erosion of the beach would result in the elimination of beachfront habitat that is exposed at high or even low tides. With an extreme loss of sand material, this area could potentially become inundated and converted permanently to surf zone or shallow marine habitat unless some action was taken by the local community to place sand on the shorefront or some relocation of the residential structures took place. Dune areas that are not currently bulkheaded could become bulkheaded as residents respond to the erosion.

It is expected that the existing sediment transport regime would not change under the current conditions. Continued erosion would have the potential to allow storm damage to structures that are potentially eligible for the National Register of Historic Places.

As has been discussed, overwash of sand material over Asharoken Avenue has occurred in the past and is expected, with medium to high probability, to continue to take place. It has been observed that sand has been transported across Asharoken Avenue near Bevin Road and deposited on the bayside in Duck Island Harbor. Figure 14, shows this transitional area.

Figure 14: Sand-dune habitat on bayside of Asharoken Avenue at Duck Island Harbor

A sand-dune plant community already exists on the bayside of Asharoken Avenue at Bevin Road and across from the Corps Section 103 Emergency Erosion Control project. Margiotta observed a sandy incline vegetated with plants such as beach grass

(*Ammophila breviligulata*), dusty miller (*Artemisia stellariana*) and beach pea (*Lathyrus japonicus*) in his 1975 study of the invertebrate community within the wetland areas of Duck Island Harbor. The transportation of sediment is likely due to a combination of overwash and windblown sand deposition. Piping plovers have been known to use bayside sand flats for foraging, such as with the historical nesting site at Ram Island Causeway on Shelter Island or at the plover nesting area at Westhampton Beach spit. At Asharoken, no use of the existing sandy habitat on the bayside has been documented for foraging adult plovers. This area could potentially serve as a foraging area for adult plovers if sand deposits continued to form a spit within the harbor wetland area, although if beachfront habitat was eroded and reduced the plover population would be limited due to lack of nesting habitat. Further deposition of sand material onto the bayside of Asharoken Avenue at Bevin road is expected to increase the coverage of the area by common reed (Phragmites australis), an invasive plant already encroaching the harbor's Spartina marsh area. The common reed, which is generally considered to be a less valuable plant for wildlife foraging and to support a lower productivity environment than Spartina, would take hold as substrate elevations increased in the area.

An extreme situation would be a breach of Asharoken Avenue near Bevin Road. Sand may be redeposited in such a scenario, and potentially areas of the Duck Island Harbor Spartina marsh area could be converted to a sand-dune plant community or common reed dominated habitat on a short-term scale. It is difficult to speculate on the redistribution of sand material in such an instance. It should simply be stated that an adjustment of habitat type and plant community type would be expected and that habitat for piping plover foraging and nesting could potentially be impacted. Of course, any extreme event that would cause infrastructure to be compromised would be undesirable due to potential short-term or long-term pollution impacts to the aquatic environments of both the bay and Sound. A breach could also cause temporary or permanent impacts to the salinity of the harbor side waters.

Based on the past storm events and existing and expected without-project shoreline conditions, it is clear that wave attack and overtopping of dunes and bulkheads will continue to cause shoreline recession; damage to existing CSRM structures, infrastructure, and residences; exposure of marsh habitats; and decrease in the availability of suitable habitat for Federal and state-listed species of shorebirds, all accelerating with time in a without project future.

3.5 OPPORTUNITIES

Opportunities to solve problems in the study area have been identified by the study team. There are **opportunities** in the Incorporated Village of Asharoken to:

i. Reduce the threat of damages to existing residential buildings, and existing coastal CSRM measures caused by storm-induced wave attack, erosion, and flooding from storms and high tides.
ii. Prevent disruption and damage to Asharoken Avenue, and provide a reliable transportation route.

3.6 PLANNING OBJECTIVES

Planning objectives were identified based on the problems, needs, and opportunities, as well as on existing physical and environmental constraints present in the study area. In general, the prime Federal objective is to contribute to the National Economic Development (NED) account consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements. In support of the goal, the planning objectives are to:

i. Reduce storm-induced damages in the Village of Asharoken from inundation, wave attack and erosion.
ii. Reduce storm-related emergency costs and repair costs associated with maintaining access along Asharoken Avenue.
iii. Provide improved emergency evacuation routes for the Village of Asharoken and the community of Eaton's neck.

These objectives will be measured by estimating damages with and without the proposed project over the 50-year planning period of analysis. Assuming the proposed project is expected to be operational in 2019, the planning period of analysis for the forecast of the future without and with project is 2019 to 2069.

3.7 PLANNING CONSTRAINTS

Planning constraints are technical, environmental, economic, regional, social, and institutional considerations that act as impediments to successful achievement of the planning objectives of possible solutions. Constraints are designed to avoid undesirable changes between without- and with-plan conditions. These are defined below:

Universal constraints include:
<u>General constraints:</u>

i. The plan should meet the needs and concerns of the public within the study area;
ii. The plan should respond to the public desires and preferences;
iii. The plan should be flexible to accommodate changing economic, social and environmental patterns and changing technologies;
iv. The plan should integrate with and be complementary to other related programs in the study area;
v. The plan should be able to be implemented with respect to financial and institutional capabilities and public consensus;
vi. The plan should conform to the USACE environmental operating procedures.

<u>Technical Constraints</u>

i. Plans must be realistic and use existing technologies;
ii. Plans must represent sound, safe, acceptable engineering solutions;
iii. Plans must be in compliance with USACE Engineering Regulations;

iv. Plans must tie off into stable ground ensuring they are not flanked and fail from behind
v. Plans must not impact HTRW sites.

Environmental Constraints

i. Plans cannot unreasonably impact environmental and cultural resources;
ii. Plans must consider mitigation or replacement where a substantial impact is established, and should adopt such measures, if justified;
iii. Plans must be environmentally sustainable.

Economic Constraints

i. Plans must be justifiable; that is, plan benefits must exceed plan costs (there must be net annual benefits);
ii. Plans must be efficient; they must represent near optimal use of resources in an overall sense. Accomplishment of one economic purpose cannot unreasonably impact another economic system.

Regional and Social Constraints

iii. The needs of the region must be considered and one area cannot be favored to the unacceptable detriment of another;
iv. No favoritism can be shown; all reasonable opportunities for development within the study scope must be weighed, one against the other.

Institutional Constraints

i. The plans must be consistent with existing Federal, state, and local laws;
ii. Plans cannot be adopted which would benefit a single user to an unreasonable degree;
iii. The plan must be fair and find overall support in the region.

Study Specific Considerations:

i. Although not identified as a specific constraint, a study-specific consideration is that borrow area usage in Long Island Sound will balance sand needs, and environmental impacts associated with dredging, and be limited to a 1-time dredging for initial construction, and conducted in a manner to minimize any negative effects associated with dredging.

3.8 GENERAL SCREENING CRITERIA

Each potential solution was screened and evaluated under engineering, economic, environmental, and social criteria. The evaluation of each solution will be done primarily using National Economic Development (NED) guidelines. Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE) will be discussed qualitatively.

3.8.1 Engineering Criteria

Plan alternatives for the early phase of screening were based on a 50-year period of analysis and designed for a 2% storm event. The intent was to compare alternatives at a reasonable scale of risk reduction that would be economically feasible, would not have unacceptable impacts on environmental and cultural resources, and would be environmentally sustainable. The scale of the alternatives and level of risk reduction is considered after the selection of the plan features.

3.8.2 Criteria for the sand sources

Any measure that includes beach nourishment requires a sand source. The sources of sand are analyzed to ensure that they provide the volume of sand required and that the sand would be compatible with the existing sand on Asharoken Beach.

3.8.3 Economic Criteria

The plans will be evaluated based on the possible economic benefits as defined under NED guidelines. These benefits categories are presented below.

i. Prevention of physical damages to homes;
ii. Reduction in maintenance costs of existing CSRM structures;
iii. Reduction of emergency costs to residents, businesses, and governmental entities;
iv. Emergency relocation costs avoided and transportation disruption avoided.

3.8.4 Environmental Criteria

Plan alternatives were assessed and compared for acceptability based on the potential impacts each may have on the human environment as a result of implementation. The environmental evaluation was conducted in accordance with the National Environmental Policy Act (NEPA) of 1970, as amended. Public and interagency coordination has been conducted and will continue to be conducted to aid in the refinement and selection of alternatives and identification of environmental concerns, including environmental acceptability.

Specifically, predicted alterations of habitat structure or substrate type as well as other physical, chemical, or biological conditions were considered for evaluation of the alternatives. The plans were also assessed based on their consistency with the New York State Coastal Zone Management Program and all other applicable local, state, and federal environmental or cultural resource laws and regulations, including, for example, the Magnuson-Stevens Fishery Conservation and Management Act of 1996, as amended; the Endangered Species Act of 1973, as amended; the Fish and Wildlife Coordination Act of 1958, as amended; the National Historic Preservation Act, as amended, and the Clean Water Act of 1977, as amended.

4.0 PLAN FORMULATION

Alternative plans have been formulated for provision of coastal storm risk management for the Long Island Sound shoreline along the Village of Asharoken. The potential economically feasible plans, which would not appear to have significant adverse effects on environmental and cultural resources, were identified for further evaluation. Those plans that did not meet the goals of the feasibility study are identified but did not proceed further for more detailed evaluation.

Alternatives for reducing damages from bayside flooding (tidal inundation) were initially considered. Due to the relatively infrequent damages from bayside flooding the damages are considered to be minor compared to the damages caused by wave attack and erosion from the Long Island Sound. Structural solutions such as seawalls would not be viable and were not considered further. Nonstructural measures were considered, but would not be viable and were eliminated early in the screening process. For this reason the alternative development focuses of measures that would address damages from erosion wave effects and inundation from Long Island Sound.

4.1 MANAGEMENT MEASURES

Plans are composed of measures. A measure can be nonstructural (actions to reduce flood damages without significantly alternating the nature of extent of flooding) or structural (a physical modification designed to reduce the frequency of damaging levels of flood inundation).

They can be used individually or combined with other management measures to form alternative plans. Measures were developed to address problems and to capitalize upon opportunities. They were derived from a variety of sources including prior studies, the public scoping process, and the study team’s experience.

The following nonstructural and structural measures were considered to provide coastal storm risk management and maximize project benefits. All measures were screened for their capability to meet objectives and avoid constraints, for engineering and economic feasibility. Measures that warranted consideration were assembled into alternative plans. Below are the nonstructural and structural measures that were considered.

4.1.1 No Action

No Federal Action assumes that no work is undertaken as a result of this Feasibility Study. This alternative fails to meet the objectives or needs of the project area. Its effects have already been detailed in the Future Without Project Conditions. The no action plan provides the base against which the alternatives are compared and from which project benefits are measured.

4.1.2 Nonstructural Measures

Buy-out Plan. This measure includes permanent evacuation of existing areas subject to erosion and/or inundation, by acquisition of this land and its structures, either by purchase through a willing seller or by exercising the powers of eminent domain. Following this action, all development in these areas is either demolished or relocated. With an anticipated high-depreciated replacement cost of structures in the 2% storm event design frequency floodplain, including land and relocation, this measure would appear to be prohibitively expensive and was thus dropped from consideration as a comprehensive solution. Due to the high value (Mean house value in excess of $500,000) and number of structures (50-100 for houses fronting the beach), a buy-out plan would be cost prohibitive and not reduce the erosion and wave attack threat to Asharoken Avenue.

Zoning. Through proper land use regulation, floodplains can be managed to insure that their use is compatible with the severity of a flood hazard. Several means of regulation are available, including zoning ordinances, subdivision regulations, and building and housing codes. Zoning regulations by New York State under the Coastal Erosion Hazard Act (CEHA) and under the Federal Emergency Management Agency (FEMA) flood insurance program exist to deal with structures that have more than 50% of their value damaged by a storm. In the case that a structure is estimated of incurring damages higher than 50% of its value, it is rebuilt to current FFRM zoning standard. Under both programs, no repair is permitted if there is more than 50% damage to the structure after a storm event. It should be noted that the CEHA has not yet been implemented in this area, limiting the present effectiveness of this measure. This could gradually mitigate the repetitive damage in high-risk areas over time by removing severely damaged structures from the hazard zone. However, it should also be noted that the point where there would be 50% damage to a structure would not likely occur for some period of time and only for a limited number of structures per storm event and therefore would not have a significant effect in reducing the risk of frequent damages to the bulkheads nor reduce the threat of damage to Asharoken Avenue. The Corps does not have regulatory authority to implement a zoning plan, although the Corps could provide storm damage risk information for any zoning changes to be implemented by the non-Federal Sponsor.

Retrofitting. Retrofitting, by definition, is a body of techniques for preventing damages due to floods, and requires adjustments both to structures and to building contents. It involves keeping water out of structures, as well as reducing the effects of water entry. Such adjustments can be applied by an individual or as part of a collective action, either when buildings are under construction or as part of a remodeling or retrofitting of existing structures. Retrofitting typically includes elevating the structure but could also consist of a ring levee to protect the house, or the structures. Retrofitting alternatives are typically effective for low-lying homes that are subject to inundation. Retrofits are generally not applicable to homes which are subject to erosion and waves damages. Based upon the existing structure vulnerability to waves and erosion, retrofits were eliminated as a possible measure.

Relocation. Relocation includes the effort necessary to move an existing structure from the erosion prone area further inland. This can include relocation of a structure to an adjacent empty lot or relocation further back within the existing lot. Relocation of a building to an adjacent lot is not cost effective or implementable due to the high cost of acquiring property and the limited availability of vacant lands for relocation. This measure could somewhat reduce the threat of erosion to the buildings but not the overall long-term threat to Asharoken Avenue. Even if there were room to relocate the structures, the costs would make such a plan uneconomical.

In summary, nonstructural measures were not considered further.

4.1.3 Structural Measures

The following sections briefly describe various structural CSRM techniques considered as potential elements of a comprehensive coastal storm risk management solution.

Floodwalls and Levees. Floodwalls and levees are intended to provide CSRM against coastal and riverine flooding. These structures can be cost-effective measures against tidal flooding when placed landward of or away from direct wave exposure. Used in this manner, floodwalls and levees provide CSRM to interior structures. Levees and floodwalls would not be applicable for this project since the predominant damages to the project area are due to shore erosion and storm wave damages which would not be addressed by these structures.

Beach Nourishment. Beach nourishment involves the placement of sand on an eroding shoreline to restore its form to reduce damages for storm surges, wave forces, storm recession and long-term erosion. A beach fill typically includes a berm backed by a dune; these elements combine to reduce the risk of damages from erosion, wave impact, and inundation damages to leeward areas. Beach nourishment represents a near natural, reversible soft solution for reducing damages on the open coast. Beach renourishment, on 3 to 10 year cycles, is usually required over the life of the project to counteract long term and storm-induced erosion and additional erosion from sea level change. A typical beach nourishment section with berm and dune fill is shown in Figure 15. In the Asharoken area, the initial scale considered was an average dune elevation of +15 to +17 ft. NGVD29, a 25 ft dune crest width, 1V:5H dune slopes, and a 50 to 100 ft. berm width having a berm crest at el. +8 to 9 ft NGVD29 (the historically most stable berm crest elevation to prevent scarping) with a historically stable 1V:15H foreshore slope and sand fence and beach grass for added dune stability. The cost of the beach fill only option is approximately $1,000 to $1,200 per linear foot of shoreline plus approximately $500 to $700/ l.f. for renourishment at 5 year cycles, including operation and maintenance costs of the project.

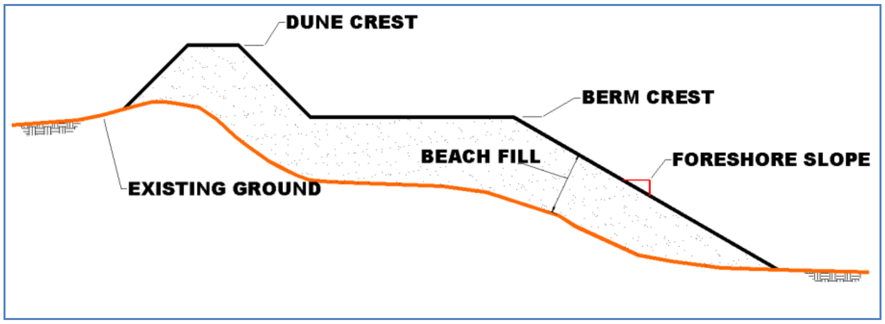


Figure 15: Typical Beach fill Alternative

Reinforced Dune with Beach fill. A reinforced dune is similar to a beach fill dune, however, the core of the dune is strengthened with structural elements such as a buried rock seawall. The reinforced dune would prevent the potential for breaching of the dune line exposed to severe events and limit the overtopping from wave action due to the more permanent nature of the dune reinforcement vs. the erodable nature of a sand dune. Less initial fill and renourishment is required for the reinforced dune option since the sand losses are less for the narrower berm required for the reinforced dune due to reduced storm induced erosion losses. A typical reinforced dune and beach fill section is illustrated in Figure 16. The cost for a typical reinforced dune with beach fill is approximately $2,500 to $3,000 /l.f. including a 15 ft dune crest width, 1V:3H dune slope encapsulating a trapezoidally shaped stone seawall with a crest elevation of +13 to +13.5 ft. NGVD29 for a 10 ft. width and 1V:1.5H side slopes, 100 ft.berm width at el. 7 to 8 ft. NGVD29, a 1V: 15 H foreshore slope and a $400 to $600/l.f. beach fill renourishment at 5 year cycles throughout the life of the project.

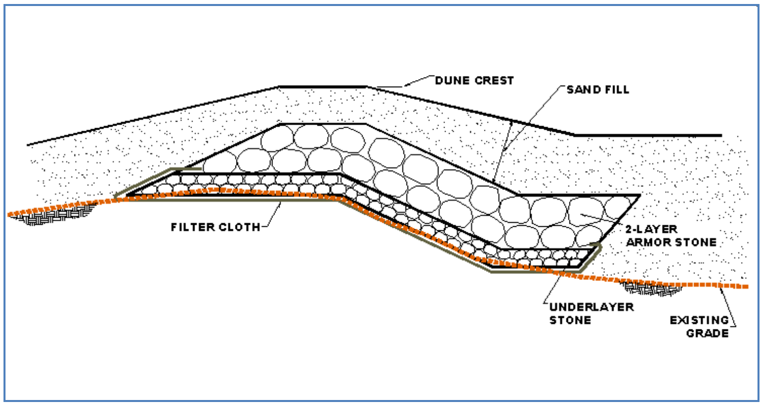


Figure 16: Typical Reinforced Dune

Bulkhead or Bulkhead with Raised Dune. Bulkhead shore stabilization measures offer both erosion and wave impact protection for shorefront structures. Bulkhead material may be steel or composite high density plastic with tie-backs, stone splash blanket, and toe-protection. Bulkhead stabilization measures help to reduce effects of wave action, minimize overtopping floodwaters, and limit landward movement of the shoreline. Costly stone toe and stone splash blanket protection is required to preclude undermining and overtopping damage to the bulkhead. A typical bulkhead section is shown in Figure 17. The cost of a bulkhead can run over $2,000/ l.f., in part because of the costly stone toe and stone splash blanket protection, even without beach fill. Bulkheads are a type of seawall and do nothing to offset the loss of beach. Most residential properties are already bulkheaded with wooden bulkheads, and the Section 103 project is a temporary bulkhead. The cost of this structure would be approximately $2,500 /ft. This measure is not recommended for further consideration.

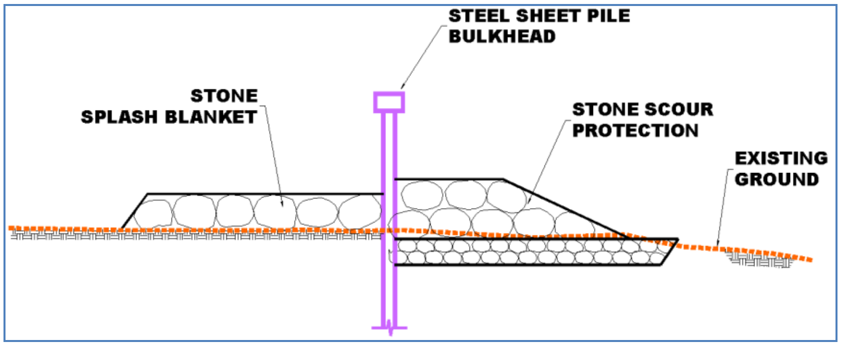


Figure 17: Typical Bulkhead with Raised Dune

Groins with Beach fill. Groins are rubblemound or timber/steel sheet piles constructed perpendicular to shoreline. Very popular in the 1940's-1950's, remnants of some locally constructed timber groins are buried under the existing beach fill. To be effective against a critical rate of erosion, new groins would have to be constructed. By properly setting the groin length and the space between groins, existing and new beach fill material will be retained to reduce the long-term erosion. However, groins are not effective to reduce offshore movements of beach material during storms. In order to retain material moving offshore, a T-groin field with shore-parallel section attached to the groin head can be considered. Assuming 500 ft spacing between groins and a 150 ft length, approximately 24 groins would be necessary with total cost of approximately $5,000/l.f plus $300 to $400/ l.f. for renourishment. Although a T-groin field with beach fill would be effective, a typical groin field would also induce considerable change to the prevailing environmental conditions.

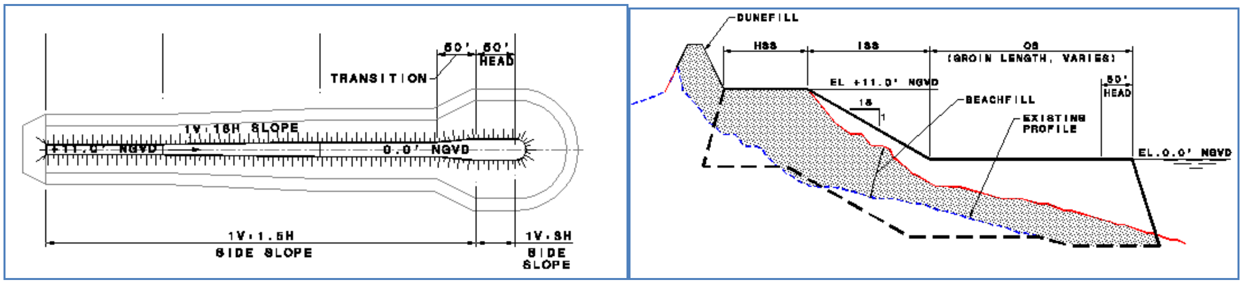


Figure 18: Typical Groin Plan and Profile

Localized Groins with Beach fill. Instead of a groin field of 12 to 24 groins, a limited number of groins could be provided to shoreline locations with historical high erosion rates and at locations experiencing high storm damages. There were two reaches identified within the Study Area where groins could be considered:

i. **Reach 1A** – Approximately 900 ft of shoreline fronting the Steel bulkhead seawall is experiencing severe toe erosion due to a rock groin located just upstream (east) of the seawall. The seawall toe requires stabilization to reduce future storm damage repairs;
ii. **Reach 2A** – Groins should be considered at the downstream (west) of the existing bulkheads. Reach requires frequent renourishment to retain a minimum design berm width for the design level of performance.

Offshore Breakwaters with Beach fill. Offshore breakwaters are rock mounds constructed along the shoreline in approximately -5 ft MLW depth. The reef like structures are effective at retaining beach material lost due to long term erosion and reducing sand movement offshore during storms. In addition, wave runup and overtopping would be reduced due to pre-breaking of storm waves. Beach fill renourishment may be reduced because of isthmus (sand trapping) formation. Each reef segment would be 800 ft long with a 200 ft gap between segments, requiring approximately 10 offshore reefs. Like groins, offshore breakwater would result in considerable change to the environment. A typical offshore breakwater plan and section is illustrated in Figures 19.

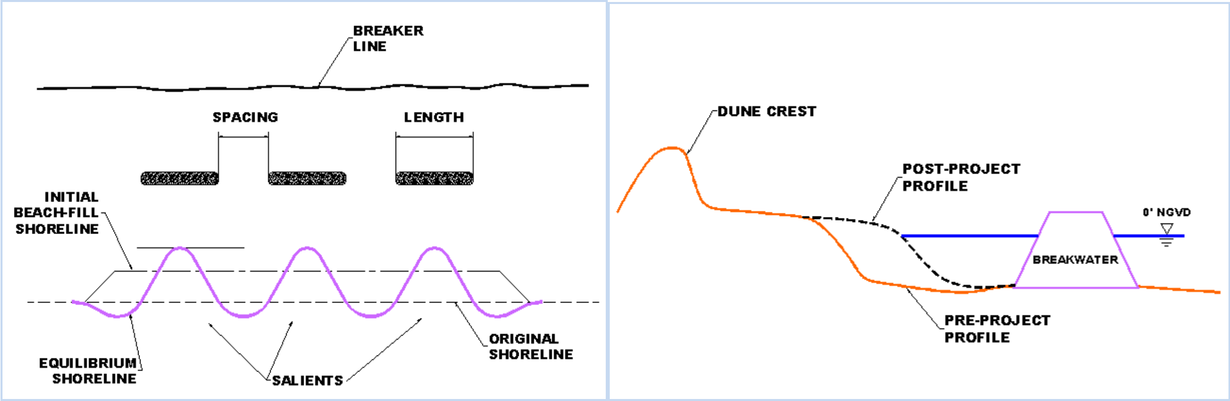


Figure 19: Typical Breakwater Plan and Profile

4.1.4 Regional Sediment Management Alternatives

Sand Bypassing. The power plant operators have historically been by-passing sand to the downdrift (west) side of the jetties. The source of the sand has been the dredging of the entrance channel to the cooling water intake lagoon, supplemented with upland sources. An average rate of 15,000 cy/year have been placed downdrift in recent years as a result of bypassing, which matches the estimated volume of sediment entering the system from the east. Since there is a limited supply of littoral material from the east, even the Future Without Project assumed bypassing all of the estimated 15,000 cy/yr typically available would be insufficient to keep up with the estimated downdrift erosion rate. The existing bypassing would have to be supplemented with an additional 10,000 cy/yr of material to offset the long-term trends. Bypassing does not wholly address storm damage reduction needs since it does not establish the higher and wider beach and dune elevation that would be required.

Installation of a Diffusion Pipe. Based on data provided by the power plant operators, the power plant is discharging approximately 1,100 cfs (494,000 gpm) of cooling water to Long Island Sound via an overflow weir located to the east of the power plant at the mouth of the cooling water retention pond. The discharge flow plume centerline velocity is up to 7 feet per second (fps) at peak flow (Taylor Engineering, July 2001). Based on preliminary modeling results, some littoral materials are carried by the effluent flow and re-deposited to a distance generally not exceeding 600 ft. offshore where some of it moves into the inlet channel to the west. In order to position the exit of a diffusion pipe beyond the active surf zone at approximately the 24 ft depth contour, a 6,000 ft diffusion pipe would have to be installed at the cost of approximately $6,000,000. This option, however, would not solve the near littoral block that the jetties and the intake channel form. If the diffusion pipe were put in place, the westward sand movement would still be largely blocked by the jetties and as such this measure was not pursued further.

Modifications to Jetties. The east and west jetties were renovated with rock material after the cooling water intake channel and lagoon were dredged in 1966 and Unit #1 of the power plant was on line in 1967. Littoral material has continued to accumulate in the intake channel and east of the east jetty. In recent years, the fillet growth appears to have stabilized with little additional sand being trapped to the east. The fillet area also overlies cable and pipelines vital to the powerplant operations and dredging in the area is not viable. Dredging records indicate that an average of approximately 10,000 cy/year of sand has been dredged from the intake channel and Northport basin and placed on downdrift beach periodically. As the east (updrift) jetty gradually reaches its impoundment capacity, additional littoral material may be transported around and over the jetty to the intake channel requiring dredging a larger quantity of material and likely more often. This increase in dredged material bypassed to the west is not expected to be significant relative to the erosion losses from the downdrift (westerly) shores. In order to increase the amount of material bypassing the inlet, the rock jetties would have to be significantly shortened or removed to achieve this goal. However, littoral material would continue to be trapped in the dredged channel and Northport basin and frequent, perhaps annual, dredging would be required. Shortening the jetties, which would be very costly, would initially release accumulated updrift fillet material on a one time basis. This material, estimated to be only in the amount of tens of thousands of cubic yards of material, would not significantly reduce the downdrift storm damage risk but would reduce the intake channel depth making it difficult to maintain and potentially disrupting power plant operations. The measure of modifying the jetties was not pursued further in the plan formulation process.

*Dredging the Updrift Fillet Areas***.** Consideration was given to direct bypassing of material impounded by the east (updrift) jetty of the intake lagoon. The amount of the fillet material that could be removed is very small relative to the amount of material needed to reduce the down drift storm damage risk. Furthermore, the fillet overlies electric cables and pipelines vital to power plant operations, and dredging in the area is not viable considering the required buffers around cables and pipelines. For similar reasons dredging the material offshore of the warm water outflow is not considered advisable. Sediment samples from this area showed that the material is relatively fine grained and not well suited as potential beach fill material. In the near shore fillet area just east of the warm water outflow, it might be possible to identify a small quantity of suitable material that could be bypassed to the westerly shores (likely by trucking). This source of bypassing material, though small in quantity, would also be renewable from the updrift littoral processes. For the same reasons described in the sand-bypassing alternative, this bypassing measure was eliminated from further consideration in the plan formulation process.

4.1.5 Modification to the Roadway and Utilities

Causeway. One way to protect Asharoken Avenue through modification of the roadway would be to elevate the road on concrete pilings and build a causeway. This would protect the road by elevating it and allowing overwashes to go under the road. Depending on the road elevation, damages from severe storms might still occur. This option was not considered further because of the high cost, the problem of interfacing with existing driveway and property grades and the potential environmental changes to Northport Bay via Duck Island Harbor.

Road Raising. This measure would utilize the roadway as the primary protective element in Reaches 1A and 1B. The road would be raised and a protective bulkhead and /or heavy riprap would be placed immediately adjacent to the roadway fronted by a small amount of beach fill. This plan is similar to the reinforced dune plan with the dune located as far landward as possible or as part of the road to minimize cost and impacts. Road grade and driveway impacts would still need to be addressed. This measure would maintain reasonable access to Eatons Neck during most storms. It does not address the risk of damages to the residential structures in Reach 2A and would not directly affect the long-term erosion, which could impact the long-term effectiveness of this plan. For this reason this measure was not considered further.

4.2 SCREENING OF MEASURES

The management measures described above were retained for further consideration based on their ability to meet the following measures screening criteria:

i. Does the measure meet objectives?
ii. Does the measure avoid constraints?

Those measures that did not meet these criteria were removed from further consideration, or combined into alternative plans with those measures that did meet the criteria. Table 5 summarizes the screening of measures.

Table 5: Screening of CSRM Measures

Measure	Screening	Reason for Consideration/Elimination
Buy-Outs	Eliminated	Not Cost effective (100 houses, 50M)
Zoning	Eliminated	Not effective for existing structures
Retrofitting	Eliminated	Not effective for most structures facing L.I. Sound which are subject to erosion and wave attack.
Relocation	Eliminated	Not Cost Effective
Floodwalls and Levees	Eliminated	Not effective against erosion and wave attack
Beach Nourishment	**Carried Forward**	Cost Effective (12,400 ft length; 22M)
Reinforced Dune with Beach Nourishment	**Carried Forward**	Cost Effective (12,400 ft length; 43M)
Bulkhead or Bulkhead with Raised Dune	Eliminated	Not recommended because of frequent maintenance
Groins with Beach Fill	Eliminated	Not Cost Effective (24 groins; 45M)
Localized Groins with Beach Nourishment	**Carried Forward**	Cost Effective
Offshore Breakwater with Beach Fill	Eliminated	Not Cost Effective (10 breakwater segments; 50M)
Sand Bypassing	Eliminated	Not effective to reduce storm damage risk. Limited updrift supply of material available..
Installation of a Diffusion Pipe	Eliminated	Not effective as jetties and intake channel form an effective littoral blockage
Modification of the Jetties	Eliminated	Not effective as storm damage reduction measures. Would adversely impact power plant operations.
Dredging the Updrift Fillet Areas	Eliminated	Not Cost Effective
Causeway	Eliminated	Not Cost Effective
Road Raising	Eliminated	Not Cost Effective, Incomplete Solution
Road Raising with beachfill	Eliminated	Not Cost Effective

As discussed in the prior table, the widespread application of nonstructural measures would not be cost effective at reducing storm erosion losses. Building retrofits are not viable due to site conditions, and buy-outs or relocations would not be cost-effective due to the high cost of property.

Of all the structural measures considered only those plans that include a beach fill component were carried forward in the plan formulation process. The use of hard coastal structures alone to reduce erosion and wave attack risk would be too costly. Such hard structural measures would also introduce significant changes to the area's environment and aesthetics. The reinforced dune measure and localized groin measure were carried forward in the plan formulation process because they could reduces beach fill requirements and because the adverse environmental and aesthetic impacts would be minimal, and potentially offset by reductions in the volume of sand that would need to be placed.

There were no regional sediment management measure carried forward in the planning process. The existing bypassing being undertaken by the powerplant operators is effective in bypassing the quantity of material that enters the system.

Measures that warranted continued consideration were assembled into **alternative plans**. An alternative plan (also known as, “**plan**” or “**alternative**”) is a set of one or more management measures functioning together to address one or more planning objectives. Measures were grouped into the following **design strategies,** which formed the basis of the alternatives.

i. **Dune and Beach fill Only Strategy (Alternative 1):** This strategy consists of beach and dune fill in a portion of the project area. Measures: beach and dune fill
ii. **Reinforced Dune with Beach fill Strategy (Alternative 2):** This strategy consists of a reinforced dune coupled with a beach and dune fill. The core of the dune is strengthened with structural elements such as a buried rock seawall. Measures: reinforced dune and beach fill
iii. **Partial Reinforced Dune with Beach fill Strategy (Alternative 3a/3b):** This strategy consists of a reinforced dune coupled with a beach and dune fill for a portion of the project boundary. The core of the dune is strengthened with structural elements such as a buried rock seawall. Measures: reinforced dune and beach fill
iv. **Beach fill with Localized Groins Strategy (Alternative 4 & 5):** This strategy consists of additional groin fields at localized erosion areas to protect against storm damage and reduce renourishment frequency and quantity. Measures: beach fill, groin field

Table 6 shows the alternatives analyzed with the specific features utilized for each reach.

Table 6: Storm damage reduction features comprising design strategies.

	WEST			*EAST*
1	Dune and Beachfill			
2	Reinforced Dune and Beachfill			
3A	Reinforced Dune and Beachfill	Beachfill		
3B	Beachfill	Reinforced Dune and Beachfill		
4	Groin Field	Beachfill		
5	Groin Field	Beachfill	Groin Field	Beachfill

4.3 PLAN ALTERNATIVES

The Beach Fill Only, the Reinforced Dune with Beach fill, and the localized groin field measures described in the previous section were further developed to produce comprehensive alternatives that would be analyzed further.

4.3.1 Alternative 1

Dune and Berm Plan

This alternative includes 12,400 linear feet of beach berm and dune fill, from intersection of Bevin Road and Asharoken Avenue south, east to the west jetty of the power facility's inlet basin. The beach design template includes a dune height at elevation +16 NGVD29 with a 15 ft dune crest width, landward and seaward dune slopes of 1V:3H, a 50 ft berm width at elevation +9 NGVD29 and a foreshore slope of 1V:15H to the existing bottom. The dune includes beach grass on the dune crest and landside slope, and sand fence on the dune seaward slope for dune enhancement and long-term performance. Figure 20 shows typical dune and beach fill and typical berm fill only sections. In Reach 2 the design transitions to a berm fill only section in front of the existing bulkheads with a top elevation of +9 ft NGVD, and a berm width of 50 ft. This cross-section would cover the southeastern 6,200 ft of shoreline.

The dune alignment fronting the Section 103 project will be shifted slightly seaward with 300 ft to 500 ft transitions at each end, to be able to wrap around the steel bulkhead seawall. This alternative will require approximately 20,000 cy/year of re-nourishment with 3-year renourishment period and 50 ft advanced berm fill in Reach 2.

The borrow area for initial construction will be from an offshore source, identified as Borrow Area A, in the Long Island Sound approximately 3 miles north of the project area. Future renourishment source will be from an approved upland source. The costs for Alternative 1 are presented in table 7.

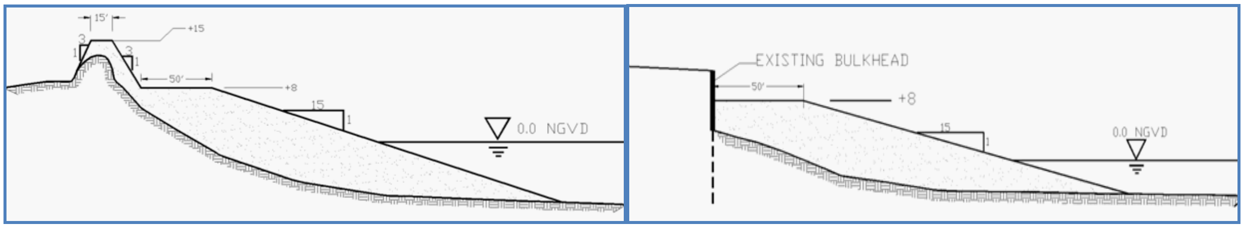


Figure 20: Typical Dune and Beach fill Section

Table 7: Alternative 1 – Initial and Annualized Costs

	Alternative 1 Beachfill Only
Initial Fill Volume (CY)	600,000
Coastal Structures	n/a
Nourishment (cy/period)	60,000 cy/3 yrs
Total Nourishment in 50yrs	1,000,000 cy
COSTS	
Initial Construction Cost	$21,552,000
Annualized Initial Constr.	$734,000
Annual Nourishment Cost	$1,143,000
Annualized Monitoring Costs	$50,000
Annualized Maintenance and Rehab	$147,000
Total Annual Cost	$2,074,000

Note: Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

4.3.2 Alternative 2

Reinforced Dune (Buried Stone Seawall) with Berm Plan

This alternative includes 12,400 linear feet of beach berm, reinforced dune and dune fill cover for the same project length as Alternative 1. The sand dune design template has a crest width of 15 ft at elevation +14 NGVD29 and both the seaward and landward slopes of 1V:3H that completely encapsulate a trapezoidal shaped stone seawall of crest width 10 ft at elevation +11.5 to +13 NGVD29 with 1V:1.5H side slopes. The seawall has a crest cover of minimum 1 ft of sand and a 0.5 ft. of topsoil for dune grass planting at the crest and backslope. Sand fence is included to maximize sand cover. The dune alignment, as with Alternative 1, is shifted seaward with 500 ft transition in the area of the Section 103 project to be able to front the project's bulkhead. For the 6,200 ft southeastern shoreline, a low-profile dune will be designed to accommodate with the existing bulkhead elevation. The renourishment of this alternative will include approximately 200,000 cubic yards of fill every 10 years through the 50-year period of analysis. Due to reinforcement, the renourishment frequency is reduced from once every 5 year to 10 year. The borrow area for initial construction is the same offshore area used for Alternative 1. The reduction in beach nourishment frequency is due to reduced risk of storm damage by dune reinforcement.

The additional advantage of Alternative 2 is the lower required dune crest elevation for the same level of performance. This is because Alternative 2 can tolerate more overtopping (crest can be set lower) due to its buried splash blanket protection, landside of the dune, to protect undermining of the structure. Alternative 1, which has no splash blanket protection and is subject to dune lowering, therefore permits smaller threshold overtopping (with a higher required dune elevation) to preclude damage to the deformable dune. This lower dune elevation allows for less obstructed views (by approximately 2 feet). A typical reinforced dune section is shown in Figure 21. The costs for Alternative 2 are presented in table 8.

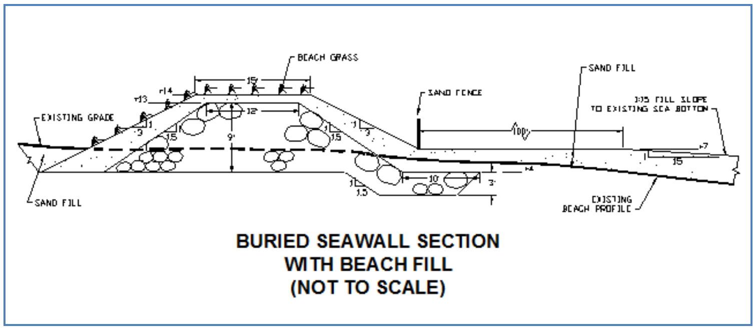


Figure 21: Typical Reinforced Dune Section

Table 8: Alternative 2 – Initial and Annualized Costs

	Alternative 2 Beachfill and Buried Seawall-full shoreline
Initial Fill Volume (CY)	375,000
Coastal Structures	buried seawall
Nourishment (cy/period)	200,000 cy/10 yrs
Total Nourishment in 50yrs	1,000,000 cy
COSTS	
Initial Construction Cost	$66,931,000
Annualized Initial Constr.	$2,310,000
Annual Nourishment Cost	$997,000
Annualized Monitoring Costs	$50,000
Annualized Maintenance and Rehab	$353,000
Total Annual Cost	$3,710,000

Note: Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

4.3.3 Alternative 3

Alternative 3 has been is presented in two versions. Quantities remain the same in both versions; 3A consists of a dune and beach fill in the eastern portion of the alignment, while 3B consists of dune and beach fill in the western portion of the alignment. The costs for Alternative 3 are presented in table 9.

4.3.3.1 3A - Eastern Dune and Beach fill

Combination Reinforced Dune at Eastern 6,200 ft and Beach fill for the Rest Plan

This plan includes 6,200 ft of beach and dune fill from Bevin's Rd. south (same as Alternative 1) and 6,200 ft of beach fill with reinforced dune (same as Alternative 2) from the southern border of non-reinforced dune to the west jetty of the power plant facility. Renourishment is the same for each 6,200 ft. reach as their associated alternatives. Post-storm damage repairs will not be necessary assuming both critical areas will be reinforced.

4.3.3.2 3B - Western Dune and Beach fill

Combination Reinforced Dune at Western 6,200 ft and Beach fill for the Rest Plan

This plan includes 6,200 ft of reinforced dune with beach fill from Bevin's Rd. south (same as Alternative 2) and 6,200 ft of beach fill only (with advance fill, same as Alternative 1) from the southern end of reinforced dune with beach fill to the west jetty of the Keyspan power plant facility. Renourishment is the same for each 6,200 ft. reach as their associated alternatives.

Table 9: Alternative 3 – Initial and Annualized Costs

	Alternative 3 Beachfill and Buried Seawall-half shoreline
Initial Fill Volume (CY)	450,000
Coastal Structures	partial buried seawall
Nourishment (cy/period)	200,000 cy/10 yrs
Total Nourishment in 50yrs	1,000,000 cy
COSTS	
Initial Construction Cost	$45,940,000
Annualized Initial Constr.	$1,579,000
Annual Nourishment Cost	$997,000
Annualized Monitoring Costs	$50,000
Annualized Maintenance and Rehab	$259,000
Total Annual Cost	$2,885,000

Note: Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

4.3.4 Alternative 4

Beach fill with West localized Groin Field Plan

In addition to the initial beach fill, this alternative includes a groin field at the critical erosion area in front of the existing Section 103 Project to reduce renourishment frequency and quantity. A groin field will be constructed in front of the existing Section 103 project, west of the existing (150 ft) rock groin in Reach 1A (see Figure 10). This groin field consists of three rock groins with lengths 120 ft, 100 ft, and 80 ft tapering from east to west. The layout of the 120 ft and 100 ft groins will be on top of the footprint of the existing groins located in this area. The purpose of this tapered groin field is to retain the design beach fill width with less frequent renourishment which provides more consistent toe protection of the steel bulkhead seawall and reduction of wave height, runup, and overtopping at this location.

Historically, this section of bulkhead seawall experienced frequent storm damage due to disruption of sediment supply caused in part by the existing rock groin. A number of specific configurations of groins scenarios were considered in this area. An option of shortening or removal of the existing 150 ft groin was considered but discarded due to concerns of potential de-stabilization of the upstream (eastern) dune and beach shoreline. In addition, the shoreline response of groin shortening was not as effective as the groin field.

The advantages of the west tapered groin field are that it will Stabilize the shoreline in front of the existing Section 103 project and reduce frequent renourishment. The estimated nourishment volume reduction is 40,000 cy in 10 years. This will also Maintain the integrity and stability of the updrift dune and beach shoreline without shorting or removal of the existing rock groin. This plan also Includes advanced fill tapers at the downdrift shoreline, approximately 500 to 1,000 ft in shoreline length as part of initial construction and renourishment to ensure no downdrift effects, and includes post-construction monitoring for the design and adaptation of future renourishments at this area. The costs for Alternative 4 are presented in table 10.

Table 10: Alternative 4 – Initial and Annualized Costs

	Alternative 4 Beachfill and Three West Groins
Initial Fill Volume (CY)	**600,000**
Coastal Structures	**3 rock groins**
Nourishment (cy/period)	**80,000 cy/5 yrs**
Total Nourishment in 50yrs	**800,000 cy**
COSTS	
Initial Construction Cost	**$23,665,000**
Annualized Initial Constr.	**$806,000**
Annual Nourishment Cost	**$883,000**
Annualized Monitoring Costs	**$50,000**
Annualized Maintenance and Rehab	**$156,000**
Total Annual Cost	**$1,895,000**

Note: Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

4.3.5 Alternative 5

Beach fill with both West and East Localized Groin Field Plan

In addition to the initial beach fill, this alternative includes a groin field at both the west and east critical erosion areas to reduce both renourishment frequency and quantity. In addition to Alternative 4, a groin field layout would be constructed along the east critical erosion area and tapering along the entire Reach 2A shoreline (see Figure 10). This additional east groin field consists of eight rock groins with lengths ranging from 80 to 120 ft, and with average spacing of 800 ft.

The purpose of this east groin field is to retain a design beach fill with less frequent renourishment. Historically, this section of bulkhead experienced frequent storm damage. The shoreline erosion rate at the east critical area range from 10 to 15 ft/year.

The advantages of adding the east groin field are that it will stabilize the east critical erosion shoreline and reduce frequent renourishment. The estimated volume reduction base on model result is approximately 96,000 cy in 10 years with a longer renourishment period. As with Alternative 4, this alternative includes advanced fill tapers and taper groins at the downdrift shoreline, approximately 1,000 ft in shoreline length; provides a feeder beach in the form of higher and wider dune and berm widths to compensate the erosion, and includes post-construction monitoring for the design and adaptation for future nourishments at the high-erosion areas. The costs for Alternative 5 are presented in table 11.

Table 11: Alternative 5 – Initial and Annualized Costs

	Alternative 5 Beachfill and 3 West, 8 East Groins
Initial Fill Volume (CY)	600,000
Coastal Structures	11 rock groins
Nourishment (cy/period)	100,000 cy/10 yrs
Total Nourishment in 50yrs	500,000 cy
COSTS	
Initial Construction Cost	$32,426,000
Annualized Initial Constr.	$1,114,000
Annual Nourishment Cost	$504,000
Annualized Monitoring Costs	$93,000
Annualized Maintenance and Rehab	$196,000
Total Annual Cost	$1,907,000

Note: Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

4.4 RENOURISHMENT AND SAND SOURCE ALTERNATIVES

Renourishment Requirements

The following table summarizes the sand requirements for each of the described alternatives. More frequent renourishment cycles are required if the critical erosion areas are not reinforced or beach fill retained with groins. Based on historical shoreline and sediment budget analysis, both the west and east critical areas experienced up to 10 ft/year erosion rate, therefore, a 3-year renourishment cycle is required. The erosion rate is greatly reduced with groin field in place.

Table 12: Alternatives Renourishment Quantity Estimates

	Scheduled Renourishment			Total Volume in 50 years (cy)
Alternative	Renourishment per Cycle(years)	Annual (cy/yr)	Quantity/Cycle (cy)	
1-Beach fill Only	3	20,000	60,000	1,000,000
2-Full Buried Seawll	10	20,000	200,000	1,000,000
3-Half Buried Seawall	10	20,000	200,000	1,000,000
4-West Groin Field Only	5	16,000	80,000	800,000
5-West & East Grin Field	10	10,000	100,000	500,000

Notes: 1. Sediment bypassing from power plant is accounted for and included in the scheduled nourishment; 2. The scheduled renourishment quantity is based on sediment budget analysis; 3. Volume reduction quantities are based on GENESIS model results.

Because the alternative plans to be developed for detailed evaluation all involve beach fill for initial construction as well as for periodic nourishment to reduce the risk of storm erosion and wave attack forces, it is crucial to identify resources of suitable material. Not only is the amount or volume of suitable beach fill material important but so is the determination of the environmental effects of obtaining (typically referred to as "borrowing") the fill and placing the fill on the shoreline.

Borrow source investigations included both offshore and upland sources. The grain size distributions and available volumes of the potential borrow sources are obtained from samples collected at the upland sources and offshore vibracore samples collected for this study. The grain sizes are compared with typical native beach sand size distribution taken from the project site to determine the compatibility of the borrow material. Those suitable borrow sources are checked to determine if volume at the borrow site would be sufficient for the beach fill project.

The existing beach material at Asharoken Beach is a coarse grain sand with a median grain size of 0.9mm. Historically, the beach was a fine/medium grain sand with a median grain size of 0.2 to 0.4mm, but due to continued erosion and a lack of a sediment supply from the updrift (easterly) shores, the finer materials have washed out from Asharoken Beach resulting in a much coarser median grain size. As with most north shore of Long Island beaches, there is also a certain amount of gravel and small stones mixed with the sand.

In order for borrow material (sand taken from other sources) to be considered to be suitable as beach fill, one criterion requires that borrow material have an equal or slightly larger median grain size than the existing beach.

4.4.1 Alternative Borrow Sources

Both upland (sand pits or quarries) and offshore borrow sources were investigated. Upland sources can usually mix medium and coarse sand material to meet the grain size compatibility requirements. A major concern with upland sources is the distance from the placement site, the trucking costs for transport and delivery, and the quantity of sand that needs to be trucked. To locate suitable offshore borrow material, samples (cores) are taken and examined to identify underwater areas that have compatible grain sizes. The depths below the sea bottom are also examined to determine the volumes of suitable material and the types of equipment needed to excavate the material. Such excavation or dredging from offshore borrow areas around Long Island typically utilizes some form of hydraulic dredging process to suck the material from the sea bottom and transport it via slurry pipelines to beach fill site, where grading equipment distributes the material in the desired beach fill configuration.

Table 13: Alternative Borrow Schemes

Borrow Location/ Potential Volume	Distance from Project Site	Method of Construction for Dredging/Transportation	Borrow Site Restrictions
Asharoken Offshore Borrow Area A 3.75 million cubic yard **(Recommended)**	2 miles	Cutterhead pipeline dredge	Require dredging permit based on future environmental testing
Asharoken Offshore Borrow Area B 0.8 million cubic yard **(Alternative Site)**	5 miles	3,000 cy hopper dredge with pump-out facility	Require dredging permit based on future environmental testing
Upland Long Island Horan Sand and Gravel **(Backup Site)**	20 miles	Trucked to site	See Note Limited available volume Median grain size=0.6mm
Upland Long Island Ranco Sand and Stone **(Backup Site)**	40 miles	Trucked to Site	See Note Limited available volume Median grain size=0.6mm

Notes: 1. All upland sources require additions of coarser grain sand to become suitable; 2. Upland sources may be used for future nourishment.

Potential upland sites were narrowed down to two sites: Horan Sand & Gravel Corp near Central Islip (20 miles) and Ranco Sand & Stone at Manorville (40 miles) based on screening of volume availability and grain size. Next, the existing geologic maps and boring samples in Long Island Sound and within reasonable distance from the project site were examined. Details of the literature reviews and results are summarized in the Engineering Appendix (see Appendix A). Two potential sites were short-listed based on their available size, suitability, and environmental considerations. The two sites are summarized as follows:

i. An Offshore source in Long Island Sound, Borrow Area “A” located north of Asharoken, approximately 1 to 2 miles from the beach fill site, ½ miles offshore;
ii. An Offshore source in Long Island Sound, Borrow Area “B” located northeast of Asharoken, approximately 5 miles from the beach fill site;

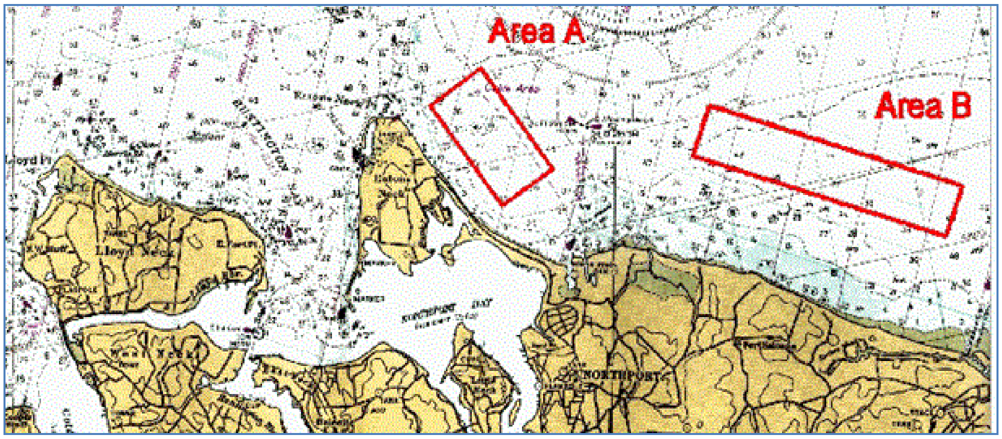


Figure 22: Potential Offshore Borrow Area

4.4.2 Suitability of Borrow Sources Alternatives

The upland sand source samples from the quarries are considered “unsuitable” for the Asharoken project based on the suitability criteria. However, these sources could be considered for renourishment if mixed with coarser sand. Upland sources would not be economical for initial construction based upon the volume of sand required, but are considered for renourishment as more economical than utilization of an offshore borrow area.

Within Borrow Area A, glacial contact deposits were identified that are suitable using the comparison of the grain size and distribution compared to the existing sediments on Asharoken Beach. The total estimated available volume of suitable glacial contact deposits in Borrow Area A is approximately 3,750,000 cy, assuming a dredge cut of 10 ft in areas that are deeper than 30 ft MLLW.

Within Borrow Area B, approximately 83% of the seabed is composed of an active shoal deposit of very fine sands that are unsuitable for beach fill use based upon comparison with the native beach material. The remainder of the borrow area are classified as transition zone deposits which account for remaining 17% of the sediments. The sediment in this area is predominantly a marginal borrow source, with one location identified as suitable. Based on a 10 ft. of dredging depth, it is estimated that there are approximately 1,700,000 cy of potential borrow material, but only a portion of the area has sufficient data to be used as a borrow source immediately. This immediately available area contains 900,000 cy.

4.4.3 Constructability of Borrow Sources Alternatives

Constructability refers to the methods employed in the extraction and delivery of suitable offshore sources of borrow materials to the project beaches at Asharoken. The areas with potential borrow sources, Borrow Areas A and B, are located as close to the project beaches as possible and dimensioned to avoid encroachment on both the pipeline and cable emplacement areas, and the leased shellfish beds. The borrow sources are located at -30 ft. NGVD29 depth contour or deeper, which is beyond the active surf zone limit at approximately -24 ft. depth contour. Therefore, there would be minimal coastal process impact due to dredging. The material in any or all of these designated potential borrow sites are suitable and there should be no serious impediments to dredging due to environmental or location factors. However, there may be some constraints imposed by the presence of cobbles and boulders in the borrow areas, particularly in Borrow Area A. The Glacial Contact deposits in Borrow Area A have a larger content of gravels, some cobbles, and signs of occasional boulders. This content may affect the choice of dredging methods used, dredging operations, and production rates.

A clamshell dredge or a large backhoe on a spud barge is probably the best suited to dredge boulders and cobbles when they are buried in a matrix of sand and gravel, particularly if large boulders are present. However, this equipment is limited by the size of the bucket. A Backhoe Dredger, which was used in a recent test in the Kill Van Kull, has a bucket volume of five cubic yards. This dredging method requires a separate barge to receive the material for transport to shore, and the production rate is lower. Cutterhead dredge would be the preferred method of dredging in Area A since it combines the qualities of high productivity in difficult soils with the ability to transport via pipeline to shore over distances of up to 15,000 ft. and 30,000 ft. with a booster pump. However, the Cutter Suction is unsuitable for large production in cobbles. Bars may be installed at the input end of the suction tube to reject large cobbles at their source. Where the cutterhead dredge cannot efficiently work, the backhoe or clamshell dredge would be utilized. Cutterhead with a booster pump (mounted on a spud barge) or hopper dredge may be used in Borrow Area B where the material is finer with apparently lower levels of cobbles and boulders.

4.4.4 Selection of Borrow Source(s)

Selection of the best feasible borrow source was based on the criteria of suitability, available volume, distance to project site, and permit considerations (described further in the EA). Offshore Borrow Area A contains the larger volume of suitable material and is closer to the project site and therefore is recommended as primary borrow source for initial construction. Borrow Area A can also be dredged in a manner to cut into the existing side slope and avoid depressions below grade. Based upon the volume of sand required for renourishment, upland sources are the recommended borrow source for renourishment.

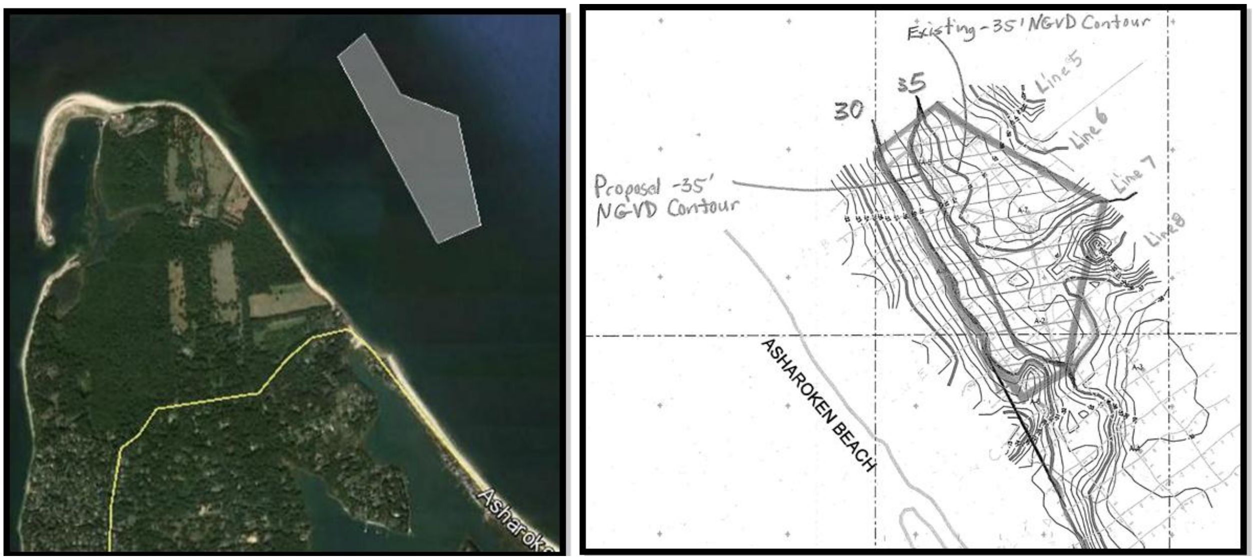


Figure 23: Selected Offshore Borrow Area

Several alternative dredging scenarios were developed based on the location of potential borrow sources and methods of construction. These are discussed in detail in the Engineering Appendix.

4.4.5 Summary of Initial Alternative Costs

Based upon the alternatives described above and the proposed borrow sources, the following table of costs was developed for the final array of alternatives, as the basis for comparing alternatives.

This table illustrates that Alternatives 1, 4, and 5 all have very similar lifecycle costs. Since each plan was developed to provide a similar level of risk reduction, each plan would have comparable benefits. As a result, Alternatives 1, 4, and 5 have been carried forward as the short-list of alternatives for selection of the Tentatively Selected Plan.

Table 14: Array of Alternatives: Initial and Annualized Costs

	Alternative 1 Beachfill Only	Alternative 2 Beachfill and Buried Seawall-full shoreline	Alternative 3 Beachfill and Buried Seawall-half shoreline	Alternative 4 **Beachfill and Three West Groins**	Alternative 5 Beachfill and 3 West, 8 East Groins
Initial Fill Volume (CY)	600,000	375,000	450,000	**600,000**	600,000
Coastal Structures	n/a	buried seawall	partial buried seawall	**3 rock groins**	11 rock groins
Nourishment (cy/period)	60,000 cy/3 yrs	200,000 cy/10 yrs	200,000 cy/10 yrs	**80,000 cy/5 yrs**	100,000 cy/10 yrs
Total Nourishment in 50yrs	1,000,000 cy	1,000,000 cy	1,000,000 cy	**800,000 cy**	500,000 cy
COSTS					
Initial Construction Cost	$21,552,000	$66,931,000	$45,940,000	**$23,665,000**	$32,426,000
Annualized Initial Constr.	$734,000	$2,310,000	$1,579,000	**$806,000**	$1,114,000
Annual Nourishment Cost	$1,143,000	$997,000	$997,000	**$883,000**	$504,000
Annualized Monitoring Costs	$50,000	$50,000	$50,000	**$50,000**	$93,000
Annualized Maintenance and Rehab	$147,000	$353,000	$259,000	**$156,000**	$196,000
Total Annual Cost	$2,074,000	$3,710,000	$2,885,000	**$1,895,000**	$1,907,000

Note: 1. Nourishment quantities are preliminary and are based on sediment budget study and GENESIS Modeling estimates; 2. Annual costs are developed based on 50 year period of analysis; 3. Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

4.5 OPTIMIZATION OF BEACH DIMENSIONS

Alternatives 1, 4 and 5, identified above as the short-listed alternatives were further evaluated to determine the optimal beach dimensions for achieving the coastal storm risk management objectives. A range of beach fill configurations is typically differentiated by various changes to dimensions in the design profile. The alternative design profile involves different volumes of suitable beach fill material which in turn involves different implementation and renourishment costs. Besides difference in volumes and cost, the beach fill design profile also varies in the degree of effectiveness in reducing the risk of storm erosion and wave damages.

In finding the different dimensions of the sand and dune placement option, three different configurations were explored. These configurations involved a 30 ft., 50 ft., and 70ft. berm width in combination with a dune at elevation +15 ft NGVD29. The dune crest width would be 15 ft wide and the side slope would be 1V:3H. Table 15 presents the initial and annualized cost estimates for the array of berm widths.

Table 15: Cost for Array of Berm Widths

	30 ft berm	**50 ft berm**	**70 ft berm**
Initial Fill Volume (CY)	510,000	600,000	690,000
Coastal Structures	3 rock groins	3 rock groins	3 rock groins
Nourisment (cy/period)	80,000 cy/5 yrs	80,000 cy/5 yrs	80,000 cy/5 yrs
Total Nourishment in 50yrs	800,000 cy	800,000 cy	800,000 cy
COSTS			
Initial Construction Cost	$23,035,000	$27,100,000	$31,165,000
Annualized Initial Constr.	$966,450	$1,137,000	$1,307,550
Annual Nourishment Cost	$567,000	$567,000	$567,000
Annualized Monitoring Cost	$50,000	$50,000	$50,000
Total Annual Cost	$1,583,450	$1,754,000	$1,924,550

Note: Values calculated at October 2014 price levels and Federal discount rate of 3.375%.

5.0 ECONOMIC EVALUATION

Benefits from the proposed plans of improvement were estimated by comparing damages with and without the proposed project alternatives under existing and future development conditions. In calculating storm damage reduction benefits, the type of damage causing the maximum impact was identified at each structure for various storm frequencies. To prevent double counting, only this maximum damage was included in the calculation of project benefits.

Benefits that accrue from the implementation of measures to protect the isthmus may arise not only from the prevention of physical damage to the road, utilities and existing CSRM structures, but also from the avoidance of responses to storm events and subsequent measures taken to ensure the safety and well-being of the residents of the Eatons Neck peninsula. The impact of a storm event on residents may range from minor inconvenience to a major threat to public safety, and in order to comprehensively assess the economic cost of all consequences of an event which obstructs or severs the isthmus, a socioeconomic study of the affected area and its population has been undertaken.

5.1 EVALUATION METHODOLOGY

Benefits and costs were expressed as average annual values at October 2014 price levels and Federal discount rate of 3.375% and a period of analysis of 50 years.

There are two major sources of damages associated with this study, of which the first is the current vulnerability of the road, utilities and existing CSRM structures to storm-induced overtopping or breach at the northern end of the isthmus. The second source of damages is the vulnerability of residential structures to erosion at the southern end of the isthmus.

For calculating benefits, ground elevations and footprints of individual structures were determined from topographic maps and verified from field inspections. The choice of analytical approach to estimate benefits for this study has been ultimately determined by the nature of the problem and the degree of accuracy or certainty with which data values can be realistically estimated. This assessment has used a risk-based approach to model the potential damages from simulated series of storm events.

An Excel spreadsheet model was compiled for each reach under consideration in which infrastructure or buildings are assumed to be vulnerable to damage. Each model simulates the occurrence of storm events over the period of analysis and quantifies the resulting damages.

After consideration of the damage risk/potential in some detail, a range of benefit categories for inclusion in the analysis has been compiled. Benefits for this study in reaches are based on the avoidance of physical damages to the structures, road, utilities, and existing CSRM measures as well as the avoidance of costs associated with the impact of storm damage to the road such as accommodating stranded or evacuated residents.

If measures are not implemented to protect Asharoken Beach (and hence the road) at the northern end of the isthmus, damages are anticipated in the following increments:

i. **Pre-overtopping**: erosion of beach material from the Long Island Sound side, leading to undermining of bulkheads and other existing protection.
ii. **Still water overtopping**: periodic non-aggressive inundation of the isthmus by still water, hindering access but not resulting in significant damages to the road or utilities.
iii. **Minor overtopping**: inundation of the road during minor storm events, resulting in access difficulties such as traffic delays, overwash of sand and debris, and the limited mobilization of emergency response teams.
iv. **Major overtopping**: inundation by more serious storm events, resulting in blockage of the road, increased debris overwash, significant damage to the road surface, and major emergency response mobilization.
v. **Breach**: destruction or severance of the service and transport links that enable habitation of the peninsula; erosion of the isthmus resulting in loss of the roadway, roadbed, above ground and buried utilities, and complete isolation of the peninsula.

5.2 CONSIDERATION BY REACH

Depending on the reach, different categories of benefits from damage risk reduction will predominate. Within Reach 1A and Reach 1B the majority of the benefits would derive from emergency relocation costs avoided due to the risk of closure of Asharoken Avenue. These benefits would be the average annual costs saved by assuring the safe entry and exit of the inhabitants of Eatons Neck. Within Reach 2A and 2B the major benefit pool is from reduced damages risk to buildings and structures and reduced local cost of maintaining existing coastal structures.

The potential consequences of continual erosion without implementation of a project could range from likely events with the highest probability to extreme events with the lowest probability as listed below:

i. Failure of bulkheads and damage to structures west of the power plant due to wave impacts (Reach 2).
ii. An overwash and temporary closure of Asharoken Avenue (This may also include undermined utility poles blown over onto the road that cause road closure), including buried and overhead utility line damage, isolating Eatons Neck (Reach 1).
iii. A severe undermining of Asharoken Avenue anywhere between Duck Island Lane and Bevin Road, isolating Eatons Neck (Reach 1). Additional damage to structures in Reach 2.
iv. A complete breach of Asharoken Avenue anywhere between Bevin Road and Duck Island Lane (Reach 1), isolating Eatons Neck. Severe damage to structures in Reach 2.

Each of the types of storm damage has a certain risk or probability, expected cost of repairs, and impacts on Asharoken Avenue. All the impacts, except a breach, have been experienced by people in the Village of Asharoken. However, with worsening beach front conditions, a breach of Asharoken Avenue could be a reality. Under the most severe damage mechanisms, closure of Asharoken Avenue may require the temporary relocation of the population of Eatons Neck to temporary housing. A temporary closure of Asharoken Avenue would result in the stranding of 1,600 to 1,700 people, the severance of normal emergency services, and the severing of vital utilities.

5.2.1 Damage Categories by Reach

Table 16 presents a summary of the without-project equivalent annual damages by category.

Table 16: Without-Project Equivalent Annual Damages by Category

Damage Category	Reach		
	Reach 1A	Reach 1B	Reach 2
Bulkhead/Dune restoration	$235,000	$67,900	$726,500
Emergency/Cleanup	$8,200	$3,600	N/A
Road and Utility Reconstruction	$29,000	$9,000	N/A
Traffic Delays	$500	$0	N/A
Stranding	$1,000	$300	N/A
Evacuation	$318,000	$3,500	N/A
Structure Damage	N/A	N/A	$1,357,400
Reach Totals	**$591,700**	**$84,300**	**$2,083,900**
Project Area Total			***$2,763,200***

Price Level October 2014, FDR 3.375%, Period of analysis 50 years

Based on the above assessment of the existing and expected without-project shoreline conditions, it is clear that the primary storm damage mechanisms are long term erosion, storm recession, and wave attack damages due mostly to overtopping dunes and bulkheads.

5.3 ATTRIBUTION AND QUANTIFICATION OF BENEFITS

The analysis of benefits that may be realized by the implementation of various alternative measures to protect the vulnerable isthmus at Asharoken Beach was conducted with various analytical methods. These benefits are derived from the avoidance of physical damage to the infrastructure links that make the Eatons Neck peninsula habitable, and the avoidance of costs associated with maintaining residents' safe access to and from the peninsula.

Tables 17 and 18 presents a summary of the with-project equivalent annual damages and benefits for the 30 ft, 50 ft, and 70 ft berm width alternatives. Results show that the total damages decrease as the berm widths increase. The 50 ft berm results in a significant reduction in damages compared to the 30 ft berm width. The 50ft berm proved to be the optimal width when compared to the 70ft berm since the difference in total damages between these two scenarios is a very small decrease in damages for a significant increase in sand. Modeling shows that the optimal alternative with the highest benefits is the 50 ft berm width scenario.

Table 17: With-project Average Annual Total Damages

Reach	W/O Project	30 ft Berm	50 ft Berm	70 ft Berm
1A	$596,100	$90,000	$64,300	$59,000
1B	$83,200	$46,200	$4,300	$4,300
2A	$2,083,900	$354,400	$123,700	$112,000
Total	**$2,763,200**	**$490,600**	**$192,300**	**$175,300**

Price Level October 2014, FDR 3.375%, Period of analysis 50 years

Table 18: With Project Average Annual Benefits over Reach 1A, 1B and 2A

Reach	30 ft Berm	50 ft Berm	70 ft Berm
1A	$497,100	$520,200	$525,900
1B	$36,500	$79,400	$79,400
2A	$1,729,500	$1,960,200	$1,971,900
Total	**$2,272,600**	**$2,570,900**	**$2,587,900**

Price Level October 2014, FDR 3.375%, Period of analysis 50 years

6.0 TENTATIVELY SELECTED PLAN

The selection of the Tentatively Selected Plan is based upon identifying the plan that reasonably maximizes net excess benefits for coastal storm risk management, consistent with the environmental laws of the nation.

6.1 COSTS AND BENEFITS

Total annual costs include annualized Initial construction cost, monitoring, and annual renourishment costs. These costs and the estimated effectiveness of each plan are used to rank each plan. The effectiveness of each alternative are measured on how much storm or erosion damages are reduced which are classified as benefits.

Table 19: Comparison and estimated cost for construction of each alternative.

Asharoken, Long Island, New York					
	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
	Beachfill Only	Beachfill and Buried Seawall-full shoreline	Beachfill and Buried Seawall-half shoreline	Beachfill with West Groins	Beachfill with West and East Groins
Initial Fill Volume (CY)	600,000	375,000	450,000	600,000	600,000
Coastal Structures	n/a	buried seawall	partial buried seawall	3 rock groins	11 rock groins
Nourishment(cy/period)	60,000 cy/3 yrs	200,000 cy/10 yrs	200,000 cy/10 yrs	80,000 cy/5 yrs	100,000 cy/10 yrs
Total Nourishment in 50yrs	1,000,000 cy	1,000,000 cy	1,000,000 cy	800,000 cy	500,000 cy
COSTS					
Initial Construction Cost	$21,552,000	$66,931,000	$45,940,000	$23,665,000	$32,426,000
Annualized Initial Constr.	$734,000	$2,310,000	$1,579,000	$806,000	$1,114,000
Annual Nourishment Cost	$1,143,000	$997,000	$997,000	$883,000	$504,000
Annualized Monitoring Cost	$50,000	$50,000	$50,000	$50,000	$93,000
Annual OMRR Cost	$147,000	$353,000	$259,000	$156,000	$196,000
Total Annual Cost	$2,074,000	$3,710,000	$2,885,000	$1,895,000	$1,907,000
Annual Damage Benefits	$2,570,900	$2,570,900	$2,570,900	$2,570,900	$2,570,900
Net Benefit:	$496,900	-$1,139,100	-$314,100	$675,900	$663,900
Benefit/Cost Ratio:	**1.24**	**0.69**	**0.89**	**1.36**	**1.35**

Notes
1. All quantities and costs shown are conceptual and are for comparison only;
2. Nourishment quantities are preliminary and are based on sediment budget study and GENESIS Modeling estimates;
3. Annual costs are developed based on 50 year project life;
4. Cost estimates are based on M2 estimates as shown in the Cost Appendix;
5. Values calculated at October 2014 price levels and current Federal discount rate of 3.375%.

6.2 FINAL ARRAY OF ALTERNATIVES

The evaluation of lifecycle costs showed that Alternatives 1, 4, and 5 all have similar lifecycle costs. Alternative 1 has the lowest initial construction cost, and the highest renourishment cost. Alternatives 4 and 5 present increasing initial construction costs, but with corresponding reductions in renourishment. Of the three alternatives, Alternative 4 has the highest BCR and the highest net benefits, but only slightly higher than Alternatives 1 and 5. The comparison of these alternatives is also very sensitive to changes in the cost of stone or sand, and when factoring in the costs uncertainties can be considered as equal in terms of cost. From a planning point of view, because their benefits are the same they are equal in terms of effectiveness and efficiency.

Alternatives 1, 4 and 5 are in the same cost-benefit tolerance range with net annual benefits approximately $500,000 to 600,000 annually, with BCRs ranging from 1.2 to 1.4.

Although the three alternatives are comparable, Alternative 4 has been identified as the Tentatively Selected Plan based on the following justifications:

i. Alternative 4 is the most cost-efficient alternative based on NED criteria;
ii. Alternative 4 provides a system-wide erosion control approach of the entire project shoreline, including initial fill of project shoreline, advance fill at eastern shoreline which provides advanced nourishment for the downdrift beach, and providing short groins downdrift of the existing stone terminal groin to mitigate downdrift erosion;
iii. Reduces the frequency and amount of renourishment that is needed to maintain this critical location.

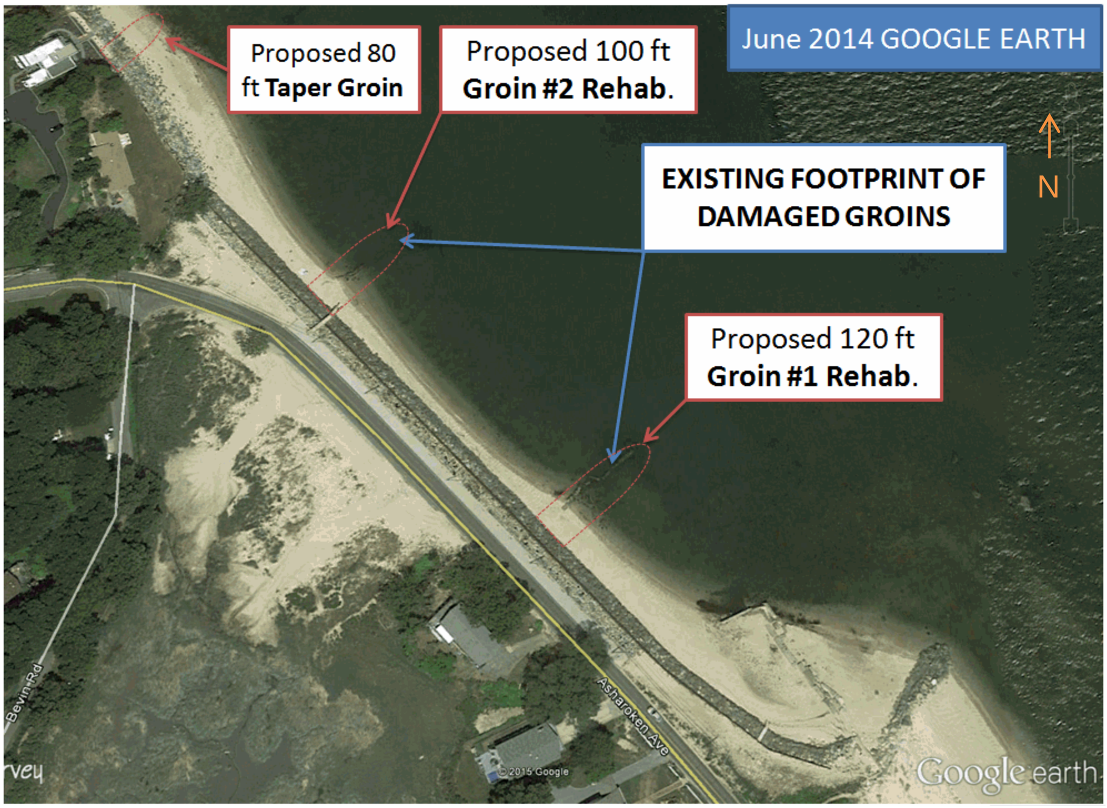


Figure 24: Proposed West Groin Field Layout

6.3 DESCRIPTION OF TSP

The Tentatively Selected Plan is identified as Alternative 4. The TSP is subject to change based upon public and agency review. The Corps' requirement is to identify the plan that reasonably maximizes net benefits, consistent with the environmental laws of the nation. Since the costs and benefits of Alternatives 1,4 and 5 are so close, it is possible that one of these alternatives could be identified as the TSP if there are compelling reasons to select the plan. The TSP and the typical sections are described below. The proposed plan includes approximately 2.4 miles of beach fill, 3 rock groins in the vicinity of the existing Section 103 Project, and periodic nourishment (table 20).

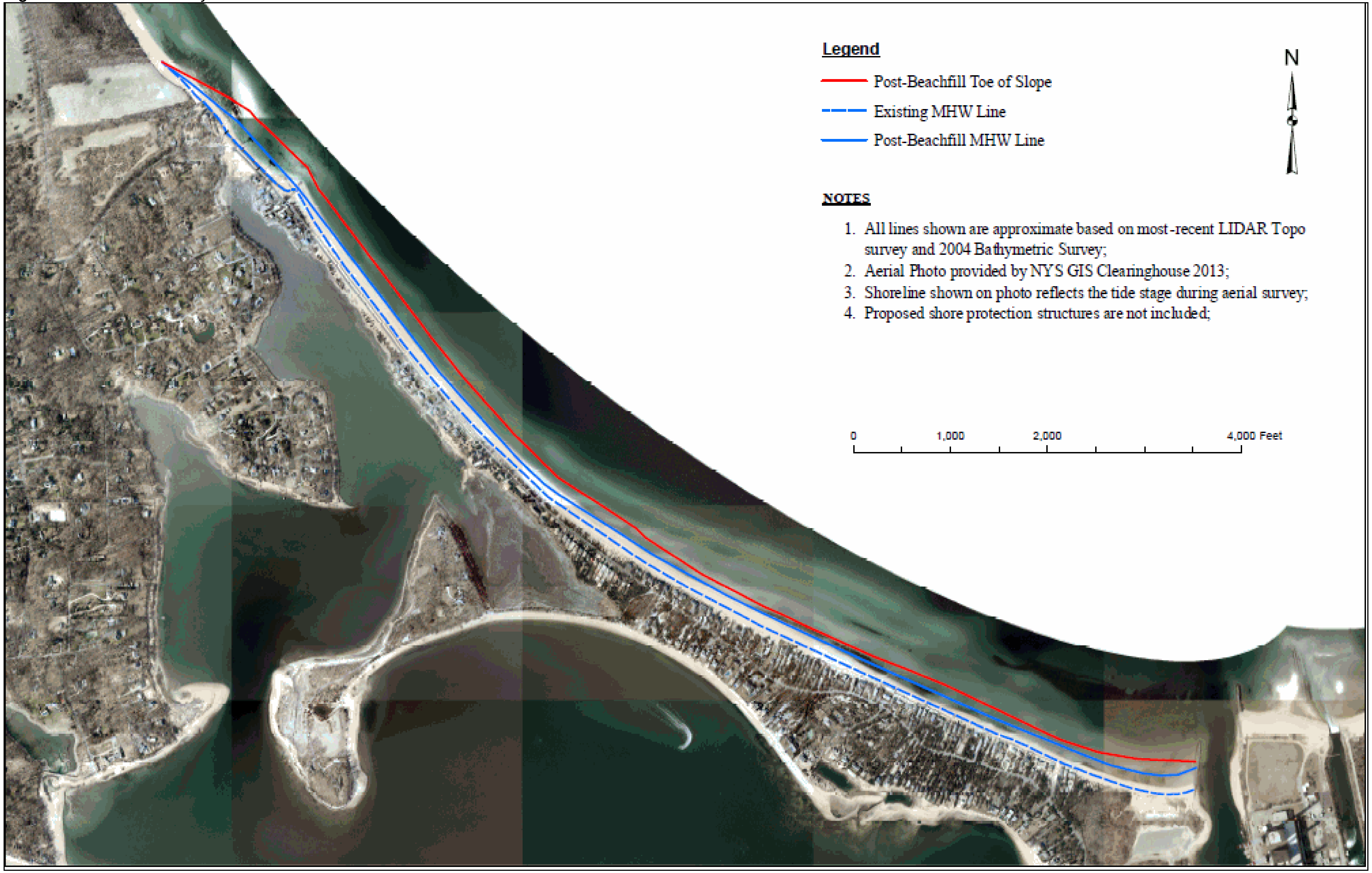
Table 20: Tentatively Selected Plan Components

TSP Components			
Beachfill and Dune			
Overall Length		12,400	ft
Height Range (NGVD29)		8.0 - 15.0	ft
Berm Width		50	ft
Berm Slope		1:15	
Initial Volume of Beachfill		600000	cy
Nourishment Cycle every 5 yrs		80000	cy
Rock Groin Dimensions			
	A	152 x 64	ft
	B	132 x 64	ft
	C	112 x 64	ft

6.4 PRELIMINARY LAYOUT PLAN AND TYPICAL SECTIONS

The general beach fill layout of the selected plan is shown in Figure 25. The layout of the western, tapered rock groin fields is shown in Figure 26.

Figure 25: TSP General Layout Plan



Note: Beach fill MHW and Toe of Slope Limits, All Proposed Groins are within the Toe of Slope

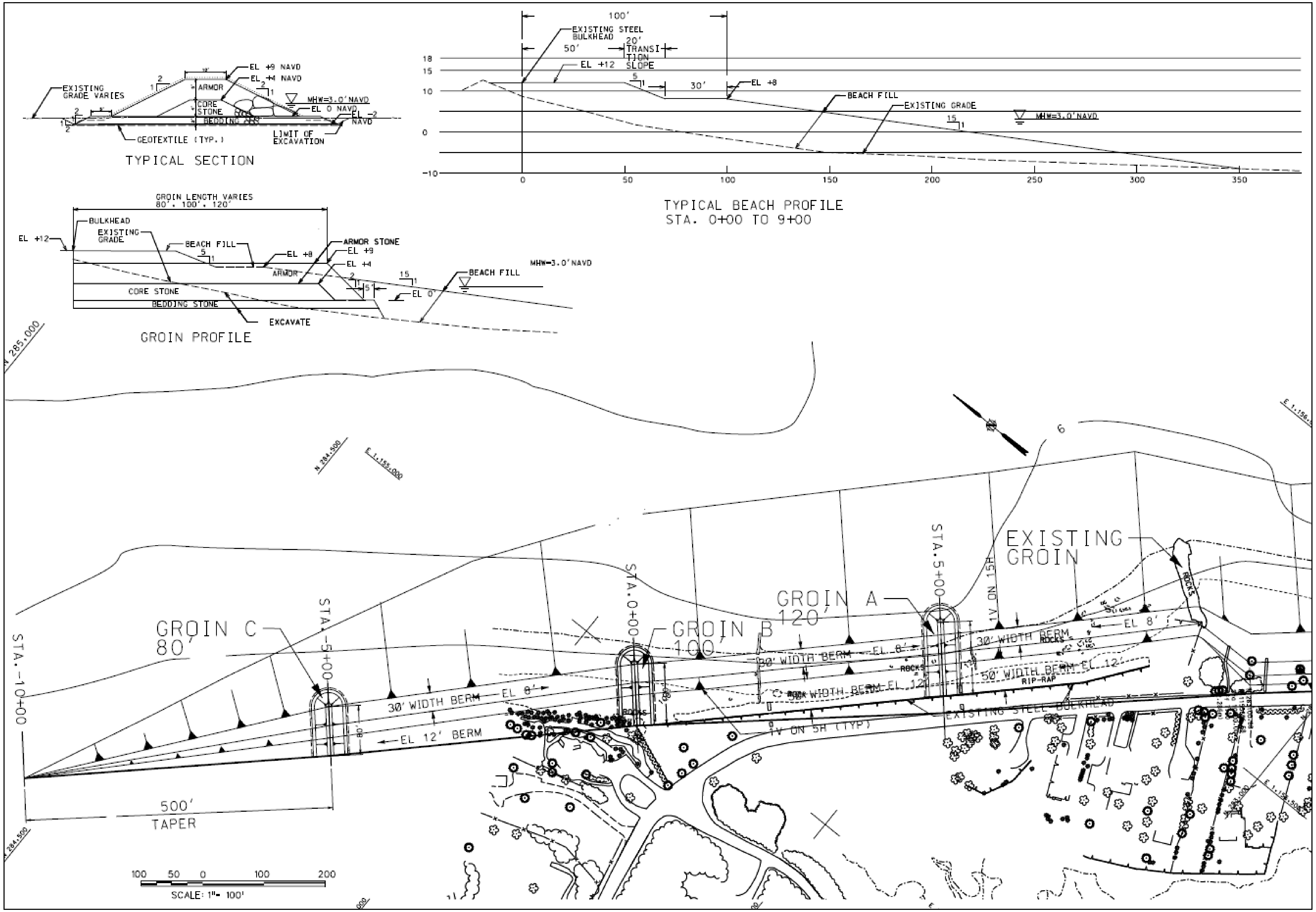


Figure 26: TSP Plan West Groin Field Layout

6.4.1 Beach fill cross-section in Reach 2A. (House #100 to #200)

The following figure shows the cross-section for the TSP in the vicinity of Reach 2A. The plan includes the construction of a beach berm at elevation +8 ft NGVD with a width of 50 ft, and shows an average added MHW beach width of 110 ft;

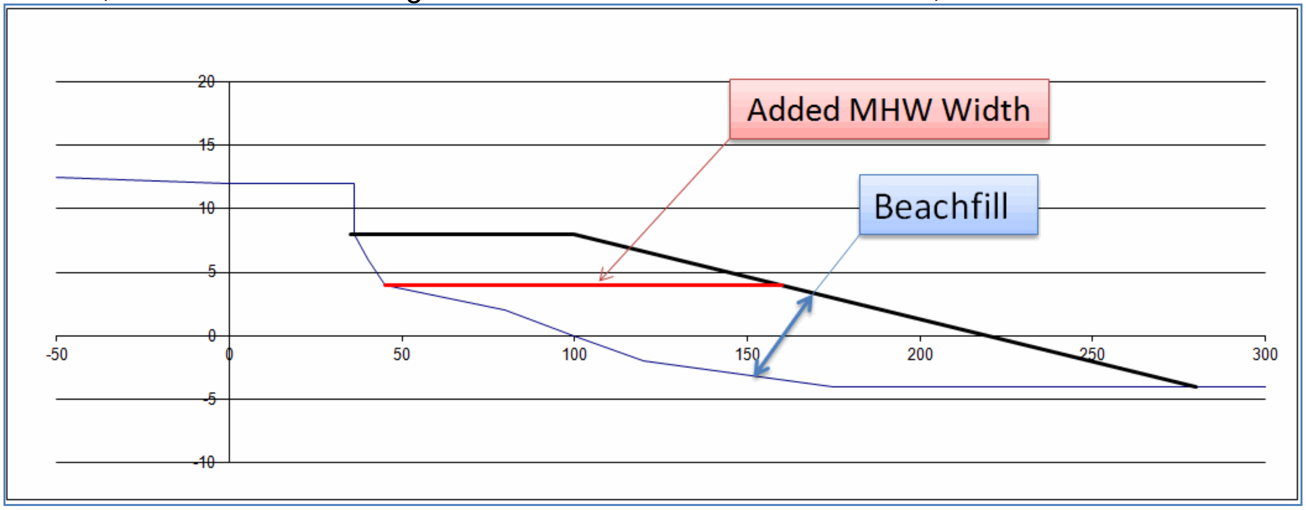


Figure 27: Beach fill at East Critical Area

6.4.2 Beach fill cross-section in Reach 1B

The following figure shows the cross-section for the TSP in the vicinity of Reach 2A. The plan includes the construction of a dune at elevation +15 ft NGVD, and a beach berm at elevation +8 ft NGVD with a width of 50 ft, and shows and added MHW beach width of 50 ft.

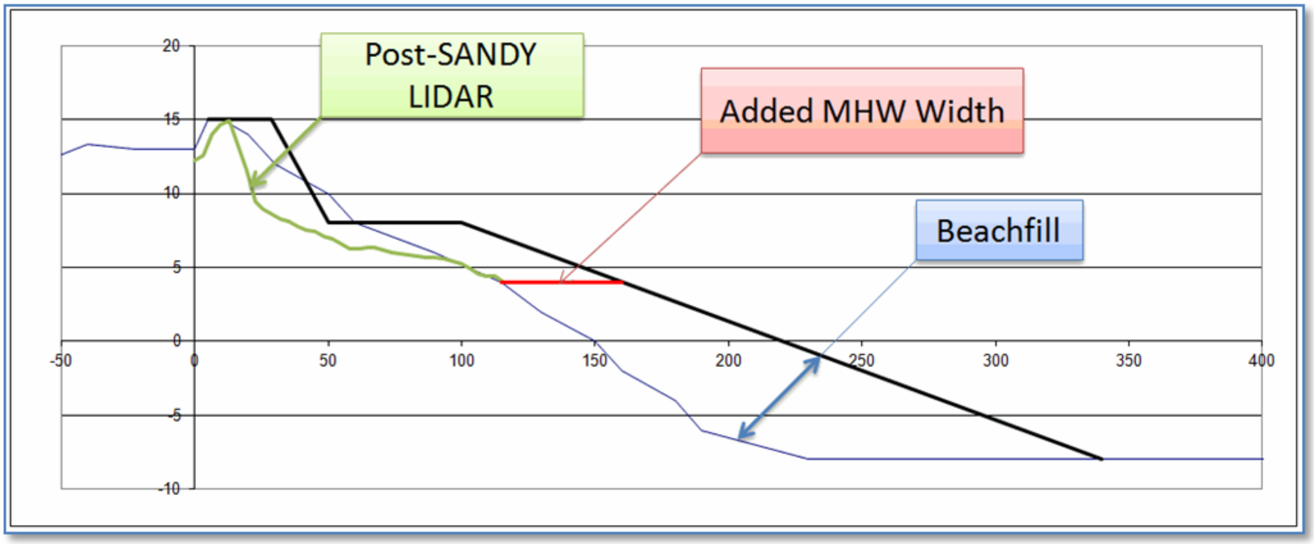


Figure 28: Beach fill at Western Critical Area

Station 0+ 00 to 9+00 – Initial 100 ft Width Composite Beach fill with Three Rock Groins and 500 ft Beach fill Tapers (**Rock Groins are for Alternatives 4 and 5 only**)

Beach fill with combination of high berm at +13 NGVD29 and low berm at +8 ft will be provided at this 900 ft shoreline fronting the existing steel bulkhead seawall. The crest width of the +12 ft berm is 50 ft, with 1 vertical on 5 horizontal seaward slope. The +8 ft berm is 30 ft wide with a 1 vertical on 15 horizontal foreshore slope (figure 29). The composite beach fill will provide storm wave protection to the existing bulkhead seawall. For the TSP, the 100 ft wide composite berm width will be retained with three new rock groins located at stations -5+00, 0+00 and 5+00. The groin lengths are 120 ft, 100 ft, and 80 ft in length respectively tapering from southeast to northwest, with crest elevation at +10 NGVD29. The typical section and profile are shown in figure 30.

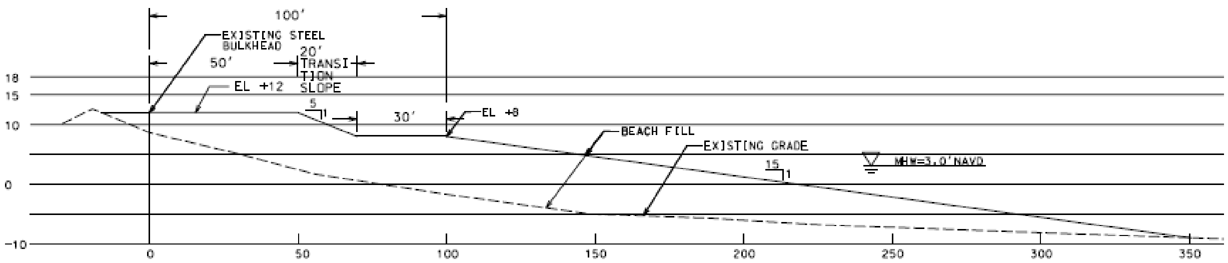


Figure 29: Typical Beach fill Section Station 0+00 to 9+00

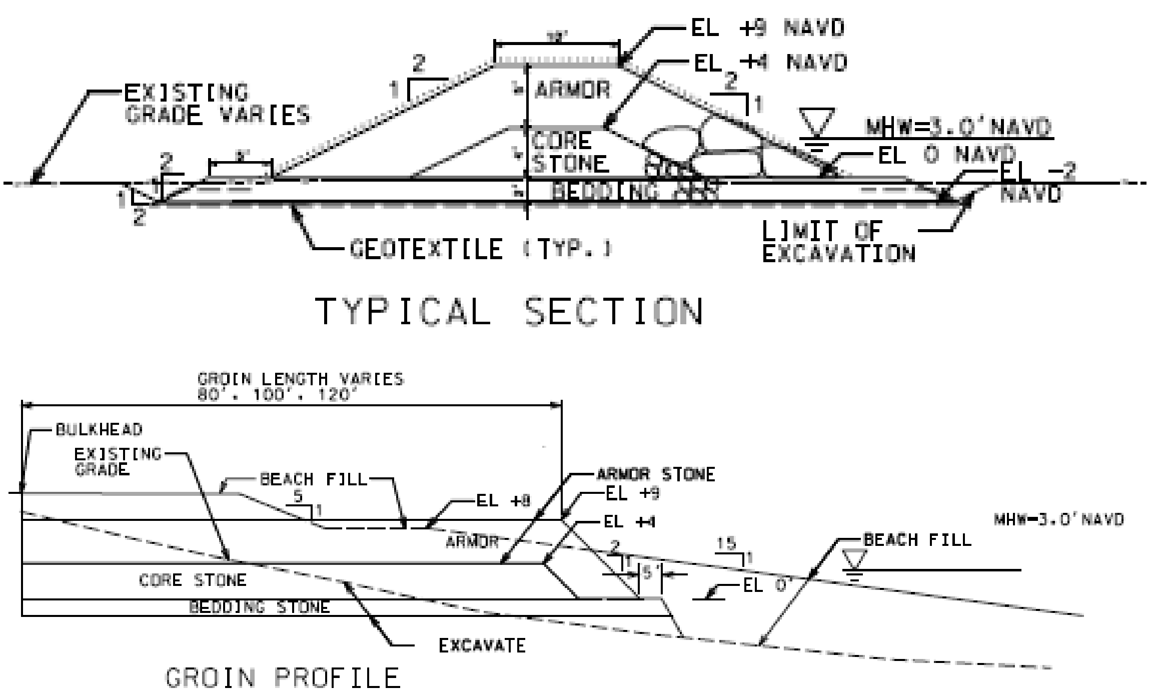


Figure 30: Typical groin section and profile

Station 11+ 00 to 61+00 – 100 ft Width Composite Dune and Beach fill (no advance fill)

A composite 100 ft wide dune and beach fill will be provided in this stretch of shoreline (Figure 31). The dune feature is a +15 ft crest width with 1 vertical on 3 horizontal side slopes on both landward and seaward sides. The berm is 50 ft wide with 1 vertical on 15 horizontal foreshore slopes. The proposed dune and beach fill will provide a total of 100 ft wide beach and a higher dune elevation. Details of the 200 ft beach fill transition from Sta.9+00 to 11+00 (berm fill to dune and berm fill) will be provided during final planning and design.

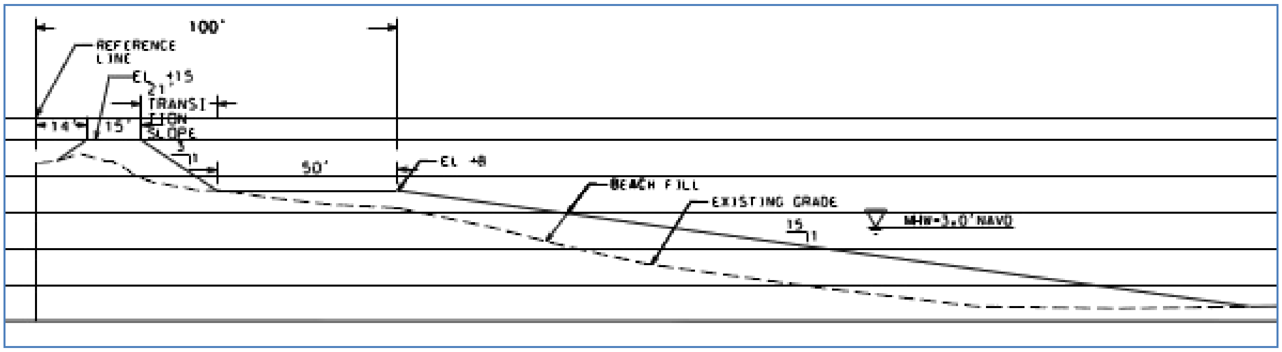


Figure 31: Typical Dune and Beach fill Sta.11+00 to Sta.61+00

Station 63+ 00 to 124+00 – 100 ft Width Beach fill Including 50 ft Advanced Nourishment

A total of 100 ft berm and beach fill will be provided along this stretch of shoreline fronting the existing timber bulkhead. The proposed beach fill will include a 50 ft wide berm at +9 NGVD29 and 1 vertical on 15 foreshore slopes, plus an additional 50 ft berm width equivalent to 5 years of advance nourishment volume, including contingency due to outdated offshore bathymetry.

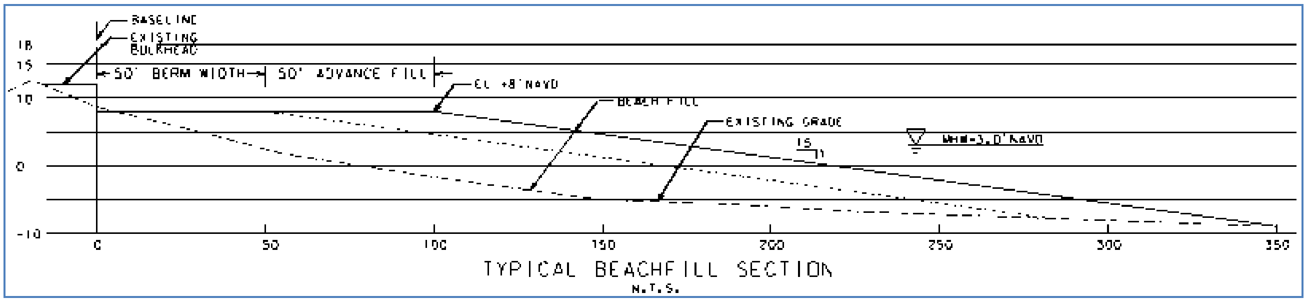


Figure 32: Typical Beach fill against Existing Bulkhead

Tapering and Transition Beach fills

A 500 ft beach fill taper will be provided from Station -5+00 to -10+00. This transition will provide a continuous beach fill shoreline and stability west of the proposed taper groin at station -5+00. Two 200 ft beach fill transitions will be provided at station ranges from 9+00 to 11+00 and from 61+00 to 63+00 to maintain a continuous shoreline.

Periodic Nourishments

Periodic sand nourishments will be provided within the 50 year period of analysis. The estimated quantities and frequency of nourishment requirements and assumptions are summarized as follows:

i. Sediment bypassing of 15,000 CY per year from power plant is accounted for and included in the scheduled nourishment;
ii. The scheduled renourishment quantity is based on sediment budget analysis;
iii. TSP renourishment estimates are based on GENESIS model results.

Table 21: Alternative 4 Scheduled Renourishment

	Scheduled Renourishment			Total Volume in 50 years (cy)
Alternative	Renourish per Cycle (years)	Quantity/Cycle (cy)	Annual (cy/yr)	
4-TSP	5	80,000	16,000	800,000

6.5 BORROW SOURCE

The initial construction for the project will be from Borrow Area A. The average distance to beach fill sites is approximately 2.5 miles including offshore and onshore pipelines. The average water depths at the borrow site range from 30 to 50 ft and the average dredging depth is 3 to 5 feet from bottom. Upland borrow sources will be used for future nourishment.

6.6 BEACH FILL, GROIN FIELDS, AND BORROW AREA FOOTPRINT

The proposed groin field lengths range from 112 to 152 feet at the offshore toe of the rock slope. As a result, the footprint of both the west and east groins are within the beach fill. The approximate footprints of beach fill area, groins, and borrow area are listed in Table 21 and are summarized as follows:

Table 22: Estimated Footprint and Quantities of the Proposed Plan

Description	Dimension	Estimated Footprint		Dredged	Placed	Avg Dredge	Remarks
		Sq. ft	Acre	Cubic Yard	Cubic Yard	Depth (ft)	
Beachfill Area	MHW to Toe of Fill	3,225,000	74.04		600,000		Include 500' Taper
	250'Wx(12,400+500)L						Use Avg. Width
West Groin Field							
Groin A-	152' L x 64' W	9,728	0.22				On Existing Damaged Groin #1
Groin B-	132' L x 64' W	8,448	0.19				On Existing Damaged Groin #2
Groin C-	112' L x 64' W	7,168	0.16				Layout to be Determined at PED
	Total:	**25,344**	**0.58**				
Borrow Area A	App. 1,200'x2,000'	2,400,000	55.00	800,000	600,000	10	1.4 mcy available
	Dredging Area						Approx. 2,000'x8,000'
							370 Acre in Area A

Note:

1. Proposed TSP is Preliminary and Quantities are Approximate
2. Assume 20% sand loss during construction
3. PED stands for Pre-construction Engineering and Design

6.7 ENVIRONMENTAL CONSIDERATIONS OF THE TSP

The following analysis represents a summary of the potential environmental effect of the TSP. More in depth analysis and impact effect details are located in the Environmental Assessment (EA), Appendix B. A Findings of No Significant Impacts (FONSI) is anticipated as a result of the environmental assessment, and a draft FONSI that can be found as Appendix J within the EA.

The TSP will increase the width of Asharoken Beach and provide a line of CSRM landward of the berm. The project offers a combination of “hard” and “soft” engineering techniques. The proposed plan for Asharoken Beach includes the dredging and placement of approximately 600,000 cy of fill material to rebuild 12,400 of beach and berm and the construction of three rock groins on the Western end of the project to retain sand and decrease erosion. Periodic renourishment is anticipated at a frequency of 80,000 cy every 5 years with the renourishment sand trucked in from an upland source. Additional post storm nourishment is estimated at 25,000 cy every 5 years. Another re-nourishment source will be sand dredged from the LIPA power station inlet to the east and “by passed” to the project site.

Initial fill will cover approximately 75 acres of intertidal and littoral nearshore benthic habitat seaward of mean high tide limit. Sand will be dredged from a nearby offshore borrow area (Area “A”) and will require dredging an area of about 55 acres to a depth estimated to be 10’ below the ambient benthic surface. Average depth of the dredge footprint will be increased from about 35 to 45 feet (MLW). The project will also require the construction of a west critical area groin field consisting of a total of 3 stone groins (152’, 132’, 112’ X 64’), with a cumulative foot print area (berm, intertidal and littoral lands) of about 0.58 acres.

Adverse environmental impacts from the initial implementation of the TSP will be localized short-term, direct and indirect impacts. They will be associated with groin construction, beach fill (berms), and dredging of sand for beach fill. Impacts will consist of direct and indirect impacts to benthic infauna, demersal fish and macroinvertebrate species at the construction and placement sites.

6.7.1 Threatened and Endangered Species

Atlantic Sturgeon

Although Atlantic sturgeon are not expected to be found in the surf zone or very shallow near shore their presence within the "action area" of the placement operation is possible. Direct impacts such as physical injury are highly unlikely. Physical injury due to the various components of the placement/groin construction is unlikely because the majority of the construction activities takes place on land or in very shallow surf or swash zone areas, and the equipment moves very slowly. Depending on how sheet pile will be set, noise disturbance from pile driving or jetting may displace fish to an adjacent area. Disturbance/avoidance due to increases in turbidity due to placement sediment dispersion is also possible, although sturgeon are known to be tolerant of relatively high levels of turbidity.

The NMFS completed their Asharoken consultation under section 7 in a letter dated 18 November 2015 (see Appendix B) in which they concurred with the District's determination that the project may affect, but is not likely to adversely affect, any (NMFS) species listed by as threatened or endangered under the ESA of 1973, as amended.

Piping Plover

Existing sandy habitat on the bayside of Eaton's Neck is potentially suitable as a foraging area for adult plovers if future sediment transport processes continue to form a spit within Duck Island Harbor. However, if beachfront habitat in other areas continues to erode, nesting habitat for piping plovers will be continue to be limited and may decrease (USACE-NYD, 2013). In addition, if the beachfront was diminished, there would be an increased potential for overlap among plover nesting areas and recreational beach areas. Without implementation of project motivated management measures, such as restricting beach use by the local community during nesting and brood rearing periods, this increased overlap has the potential to cause significant disturbance to nesting habitat for these two federally protected bird species (USACE-NYD 2013). Project site usage by the red knot is unknown. However, it can be anticipated that horseshoe crabs do utilize the beach to some degree for spawning and thus it is likely that this foraging resource is available at some level.

6.7.2 Borrow Area

The TSP will have direct and indirect impacts to habitat and communities of the borrow area. These include removal and burial of organisms as well as temporary and long term changes to the habitats affected. Water quality will experience minor adverse effects through temporary localized elevated turbidity for the duration of the in water construction activities. Benthic feeding fish species (e.g., winter flounder) as well as other fish species may experience temporary spatial displacement from the dredging and construction areas. In the case that a hopper dredge is utilized there may be direct mortality to highly demersal species such as flounders, skates and various types of none swimming crabs. In general most of local species present at the time of construction will move away from disturbance areas to feed in the surrounding areas and, therefore, would be unaffected by the temporary localized reduction in available benthic food sources. Benthic communities will naturally begin to re-establish shortly after construction is completed, forming a similar community, generally within about a one to two year period.

6.7.3 Historic and Cultural Resources

The four listed sites and the four potentially eligible sites for the National Register of Historic Places for Eaton's Neck and Asharoken Village and within the APE would not be affected by implementation of the TSP. Placement of beach fill would provide an additional measure of protection to these sites.

Based on within Borrow Area A. The placement of sand would not affect the seven magnetic targets identified within the nearshore sand placement area. These targets are located at the central section and eastern end of the APE. The construction of the western groin field should have no effect on the seven identified targets (USACE-NYD 2004).

Use of the borrow area has the potential to disturb submerged archaeological sites, such as prehistoric sites. It is recommended that controlled, periodic monitoring of the beach fill surface be conducted immediately following sand placement to look for archaeological materials that may have been disturbed by dredging. Because additional sand will be deposited on the shoreline and tidal zone of the survey area, buried pre-historic land surfaces and associated cultural resources, if these exist, would receive additional protection as a result of the proposed project action. (USACE-NYD, 2004).

During a remote sensing survey, no magnetic or acoustic remote sensing targets were identified.

7.0 PLAN IMPLEMENTATION

The implementation process will carry the Selected Plan through preconstruction engineering and design (PED), including development of Plans and Specifications (P&S), and construction. Funding by the Federal Government to support these activities would have to meet the requirements of PL113-2 or traditional civil works budgeting criteria.

7.1 CONSISTENCY WITH PUBLIC LAW 113-2

This draft feasibility report has been prepared in accordance with the Disaster Relief Appropriations Act of 2013, Public Law 113-2. Specifically, this section of the report addresses:

i. The specific requirements necessary to demonstrate that the project is economically justified, technically feasible, and environmentally acceptable, and
ii. The specific requirements necessary to demonstrate resiliency, sustainability, and consistency with the North Atlantic Coast Comprehensive Study (NACCS).)
iii. The costs and cost-sharing to support a Project Partnership Agreement (PPA).

7.1.1 Economics Justification, Technical Feasibility, Environmental Compliance

The prior sections of this report demonstrate how the TSP manages coastal storm risk. It also identifies the TSP to be economically justified for the authorized period of Federal participation.

The draft Environmental Assessment has been prepared to meet the requirements of NEPA and demonstrate that the TSP is compliant with environmental laws, regulations, and policies and has effectively addressed any environmental concerns of resource and regulatory agencies.

7.1.2 Resiliency, Sustainability, and Consistency with the NACCS

This section describes how the Asharoken feasibility study is consistent with the findings and recommendations of the North Atlantic Coast Comprehensive Study (NACCS).

The North Atlantic Coast Comprehensive Study (NACCS) was released in January 2015 and provides a risk management framework designed to help local communities better understand changing flood risks associated with climate change, and to provide tools to help those communities better prepare for future flood risks. In particular, it encourages planning for resilient coastal communities that incorporates wherever possible sustainable coastal landscape systems that takes into account, future sea level and climate change scenarios (USACE, 2015).

Resiliency is defined as the ability to adapt to changing conditions and withstand, and rapidly recover from disruption due to emergencies. Sustainability is defined as the ability to continue (in existence or a certain state, or in force or intensity), without interruption or diminution.

The process used to identify the TSP used the NACCS Risk Management framework that included evaluating alternative solutions. The TSP represents a resilient and sustainable solution.

7.2 COST SHARING AND NON-FEDERAL PARTNER RESPONSIBILITIES

The details behind the initial total project first cost of implementing the TSP are shown in Table 23. The project cost sharing for initial construction ($23,665,000) will be 65% Federal ($15,382,000), 35% non-Federal ($8,283,000). Beach nourishment ($57,765,000) will be cost shared 50% Federal ($28,883,000), 50% non-Federal ($28,883,000). The Federal Government will design the project, prepare detailed plans/specifications and construct the project, exclusive of those items specifically required of non-Federal interests. The non-Federal share of the initial construction cost ($8,283,000) includes real estate costs in the estimated amount of $5,872,000 which are credited against the Non-Federal share, reducing the non-Federal cash contribution to $2,411,000.

Table 23: Cost Apportionment

Asharoken, New York Combined Erosion Control and Storm Damage Reduction Project Cost Apportionment			
	Federal Share	**Non-Federal Share**	**Total Cost**
Project First Costs**			
Cash Contribution	$ 15,382,000	$ 2,411,000	$ 17,793,000
Real Estate Lands and Damages	-	$ 5,872,000	$ 5,872,000
Total First Cost	**$ 15,382,000**	**$ 8,283,000**	**$ 23,665,000**
Continuing Construction***			
Beach Renourishment	$ 28,883,000	$ 28,883,000	$ 57,765,000
Annual Beach Renourishment	$ 442,000	$ 442,000	$ 883,000
Annual Coastal Monitoring	$ 5,000	$ 5,000	$ 9,000
Annual Environmental Monitoring	$ 21,000	$ 21,000	$ 41,000
Annual Continuing Construction Cost	**$ 468,000**	**$ 468,000**	**$ 933,000**
Annual Beach and Groin Maintenance Cost	-	$ 26,000	$ 26,000
Annual Major Rehabilitation Cost	-	$ 130,000	$ 130,000
Total Annual OMRR&R Costs	-	**$ 156,000**	**$ 156,000**

* October 2014 Price Level
** Shared based on 65% Federal and 35% non-Federal for construction
*** Shared based on 50% Federal and 50% non-Federal for renourishment

7.2.1 Required Lands, Easements, and Rights-of-Way

The Required Lands, Easements and Right-of-Ways (LERR) are discussed in further detail in the Real Estate Appendix, Appendix E. The total LERR required in support of the Project requires approximately 87.4 acres of acquisition; approximately 0.1 acres required in fee, approximately 87.3 acres required in permanent easements. Temporary Work Area Easements will be required during constructions at sites to be designated during the Plans and Specs phase. In total, The Project impacts approximately 250 parcels, impacting approximately 228 private owners and 3 public owners.

The acquisitions of real property interest for borrow purposes are not required for the Project. Material for the initial beach-fill will be obtained from the offshore borrow area. USACE will obtain a water quality certificate from NYSDEC allowing use of the borrow area as a sand source.

7.2.2 OMRR&R Considerations

The operation and maintenance costs are estimated to represent the anticipated annual costs necessary to maintain the project throughout the period of analysis. The majority of the maintenance cost is due to groin maintenance, which is calculated as 0.5% of the total cost of the groin construction, based on historical maintenance costs for groins and seawalls. Additionally, minor maintenance costs are attributed to annual dune maintenance.

Operation, maintenance, repair, rehabilitation and replacement (OMRR&R) costs of the alternatives include routine beach profile maintenance and repair, rehabilitation of the rock groins were annualized at a total cost of $156,000. Annual dune and groin maintenance costs were estimated at $26,000, while annualized major rehabilitation cost was estimated at $130,000.

7.2.3 Coastal and Environmental Monitoring

Coastal and environmental monitoring costs have been developed and represent the annualized cost for the monitoring of flora and fauna, and surveying of borrow source and beach fill during construction. The majority of these costs occur during years 1 through 5 of the 50-year period of analysis. Annualized Monitoring Costs are estimated at $50,000.

7.3 DESIGN AND CONSTRUCTION CONSIDERATIONS

7.3.1 Preconstruction Engineering and Design

Because Asharoken has been included as a project under study as part of the P.L. 113-2 response to Hurricane Sandy, initial construction of the project would be authorized upon approval by the Assistant Secretary of the Army, although the renourishment components described in this report would require congressional authorization for implementation. If agreeable to the parties involved a Project Partnership Agreement could be entered into for initial construction of the project. The necessary Preconstruction Engineering and Design (PED) could be cost shared under this Project Partnership Agreement (PPA) (which typically only covers construction), if there are sufficient P.L. 113-2 funds to complete initial construction of the project.

For the Asharoken project, PED costs are estimated at $2,768,276 (Oct. 2014 P.L.), to be cost- shared 65% Federal and 35% non-Federal. The approximate duration for PED is 7 months, from May 2017 to December 2017, for tasks including detailed field surveys and geotechnical data collection, and construction contract award (163 days).

7.3.2 Project Implementation and Construction Schedule

The construction schedule for the TSP was developed based on the construction cost estimate. The construction duration for the TSP was estimated at 6 months. Environmental windows for dredging and groin construction were considered while developing the following construction schedule.

Table 24: TSP Implementation Schedule

Asharoken, New York Combined Erosion Control and Storm Damage Reduction Project	
Implementation Schedule	Date
Submission of Chief's Report	Oct-16
Project Partnership Agreement (PPA)	
PPA Execution	Jul-17
Plans and Specs	Jun-17
Contact Award	Nov-17
Asharoken Construction	
Notice to Proceed	Aug-17
Dredge Mobilization	Oct-17
Groin Equipment Mobilization	Oct-17
Dredge Demobilization	Dec-17
Groin Equipment Demobilization	Mar-18
Contract Completion	Mar-18

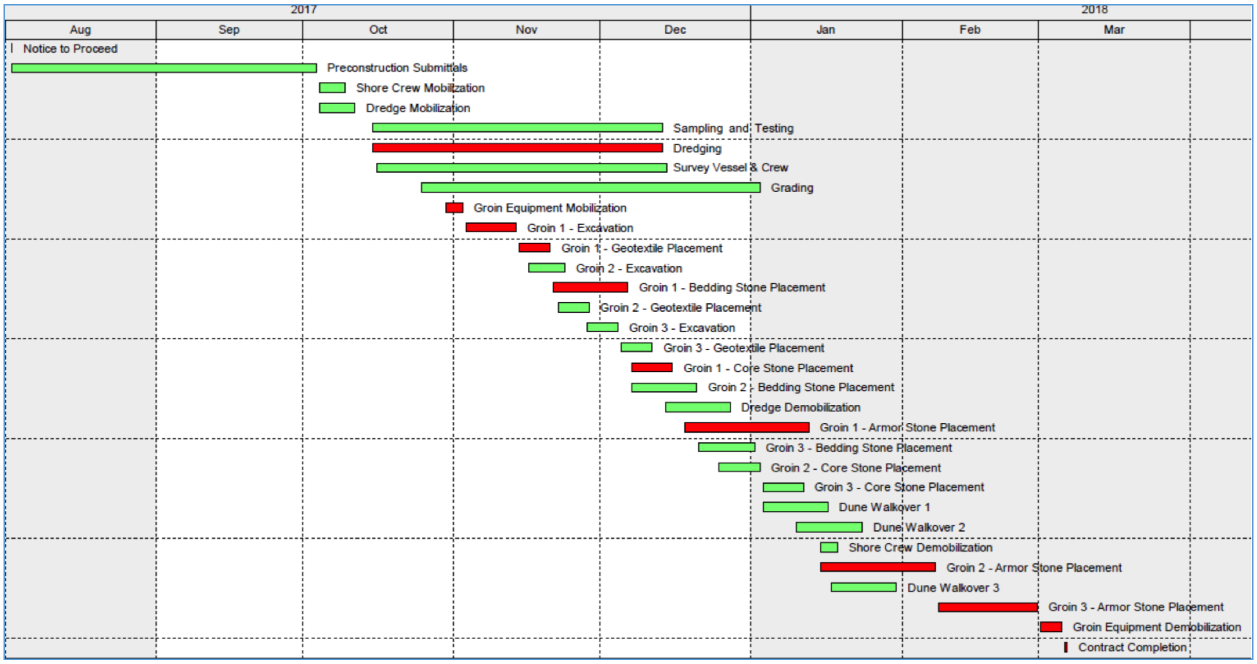


Figure 33: TSP Construction Schedule

7.4 PUBLIC ACCESS

Public access to the project area is required by USACE public access requirements which are identified in ER 1165-2-130, and based upon U.S.C 426e(d). The USACE policy requires public access points every one half mile, so that a visitor is never more than a quarter mile away from an access point while on the beach. New York State also has similar public access requirements which are identified in the State's CZM policies.

The purpose of the public access plan is to describe public accessibility to the proposed dune and beach area that will be created and renourished as a result of the proposed storm damage reduction project in the Village of Asharoken. In order for the project to be eligible for Federal and State cost-sharing, public access is required.

The Village of Asharoken and New York State DEC have submitted a Public Access Plan for the proposed project. The public access plan identifies the expected recreational use for the study area as low and cites existing use at comparable nearby facilities as evidence of the expected low recreational use of the area after construction. The public access plan identifies locations for shore perpendicular access points to the beach along the 2.4 mile project area at approximately ½ mile intervals. The plan identifies 3 known locations of public access, 1 located at the east end and 2 located at the west end of the project. The plan identifies a range of possible parcels for 2 or 3 additional access points in the middle of the project that could be acquired for access points each ½ mile. At this point the Village has not identified the specific parcels necessary for public access.

The access plan identifies the proposed parking that would be included across the project area. The plan has identified that the existing site conditions limit the availability of parking. The plan proposes a large parking lot in the east end of the project area that would provide for a relatively high density recreational use and a small parking lot in the west end of the project area that would allow for medium density recreational use. In the middle locations within the project area, the plan proposes curb cuts for drop-off locations, without parking. These sites would provide for access by facilitating circulation within the project area access points, using alternative transportation such as walking or biking, which would provide for low-use recreation.

In order to secure public access to the project area, five parcels are required in fee, two are publicly owned and three privately owned. Six-foot wide tracts of land connecting Asharoken Avenue to the beach will be acquired from the three private owners. Sites will be selected based on properties in appropriate locations where such a 6' tract can be acquired with the least impact to property owners' use and enjoyment of the property. The Non-Federal Sponsor has not yet identified the sites to be acquired for public access. Negotiations amongst the USACE stakeholders on the public access plan are ongoing.

In order to protect the integrity and erosion protection values of the proposed dune, access through the dune conservation areas will be limited to public or private dune access ways. The locations of the proposed access ways are described and delineated in the village's public access plan. Property owners shall have the right to construct private dune walkover structures provided that such structures do not violate the integrity of the dune in shape or dimension. Such structures shall be in accordance with Article 34 of Environmental Conservation Law and require approval from the U.S. Army Corps of Engineers.

The access plan provided by the Village has been reviewed by New York State and the Corps. Based upon these reviews it appears that the public access plan meets State and Corps requirements. Please note, the specific public access requirements and the public access plan could change as a result of further policy reviews within the Corps.

8.0 PUBLIC INVOLVEMENT

NYSDEC and the Village of Asharoken have expressed support for a potential project. The cooperation between the various governments indicates a strong willingness to proceed with a potential solution to the flood and storm damage problems facing the Long Island Sound side of Asharoken Beach. Public review will be used to solicit input on the alternatives and TSP. The TSP is subject to change based upon the public and agency review process.

In an effort to keep the sponsor and interested local municipalities informed, coordination throughout the feasibility phase was maintained. Meetings were held periodically among representatives of the District, NYSDEC, and Village of Asharoken.

Coordination efforts shall continue, including coordination of this report with other State and Federal agencies, such as National Marine Fisheries Service, United States Fish and Wildlife Service, United States Environmental Protection Agency, New York State Department of Environmental Conservation-Region 1, and New York State Department of State. It is currently anticipated that an informational public meeting will be held upon the release and public review of the feasibility report with the environmental assessment.

9.0 LOCAL COOPERATION

A fully coordinated Project Partnership Agreement (PPA) package (to include the sponsor's financing plan) will be prepared subsequent to the approval of the feasibility report, which will reflect the recommendations of the feasibility report. Before the selected plan can be constructed, the PPA will be negotiated with the State of New York. According to the current schedule, the Federal Government and the State of New York plan to enter into a PPA in August 2017. The non-Federal Sponsor, the New York State Department of Environmental Conservation, has indicated support of the recommendations presented in this feasibility report and the desire to execute a PPA for the recommended plan. Other non-Federal interests, such as the Village of Asharoken, and Suffolk County have indicated their support of the project.

After the signing of the PPA, the study will proceed through the Preconstruction Engineering and Design (PED) phase to project construction. A project schedule has been estimated to serve as the basis of the cost estimate based on reasonable assumptions for the detailed design and construction schedules. It will be refined as more data are available in subsequent phases of the project. (Further discussed in section 7)

9.1 INSTITUTIONAL REQUIREMENTS

The non-Federal sponsor shall be required to comply with all applicable Federal laws and policies and other requirements. A fully coordinated PPA package, which will include the non-Federal partner's financing plan, will be prepared subsequent to the approval of the feasibility phase to initiate design and construction. It will be based on the recommendations of the feasibility study. NYSDEC has agreed to comply with all applicable Federal laws and policies and other requirements that include, but are not limited to:

i. Provide all lands, easements, rights-of-way, and relocations and disposal/borrow areas (LERRD) uncontaminated with hazardous and toxic wastes.

ii. Provide additional cash contribution if the value of LERRD contributions toward total project costs is less than 35 percent, so that the total share equals 35 percent.

iii. Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the construction, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, waste-weirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

iv. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, including mitigation features, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

v. Provide the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal project partner, now or hereafter, owns or controls for access to the Project for the purpose of inspection, and, if necessary after failure to perform by the non-Federal project partner, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the non-Federal project partner of responsibility to meet the non-Federal project partner's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

vi. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.

vii. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Codes of Federal regulations (CFR) Section 33.20.

viii. Perform, or cause to be performed, any investigations for hazardous substances as are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law (P.L.) 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the construction, operation, and maintenance of the Project. However, for lands that the Federal Government determines to be subject to the navigational servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal project partner with prior specific written direction, in which case the non-Federal project partner shall perform such investigations in accordance with such written direction.

ix. Assume complete financial responsibility, as between the Federal Government and the non-Federal project partner for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the construction, operation, or maintenance of the Project.

x. As between the Federal Government and the non-Federal project partner, the non-Federal project partner shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace and rehabilitate the Project in a manner that will not cause liability to arise under CERCLA.

xi. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1790, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17),and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the construction, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

xii. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense directive 5500.11 issued pursuant thereto, as well as Army regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

xiii. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement.

xiv. Participate in and comply with applicable Federal flood plain management and flood insurance programs and comply with the requirements in Section 402 of the Water Resources Development Act of 1986, as amended.

xv. Not less than once each year inform affected interests of the extent of risk management afforded by the Project.

xvi. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the coastal storm risk management provided by the project.

xvii. Provide, during construction, any additional funds needed to cover the non-Federal share of PED costs.

xviii. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal project partner owns or controls for access to the project for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing or rehabilitating the project.

xix. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal project partner has entered into a written agreement to furnish its required cooperation for the project or separable element.

xx. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

xxi. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal partner shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

xxii. Participate in and comply with applicable Federal floodplain management and flood insurance programs.

xxiii. Do not use Federal funds to meet the non-Federal partner's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

In an effort to keep the non-Federal project partner involved and the local government informed, meetings were held throughout the feasibility phase. Coordination efforts will continue, including coordination of this study with other State and Federal agencies. It is currently anticipated that a public meeting will be held upon release of the feasibility report for public review and approval of this feasibility study.

10.0 RECOMMENDATIONS

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 State of New York and other non-Federal interests.

I recommend that the selected plan for coastal storm risk management at Asharoken, New York, as fully detailed in this Feasibility Report and Environmental Assessment, Appendix B, be authorized for construction as a Federal project, subject to such modifications as may be prescribed by the Chief of Engineers.

I recommend authorization of the coastal storm risk management project for Asharoken, NY, with such modifications thereof as in the discretion of the Commander, HQUSACE, as may be advisable. These recommendations are made with the provisions that local interests will:

i. Provide to the United States all necessary lands, easements, rights-of-way, relocations, and suitable borrow and/or disposal areas deemed necessary by the United States for initial construction and subsequent maintenance of the project.
ii. Hold and save the United States free from claims for damages that may result from construction and subsequent maintenance, operation, and public use of the project, except damages due to the fault or negligence of the United States or its contractors.
iii. Contribute to the local share of non-Federal costs for initial construction and operation and maintenance of the project, as required to serve the intended purposes. **This plan consists of beach fill and a tapered groin field at a total first cost of $23,665,000 and future nourishment cost of $57,765,000 (October 2014 price levels). The Total Fully Funded Project cost for the TSP is $24,721,000 for initial construction and $124,607,000 for renourishment over a 50 year time period. Under current guidelines, the initial project cost will be cost shared 65% Federal and 35% non-Federal and the beach renourishment costs will be cost shared 50% Federal and 50% non-Federal.**
iv. Upon completion of each project feature, acquire, rehabilitate, repair, replace, operate and maintain easements for public access to areas created or enhanced by the project. The cost of the operation and maintenance of these easements will be the responsibility of the non-Federal partner.

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.

________________________	______________________________________
Date	David A. Caldwell Colonel, US Army Corps of Engineers District Engineer

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North Shore of Long Island, Asharoken, New York Coastal Storm Risk Management Feasibility Study

Appendix A

Engineering

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Appendix B

Environmental Assessment

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Appendix D

Economics

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Appendix C

Cost Engineering

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Appendix E

Real Estate Plan

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Appendix F

Pertinent Correspondence

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