# STOCKTON UNIVERSITY
# COASTAL RESEARCH CENTER


*Hereford Inlet, Cape May County, March 10, 1991, seven years prior to the initial NJ State and municipally funded beach restoration. Bird habitat consisted of four large intertidal shoals situated between the 123rd Street groin in Stone Harbor and the rock revetment protecting North Wildwood. 25 years and 4.8 million cubic yards of beach restoration later, nesting habitat had expanded into a 7,500 foot long spit extending to a point south of the third shoal in the photo.*

# An Analysis of Thirty Years' Study of Sand Redistribution and Shoreline Changes in New Jersey's Four Coastal Counties Raritan Bay, the Atlantic Ocean Coast, and Delaware Bay Fall 1986 Through Fall 2016

## *VOLUME 1 of 4 INTRODUCTION & MONMOUTH COUNTY*

Prepared for:
New Jersey Department of Environmental Protection
Division of Coastal Engineering
1510 Hooper Avenue, Toms River, New Jersey 08753

Prepared by:
Stockton University Coastal Research Center
30 Wilson Avenue, Port Republic, NJ 08241

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Stockton University
Coastal Research Center


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Prepared by:
Dr. Stewart Farrell
Kim McKenna, Steven Hafner,
Brad Smith, Crist Robine, Holly Pimpinelli
Nick DiCosmo, Christie Tracey, Irina Beal
Alex Ferencz, Marcus Gruver, and Mat Suran

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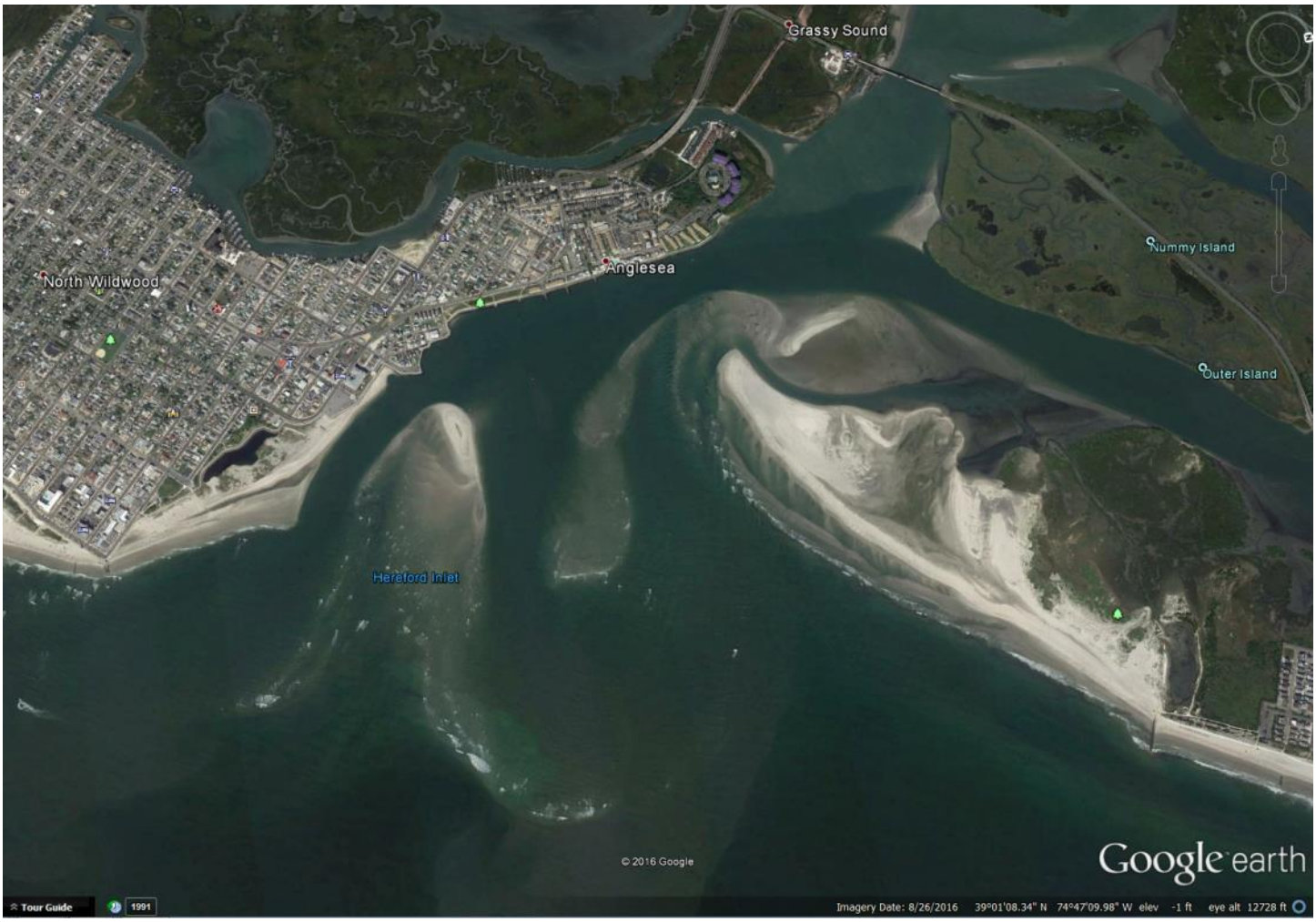


**Figure 1. August 26, 2016 aerial view of Hereford Inlet adjusted to approximate the cover photo dated 1991. The multiple beach restoration efforts by both Federal and NJ State agencies in cooperation with the Borough of Stone Harbor has had the secondary result of restoring over 7,000 feet of bird nesting habitat as a sand spit developed adjacent to the 123rd Street groin in Stone Harbor. Sand elevation enhancements to the spit in 2015 resulted in extraordinary nesting success that year. The overwash fan in the mid-section of the spit resulted from Northeast Storm Jonas in January 2016.**

Thirty years have passed since the New Jersey Department of Environmental Protection (NJDEP) initially authorized the New Jersey Beach Profile Network (NJBPN) project in 1986. While there are multiple examples where extensive changes in shoreline configuration have occurred, the Hereford Inlet example was chosen because of the cause and effect relationship between extensive beach management projects and natural wildlife habitat generation that resulted from those projects. By 1991, beach deterioration in Stone Harbor on Seven-Mile Island in Cape May County had produced total loss of the upland dune and vegetated surface of Stone Harbor Point. Large intertidal shoals existed, but useful nesting habitat was limited (cover photo). Projects in 1998, 2003, 2011 and 2013 (following Hurricane Sandy) placed 4.819 million cubic yards of sand on the oceanfront beaches of Stone Harbor. Subsequent littoral transport of sand to the south produced the changes by

2016 (shown above). Similar examples exist at Corson's Inlet, mid-beach in Ocean City, Brigantine, and at the south end of the Island Beach State Park in Ocean County. Northerly sand transport, derived from the material placed between Sea Bright and Long Branch in Monmouth County since 1995, has enhanced the Sandy Hook National Seashore by over 3.4 million cubic yards of sand. This report quantifies the changes, both positive and negative, observed at the 107 survey locations along the New Jersey Raritan Bay, Atlantic oceanfront, and lower Delaware Bay shorelines. Its goal is to provide a review of the past three decades and provide science-based guidance for future management decisions.

**STORMS:**

The first major storm to impact the New Jersey coastal zone during the NJBPN surveying era was the 1992 northeaster. An analysis of subsequent beach profile survey data indicated a four-year time span for natural recovery, via cross-shore transport, to restore the amount of beach sand that was removed during that event. The winter northeast storms in 1998 helped solidify federal involvement in shore protection projects along many areas of the Jersey shoreline. Other storms that caused either county- or state-wide coastal changes were: Mother's Day Northeaster 2008; Veteran's Day Northeaster 2009; Hurricane Irene 2011; Hurricane Sandy 2012; October Northeaster 2015; Northeaster January 2016-Jonas; and Tropical Storm Hermine 2016. Hurricane Sandy was the most devastating to the state's coastal zone, relocating over 14 million cubic yards of berm/dune sand, and reinforced the need for high dunes and wide beaches for shoreline protection (CRC, 2012; Barone, McKenna, and Farrell, 2014; McKenna, Farrell, and Gebert, 2016). The first serious storm since Hurricane Sandy occurred January 22-24, 2016 (Jonas) and resulted in a federal disaster declaration largely due to unexpected levels of tidal flooding in Cape May County (FEMA, 2016).

**SHORE PROTECTION:**

By the mid-1990s, Ocean City, Cape May City, and several communities in Monmouth County had partnered with the state and US Army Corps of Engineers (USACE) to commence beach nourishment projects with great success; providing a better level of shore protection and improving all forms of economic growth and real estate value enhancement. Federal partnerships expanded in the early 2000s to include Seven-Mile Island, Brigantine and Absecon Island, Long Beach Island, and Ludlam Island.

**SHORELINE MANAGEMENT ENDEAVORS SINCE HURRICANE SANDY:**

The Philadelphia and New York US Army Corps Districts answered the call for help following Hurricane Sandy, and with the Congressional authorization of PL 113-2 (Disaster Relief Appropriations Act of 2013) the funds were made available to restore all federally-authorized shore protection projects to design specifications with 100% Federal funding. Work started in mid-2013 and continued into 2015 at previously authorized, but unconstructed projects such as Ludlam Island in Cape May County and within the Allenhurst, Deal, and Elberon segments of Monmouth County. PL 113-2 funds were utilized to complete Long Beach Island (Beach Haven to Holgate) in 2016.

The USACE returned to beach fill maintenance mode in 2016-2017 and completed projects at Seven Mile Island (Avalon and Stone Harbor in Cape May County) and Absecon Island (Atlantic City, Ventnor, Margate and Longport). Maintenance projects are expected in Brigantine as well as in Cape May City. Repair work on the Ludlam Island project commenced following January 2016 northeast storm (Jonas).

**2015-2016**

The shoreline change values listed throughout this report represent the calculated difference in horizontal distance of the zero (NAVD88) elevation position from one beach profile to another. Advances seaward are positive and retreats landward are negative. Each number shown below is the average change for all the sites in each county. This set of data shows the influence of the January 2016 northeast storm and other events that led to a universal decline in sand volume and a shoreline retreat. The summer of 2016 allowed a net increase in sand volume which exceeded the loss in all but Atlantic County for sand volume and Cape May County for shoreline position recovery. The 18-month changes were substantially negative in Atlantic County, yet positive

in the other three. Beach restoration work was influential in Monmouth (Deal, Elberon) and in Cape May County (Ludlam Island). Work was also in progress on Long Beach Island in 2016 as well.

**Table 1. Annual County-Averaged Volume & Shoreline Changes**

**Sand Volume Changes at the NJ Oceanfront**

| | S 15 – F 15 [$yds^3/ft.$] | F 15 – S 16 [$yds^3/ft.$] | S 16 – F 16 [$yds^3/ft.$] | S 15 – F 16 [$yds^3/ft.$] |
|---|---|---|---|---|
| **Monmouth County** | **6.00** | **-10.97** | **22.90** | **17.87** |
| **Ocean County** | **14.95** | **-1.60** | **28.53** | **41.38** |
| **Atlantic County** | **-14.14** | **-13.77** | **4.42** | **-22.16** |
| **Cape May County** | **32.80** | **-5.54** | **7.57** | **35.63** |

**Shoreline Position Shifts Landward (-) or Seaward (+) at the NJ Oceanfront**

| | S 15 – F 15 [ft.] | F 15 – S 16 [ft.] | S 16 – F 16 [ft.] | S 15 – F 16 [ft.] |
|---|---|---|---|---|
| **Monmouth County** | **-7.39** | **-20.51** | **42.04** | **14.15** |
| **Ocean County** | **19.08** | **-15.67** | **38.60** | **42.02** |
| **Atlantic County** | **27.63** | **-1.77** | **-15.04** | **-44.44** |
| **Cape May County** | **58.99** | **-22.16** | **16.36** | **53.19** |

Currently Margate and Longport are scheduled to be completed in 2017. Northern Ocean County (Manasquan Inlet to Island Beach State Park) is also scheduled for major shoreline enhancement. This project has been the subject of high-stakes litigation as oceanfront owners seek to prevent the work, alleging property rights issues related to private ownership to the mean high tide line on the beach. The most recent court hearing was completed in March 2017 in Ocean County Superior Court where multiple homeowners from Bay Head, Point Pleasant Beach and Mantoloking sought injunction against the project in those communities. The judge's decision is pending, but the project is scheduled to commence south of the area of contention in Ortley Beach. The three Wildwood communities are under final design by the Philadelphia District. Once completed, all New Jersey oceanfront municipalities will be included in federal shore protection projects within the purview of either the Philadelphia District or the New York District.

Local efforts have largely focused on repairing dune damage using front end loading or bulldozing capabilities. Dune planting and public access programs remain with local communities working down to the level of individual owner options to improve their dune protection.

Challenges remain as individuals and a few communities continue to object to oceanfront sand placement which adds material that was never previously within the coastal zone to the beaches. Litigation is moving slowly to adjudicate solutions to these issues, but in the long-term view, there are looming changes to coastal habitation that must be faced, if not by this generation, certainly by the next several. Major state and federal projects have gone to completion and been exposed to a few storm events since Hurricane Sandy. These efforts tend to

greatly reduce wave damage on the oceanfront, but tidal flooding continues to take its toll on bayside properties and local infrastructure. NOAA (National Oceanographic & Atmospheric Administration) projections on sea level rise by 2100 range from 0.9 ft. minimum to a game changing 3.9 ft. vertically. The latter value puts 50% of the NJ coastal zone properties in the water every high tide, with an exponential rise in storm damage.


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## INTRODUCTION:

The New Jersey Beach Profile Network (NJBPN) project was instituted following storm damages experienced during Hurricane Gloria in 1985 to provide local and regional information on coastal zone changes and is designed to document seasonal and storm-related damage assessments of the New Jersey shoreline. New Jersey Department of Environmental Protection (NJDEP) and Coastal Research Center (CRC) personnel selected the original sites for surveys during a fall 1986 reconnaissance examination from Sandy Hook to Cape May Point. The objective was that every municipality would have one survey site with additional sites placed where conditions dictated. A few years later sites were installed at each tidal inlet margin to more closely follow the relatively rapid changes observed initially. Over the years, sites were moved a few dozen feet as development introduced obstacles along a few original profile transects, and most recently a new site was added at the most northerly beach access at Sandy Hook National Seashore to better track the vast quantity of sand moving into this natural area.

Each survey site was visited annually starting in the fall of 1986. Semiannual visits, each spring and fall, began in 1994 following the passage of New Jersey Public Law 93. The program was expanded to take surveys every spring following the winter northeasters and in the fall following summer beach accretion. The information collected consists of photographs of the beach/dune system at each site, a topographic profile of the dune, beach and seafloor to a minimum depth of 15-18 ft, and field notes on significant geologic or manmade changes. Construction activity is noted and necessary information regarding quantity and duration of such activity is gathered. The field data are used to generate graphical cross section plots, which can be used for comparison across the width of the active coastal zone. The cross section is also used to calculate sand volume and shoreline position changes.

In this 30-year report each site was subjected to an analysis of trends in shoreline position and sand volume to allow both quantitative and visual portrayals of the patterns of change. This provides us the ability to point to natural events or individual efforts that may have altered the overall trend that appears in the data.

## NEW JERSEY COASTAL ZONE:

The New Jersey coast is defined through a system of spits, headlands, barrier islands/tidal inlets. The northern coast in Monmouth County is a headland beach (a bluff of older geologic sedimentary units) that erodes during serious storm events. Long-term erosion of the headland created two barrier spits; one to the north from Long Branch (Sandy Hook), and the other to the south from Bay Head (Mantoloking to Barnegat Inlet). To the south of Barnegat Inlet, barrier islands comprise the remainder of the NJ coastline where individual islands are separated from the mainland by a series of bays and tidal lagoons, and by each other through a series of structured and non-structured tidal inlets. The general geomorphological relationship among the coastal features between Sandy Hook and Barnegat Inlet was detailed by Fisher (1967). Individual barrier islands have a different and unrelated origin as sea level rose, and as storms, tides, and waves reworked sand from continental shelf deposits that formed the barrier island chain south of Barnegat Inlet. Hicks (1953) showed that the dark, denser minerals present in beach sand still had Monmouth County traits on Long Beach Island, but from Little Beach Island south to Cape May City, the sand was finer, with different dark minerals (magnetite/illmenite) from the northern beaches (glauconite, zircon and garnet). This pattern has been observed

in the sand supplies found 2-3 mi offshore that are tapped for the shore protection material added to the present beaches. Sand mined offshore for Monmouth County beaches is coarser with garnet and zircon as heavy minerals, while sand mined offshore for Ludlam Island contained finer sands and was dominated with magnetite as the primary accessory mineral.