

Coastal Erosion in Cape May County (CMC), New Jersey.

New Jersey has 2884 km of tidally effected land and roughly 202 km of open ocean coastline (Bernd-Cohen and Gordon, 1999). Beaches are considered sandy, composed of gravel, sand and silt deposits. These sediments formed from both marine and non-marine sedimentary episodes, pre-date the present shoreline by millions of years. In most of New Jersey exposed sediments are not cemented to form bedrock like on the New England coast. Under marine processes, tidal currents and wave action, these non-lithified sediments easily erode, which explains in part, erosion problems that have anguished New Jersey residents since the 19th century (CRC, 2009a). New Jersey's eroding beach problem is also a result of anthropocentric factors such as coastal development and poor management decisions. Ninety percent of New Jersey's population lives in the coastal zone (Bernd-Cohen and Gordon, 1999). Four coastal counties: Monmouth, Ocean, Atlantic and Cape May, hold nearly 6 million residents (NJDEP, 2009a). As a result, New Jersey's shoreline is considered the most developed and densely populated shoreline in America, with only 50 km between salt marshes and the sea being void of human development (CRC, 2009a).

In the past, coastal development resulted in flattening of natural dune systems. Sediment transport has been interrupted by hard engineering structures such as seawalls, bulkheads and groins. Forty-three percent of the developed New Jersey shoreline is armoured with over 400 groins and jetties, 23 miles of seawalls and an assortment of wave breakers along the open ocean coastline (Surfrider Foundation, 2009). In addition to sediment transport and anthropogenic factors, sea level rise is expected to affect New Jersey's coast with threats of flooding and increasing rates of erosion. Based on projected sea level rise, Cooper *et al.* (2008: 475) suggested "that approximately 1% to 3% of the land area of New Jersey would be permanently inundated over the next century and coastal storms would temporarily flood low-lying areas up to 20 times more frequently".

Wooden Jetties and brush piles inside a double row of cedar pilings (early groins) were constructed shore-perpendicular, as the first measures taken against erosion in CMC. A series of constructed groins called *groin fields* eventually followed and interrupted near-shore littoral drift patterns and pushed longshore currents further offshore (NJDEP, 2009b). In 1903, when Cape May Harbour was dredged, the spoil was spread over 3,600 acres of wetlands and oyster beds to make way for development (Fox, 2007). The arrival of the railroad and subsequently trucks, allowed the transport of large rocks and soon breakwaters and seawalls were constructed along disappearing shorelines. Next concrete was used to reinforce seawalls and create new hard structures while steel allowed these structures to grow higher, longer and stronger. These hard erosion protection measures resulted in a coast with continuous seawalls and groins placed every 250 m, confining most of New Jersey's inlets with jetties (CRC, 2009a). So much of New Jersey's coastline is now covered in hard structures the environmental degradation has been termed "New Jerseyization" which describes coastal damage incurred from hard structures (Gold, 2004 as cited in Cooper and McKenna, 2007).

In CMC, bad management decisions, such as selling coastal lands with dry beach and dune systems (rather than reserving them as public property) and flattening large dune systems to make way for development, further amplified erosion (NJDEP, 2009b). The U.S. Army Corps of Engineers (USACE), in a WWII wartime emergency act, dug a 5 km canal, separating Cape May, Cape May point and West Cape May from the mainland. This canal and older jetties had a devastating affect on the Cape Island beaches. The USACE Project Engineer Dwight Pakan recently stated, "It's obvious from aerial photographs that the north

jetty creates a severe offset that interferes with the river of sand that flows offshore. The sand gets trapped at the north jetty and impedes the natural drift southward toward beaches in Cape May City, the Coastal Erosion in Cape May County, New Jersey Cove, the Meadows, the Lighthouse beach and Cape May Point,” (Fox, 2007).

A new methodology and large-scale industry formed utilizing beach nourishment, that is, moving millions of cubic metres of sand from surplus areas at inlets and from offshore dredging to eroding beaches. The practice grew largely in response to storms and in 1952, the USACE began the first large beach restoration project, nourishing Ocean City’s beach with approximately 2.5 million m³ of sand. Because CMC has sandy beaches that are geologically unstable, even small storms threaten to deplete beach sediment in brief but intense erosion periods. Beach nourishment and man-made dunes were developed as a way of combating beach overwash and flooding. In 1962, a devastating storm required beach nourishment and restoration efforts along the entire New Jersey coast. In the 1970’s, the state passed two multi-million dollar bond issues to finance beach nourishment projects. The 1980’s brought a large scale federal/state and local municipal beach restoration program; and today beach nourishment continues to be employed as one of the most extensive, expensive and successful measures taken against erosion (CRC, 2009b). Early efforts to establish foredune systems were “little more than a sacrificial engineering structure too small and too close to the water to survive large storms,” (Nordstrom, et al, 2002: 138) and built low to preserve land owners views of the sea. They often resulted in bull-dozed sand mounds and formed a linear ridge without topographic or plant diversity.

As previously stated, CMC has the most coastal restoration projects of the four coastal counties. Five coastal projects involving Federal cooperation with the State of New Jersey and the local municipality were underway in 2008. All but Ludlam Island and Wildwoods have benefited from either NJ State beach projects or Federally sponsored work (CRC, 2006). Today, New Jersey is number one in the USA in terms of the percentage of shoreline with nourishment contracts and receives the majority of Federal dollars spent on beach restoration. Between 1990 and 2005 over half a billion Federal, State and local dollars were spent placing tens of millions m³ of sand on beaches (CRC, 2009b). The USACE completed three major beach restoration projects in CMC; the first in Ocean City, the second in Cape May City and in 2002, the third in Avalon/Stone Harbor was completed (CRC, 2009b). Since 1989, the cost of rebuilding and replenishing Cape Island beaches has exceeded \$50 million and more than 30 million m³ of sand have been deposited from offshore sources to create *circa* 10 km of expanded beach, making it one of the most expensive manufactured beaches in the world (Fox, 2007). This financial commitment to beach nourishment only makes sense when seen in relation to the \$27.7 billion generated by tourist revenue and the 500,000 jobs created by businesses who pay \$5.5 billion in taxes to the New Jersey treasury (CRC, 2009a). Beach nourishment has become a large important, industry and without which, some of CMC’s beaches would not exist.

For both beach nourishment and dune development, private landowner resistance poses a problem. Originally, private landowners held up to 300 m of shoreline property, but subdivisions have created smaller lots. Education and outreach, combined with the detrimental affects of storms are often key drivers leading to acceptance of beach and dune development projects. Since 2004, the Coastal Resource Center has undertaken extensive dune system monitoring and assessment of storm damage risks from dune breaching and overwash. In 2006 geographical information systems (GIS) has been used as a tool to evaluate performance of man-made and natural beach-dune systems against storms. In 2008

they were awarded two congressional earmarks to perform statewide dune assessments in New Jersey (CRC, 2009b).

Considerations

New Jersey's coast is geologically unstable, making it especially vulnerable to storm erosion. By choosing to ignore the dynamic nature of the coast and building along it, New Jersey residents often find their homes or towns threatened. Hard structures built to "protect" the coast have interfered with natural systems of sediment transport, exacerbating downdrift erosion. CMC is especially vulnerable to erosion because of its southern location and hard, armoured structures like the Cape May Canal and jetties built along barrier island inlets. Extensive measures have been taken to keep the beaches wide, buildings safe with sand replenishment. The strongest aspect of coastal management in CMC and New Jersey as a whole is the extensive monitoring programmes. Data about erosion rates, beach response and dune development is important for making informed decisions. A wealth of information can be found through the New Jersey Beach Profile Network, USACE, NJEDP and research institutes like CRC. Beach nourishment and dune development are effective CMC erosion measures. Beach nourishment has been extremely important for the tourism industry and is used to prevent flooding and beach overwash. However, beach nourishment hides the problem and misinforms the public, giving them a false sense of stable shorelines and inviting development. It is also very expensive and only lasts until a storm system rips along the coast, as was seen on 15th November, 2009 when tropical storm Ida passed through. It caused widespread flooding and nullified beach nourishment efforts (Associated Press, 2009). Dunes are the best New Jersey response to erosion and programmes for developing dunes, like that in Avalon, should be replicated. Hard structures built to protect the shore or buildings are detrimental to sediment transport and should no longer be considered on this coast. The cost of building, installing and maintaining hard structures positioned to protect private residences or businesses is an unfair burden to society and costs are likely to increase with projections of sea level rise and increasingly violent storms due to climate change. CMC and New Jersey should continue to use beach nourishment and dune development to aid against erosion. Beach nourishment while not a perfect solution supports an important tourism industry. Grassroots initiatives and education about beach erosion and dune importance like that in Avalon, should be replicated. Building codes should be made more stringent and flood insurance should be available, but if damages are extensive, compensation should be paid on the condition that the structure is not rebuilt. Existing structures should be made more permeable and dismantling hard structures around the inlets should be considered. Additionally, a small access fee could be charged for using beaches so that those enjoying the shore would contribute to beach nourishment at a time when federal replenishment funds have been drastically reduced. The funds could also be used to create dunes and educational outreach literature and signage. Erosion and coastal management decisions should consider human values and safety, but ultimately restore sediment transport and allow dunes to function as ecosystems. This will ultimately lead to safer and economically sustainable development along the coast.

References

Associated Press (2009, November 16) Crew assesses storm damage on N.J. beaches. *New Jersey Real-Time News*. http://www.nj.com/news/index.ssf/2009/11/crews_check_storm_damage_on_nj.html. Date accessed, 6th December, 2009.

Bernd-Cohen, T. and Gordon, M. (1999). State coastal program effectiveness in protecting natural beaches, dunes, bluffs, and rocky Shores. *Coastal Management* 27: 187–217.

Cooper, M., Beever, M. and Oppenheimer, M. (2008). The potential impacts of sea level rise on the coastal region of New Jersey, USA. *Climatic Change* 90: 475–492.

Cooper J.A.G. & McKenna, J. (2007). Social justice in coastal erosion management: The temporal and spatial dimensions. *Geoforum*, doi:10.1016/j.geoforum.2007.06.007

CRC (Coastal Resource Center). (2006). The New Jersey beach profile network: Cape May County, Great Egg Harbor Inlet to Stowe Creek. Profile # 225-100. Prepared for the New Jersey Department of Environmental Protection Division of Construction and Engineering.

CRC (Coastal Resource Center). (2009a). *New Jersey geological history*. <http://inraweb.stockton.edu/eyos/page.cfm?siteID=149&pageID=3>. Date accessed, 6th December, 2009.

CRC (Coastal Resource Center). (2009b). *NJ shoreline protection and vulnerability* <http://inraweb.stockton.edu/eyos/page.cfm?siteID=149&pageID=4>. Date accessed, 6th December, 2009.

Fox, K. (2007). *Rebuilding a beach: Cape May's history with beach replenishment*. <http://www.capemay.com/Editorial/january09/beachreplenishment.html>. Date accessed, 6th December, 2009.

NJDEP (New Jersey Department of Environmental Protection). (2009a). *New Jersey coastal data*. http://www.state.nj.us/dep/cmp/czm_data.html. Date accessed, 6th December, 2009.

NJDEP (New Jersey Department of Environmental Protection). (2009b). *Coastal engineering: Shore protection structures*. <http://www.nj.gov/dep/shoreprotection/structures.htm> Date accessed, 6th December, 2009.

Nordstrom, K.F., Jackson, N.L., Bruno M.S., de Butts, H.A. (2002). Municipal initiatives for managing dunes in coastal residential areas: a case study of Avalon, New Jersey, USA. *Geomorphology* 47: 137-152.

Surfrider Foundation (2009). *New Jersey summary* http://www.surfrider.org/stateofthebeach/05-sr/state_summary.asp?zone=MA&state=nj. Date accessed, 6th December, 2009.