

# Upper Township *“Getting to Resilience”* Recommendations Report

Prepared by the Jacques Cousteau National Estuarine Research Reserve

April 2015



*Recommendations based on the “Getting to Resilience” community evaluation process.*



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## **Introduction**

The Getting to Resilience (GTR) questionnaire was originally developed and piloted by the New Jersey Department of Environmental Protection's Office of Coastal Management in an effort to foster municipal resiliency in the face of flooding, coastal storms, and sea level rise. The questionnaire was designed to be used by municipalities to reduce vulnerability and increase preparedness by linking planning, mitigation, and adaptation. Originally developed by the State of New Jersey's Coastal Management Program, the Getting to Resilience process was later adapted by the Coastal Training Program of the Jacques Cousteau National Estuarine Research Reserve (JC NERR), converted into a digital format, and placed on an interactive website. Further improving the questionnaire, the JC NERR added linkages to evaluation questions including the National Flood Insurance Program's (NFIP) Community Rating System (CRS), Hazard Mitigation Planning, and Sustainable Jersey. While this website is publicly available, through the facilitated Getting to Resilience process, JC NERR Community Resilience Specialists enhance the outcomes of the evaluation by providing community-specific recommendations, guided discussions with municipal representatives, a vulnerability analysis, and municipal plan reviews.

The Getting to Resilience process started as a facilitated discussion regarding the Township's strengths, challenges, and hurdles concerning resiliency. Upper Township is located in northern Cape May County. The Township is bordered to the north by the Tuckahoe River, Atlantic County, and Ocean City. The western border is Cumberland County. To the south are Dennis Township, Woodbine Borough, and Sea Isle City. To the east the Township is bordered by the Atlantic Ocean. Upper Township is comprised of the mainland as well as part of Ludlam Island. The Township is made up of smaller villages or towns that include Beesleys Point, Marmora, Palermo, Seaville, Tuckahoe, Greenfield, Marshallville, Steelmantown, Petersburg, and Strathmere. In order to get from the mainland areas of Upper Township to Strathmere one must travel north through Ocean City or south through Dennis Township and Sea Isle City.

Approximately fifty percent of Upper Township's lands are in the floodplain. This includes all of Strathmere on the barrier island and inland to just west of the Garden State Parkway. This also includes many of the lands near Cedar Swamp Creek and the Tuckahoe River.

Superstorm Sandy flooded portions of all of the evacuation routes in Upper Township. There was six inches of water in the Strathmere Firehouse. Dunes along Ludlam Island breached during both Sandy and Irene. Resilience strengths that Upper Township displayed included their ability to shelter their own residents as well as residents from Ocean City. Upper Township Public

Works was able to clean up quickly and helped neighboring communities with clean up of County Road 619 by clearing sand and stones.

Upper Township has worked with Stockton Coastal Research Center to monitor the beach and Corson's Inlet. The "Final Report for 2013 on the Condition of the Municipal Beaches in the Township of Upper, Cape May County, New Jersey" prepared by The Richard Stockton Coastal Research Center (RSCRC) can be accessed at [http://intraweb.stockton.edu/eyos/coastal/content/docs/municipal\\_reports/UTFinal2013.pdf](http://intraweb.stockton.edu/eyos/coastal/content/docs/municipal_reports/UTFinal2013.pdf). Additional reports prepared by RSCRC for Upper Township can be found at <http://intraweb.stockton.edu/eyos/page.cfm?siteID=149&pageID=135>. Since Sandy, Strathmere in Upper Township has seen significant erosion to the north end of the island at Corson's Inlet. In the summer of 2014 Upper Township declared an emergency at the north end of Strathmere as a result of significant loss of sand. Stockton Coastal Research Center provided a letter/report to supplement the Township's emergency declaration. The declaration gave the Township the ability to implement appropriate short-term remedies to protect people and property.

Upper Township municipal officials also reached out to staff at JC NERR to gain ideas and perspective on looking for innovative ways to diminish the effects of future storms with respect to wave action and beach erosion at this site. Staff from JC NERR and Norbert Psuty, Professor Emeritus at the Institute of Marine and Coastal Sciences, Rutgers University, met with municipal officials in September of 2014 to observe the coastal erosion issue at the northeast corner of Ludlam Island where Strathmere is located. In a letter that Norbert Psuty wrote to the township he explains that, "inlet sites present special conditions that exacerbate problems of sediment deficits and exposure to the wave energy. Inlets incorporate the additional geomorphological system of tidal deltas and channels cutting through the deltas. At uncontrolled inlets (no jetties directing the flows and channel position), the tidal channels tend to shift from updrift to downdrift locations through time." The letter continues, acknowledging the reports prepared by Stockton and the option of beach nourishment before concluding that "consideration should be given to mitigating the effects of this tidal channel in order to increase the benefits derived from the beach nourishment effort." In November of 2014 the Army Corp of Engineers was awarded a contract to reconstruct the beach with physical construction of the beach to start in January of 2015. Beach construction actually began in late May - early April 2015, extending the expected completion date to the end of July 2015.

<http://www.nap.usace.army.mil/Missions/Factsheets/FactSheetArticleView/tabid/4694/Article/490784/new-jersey-shore-protection-great-egg-harbor-inlet-to-townsend-inlet-nj.aspx>

While going through GTR municipal officials identified infrastructure projects that have been planned and implemented as resiliency strengths. Some of these projects include raising the lowpoint of roads along the bayside of Strathmere by 1.5 feet, working with the county to raise



Tuckahoe Road to the 100 year storm level, and attaining a grant for a boat ramp and berm on the bayside of Strathmere. By June of 2015 the Township has successfully raised one road in Strathmere. Officials also identified that the Township is participating in FEMA's Community Rating System (CRS) and has reached a class 6, meaning that National Flood Insurance Program flood insurance premiums receive a 20% discount.

As noted previously, during Sandy Upper Township was able to shelter Township residents as well as additional residents from Ocean City. One thing the Township is working on to improve their shelters is attaining a mobile kitchen that can supply food to the shelters and thereby make the shelters more self sufficient and resilient.

## **Methodology**

The Getting to Resilience (GTR) questionnaire is broken into five sections: Risk and Vulnerability Assessments, Public Engagement, Planning Integration, Disaster Preparedness and Recovery, and Hazard Mitigation Implementation. In order to efficiently answer all of the questions within the questionnaire, participation from a wide array of municipal officials and staff is encouraged. These can include administrators, floodplain managers, emergency managers, stormwater managers, public works officials, town engineers, and appointed and elected officials. For Upper Township this team included Paul Dietrich (Municipal Engineer), Roy Shone (Supervisor of Roads), and Scott Morgan (OEM Coordinator). The questions in the GTR questionnaire were answered collectively by this group with JC NERR staff recording answers and taking notes on the discussions connected to each question.

The GTR questionnaire was started with the town on October 3rd, 2014. JC NERR staff met with two representatives of Upper Township and one representative of the NJ Resiliency Network. A discussion of the Township's resilience strengths and challenges started the meeting. This conversation was followed by a discussion of the Township's Sea Level Rise maps at 1, 2, and 3 feet, as well as Storm Surge Maps for Categories 1, 2, and 3 storms. This lead into the Getting to Resilience questionnaire and Sections 1 and 2 were completed. On October 17th, 2014 JC NERR staff met with three representatives from Upper Township to complete sections 4 and 5 of the questionnaire. Section 3 of the questionnaire was completed by municipal officials between the two meetings.

Upon completion of the GTR questionnaire, JC NERR staff analyzed the answers provided by Upper Township, linkages provided by the GTR website, notes taken during the discussion of questions, various municipal plans and ordinances, and mapping of risks, hazards, and vulnerabilities provided by Rutgers University, the NJ Floodmapper website, and

[www.NJAdapt.org](http://www.NJAdapt.org). After reviewing all of this information, this recommendations report was drafted by JC NERR to help assist Upper Township's decision makers as the Township works to become more resilient.

## **Recommendations**

The Community Rating System (CRS) is a FEMA program, designed to reward communities for taking steps to reduce flooding risk. These activities and elements include public information, mapping, regulation, flood damage reduction, and warning and response initiatives. Actions under these categories are eligible for points that are added up to designate where the community is "rated" according to class rankings of 10 through 1. For each class the community moves up, they receive a reduction in flood insurance premiums of 5%. This can result in serious deductions for flood insurance costs for the community and its residents. Many recommendations in this report are connected to the CRS program as it helps communities save money and become better prepared.

### ***OUTREACH***

#### ***1. Make sure all outreach programs are quantified and catalogued according to CRS standards.***

Upper Township is already a member of the Community Rating System. Within the Community Rating System a significant number of points can be obtained through public outreach. Upper Township identified in the 2014 Annual Floodplain Management Planning Report that annual outreach is sent to all residents of the Township in July and August. While answering the GTR questionnaire Township officials identified that there is floodplain information provided on the Township Website and at Town Hall. Officials also identified that this information could be more frequently publicized to residents to increase awareness of existing outreach materials. The Township should continue to make this information available and advertise its availability to residents to promote preparedness and resilience while also gaining CRS points. The CRS program is based upon increasing flood preparedness and reduction of risk and it would be beneficial to plan outreach and other actions according to CRS guidelines. Outreach should also include information about the natural and beneficial functions of floodplains. A well organized and efficient outreach program can provide validated information from a trusted source and better prepare residents for natural risks. Outreach is one of the easiest sections to gain points in the CRS.

Upper Township has been working toward creating a Floodplain Management Team which will serve as a Program for Public Information (PPI). If done correctly, a PPI will make outreach initiatives more effective and can gain CRS credits in numerous categories besides outreach. In addition, the Upper Township PPI will work with the Coastal Coalition, a group of New Jersey waterfront communities that meet monthly to discuss common municipal issues, to create a regional Multi-Jurisdictional PPI that will include communities from both Atlantic and Cape May Counties. For guidance on establishing a PPI, visit [http://crsresources.org/files/300/developing\\_a\\_ppi\\_for\\_credit\\_under\\_the\\_crs\\_2014.pdf](http://crsresources.org/files/300/developing_a_ppi_for_credit_under_the_crs_2014.pdf). For more information on Outreach Projects visit [http://crsresources.org/files/300/outreach\\_projects\\_for\\_credit\\_under\\_the\\_crs\\_2014.pdf](http://crsresources.org/files/300/outreach_projects_for_credit_under_the_crs_2014.pdf), or visit page 330-2 of the CRS Coordinator's Manual. [http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

***2. Develop a pre-flood plan for public information projects that will be implemented during and after a flood.***

Upper Township is in the process of developing a collection of outreach projects in anticipation of future storm and flooding events. The outreach should cover all necessary information such as evacuation routes, safety procedures, and recovery operations. This action could be undertaken through a PPI and would help Upper Township save time and energy leading up to, during, and after a flooding event as outreach will already have been prepackaged and prepared for dispersal. Pre-flood planning should take place with careful coordination with the community's emergency manager. Examples of messages include evacuation routes, shelter locations, "Turn Around Don't Drown," when it is safe to go back, don't enter a flooded building until it has been cleared by an inspector, get a permit for repairs, substantial damage rules, mitigation opportunities during repairs, and information on mitigation grants. Pre-flood planning is eligible for CRS credits under Flood Response Preparations. For more information on Flood Response Preparations credit requirements, visit page 330-9 of the CRS Coordinator's Manual . ([http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf))

***3. Develop public presentations about flood zones, flooding risk, building recommendations, etc to be given annually at public meetings.***

After Sandy many communities led talks on various flood related topics to help their residents recover from the storm. As Upper Township is a large community with sections of the municipality on the Atlantic coast, on Great Egg Harbor Bay, Peck Bay, Ludlam Bay, the Tuckahoe River and Cedar Swamp Creek, creating a collection of annual outreach projects that

covers flood hazards topics would be beneficial to increasing resident's knowledge of different risks associated with living in a floodplain. By consistently discussing the importance of planning for flooding the Township can set an example to its residents that readiness for disaster events should be maintained even in relatively "quiet" times. Section 320 of the CRS discusses a wide variety of outreach projects and initiatives that can be covered.

A PPI can ensure these talks are well placed and effective. Well publicized and attended talks can reduce the workload on Township staff that would otherwise need to give numerous one on one meetings. However, continuing to have staff available for one on one meetings is highly recommended as it is highly beneficial and earns CRS credits in the Regulations Administration section. Suggested topics for public presentations could include science behind storm surge, Base Flood Elevations, and elevating buildings to increase resiliency and reduce flood insurance rates. Additionally, these meetings can become an action in the Hazard Mitigation Plan. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. For more information on the Regulations Administration credit requirements, visit page 430-40 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

***4. Continue updating the Floodplains Information page on the Township of Upper website and consistently make the link visible and available on the Township website homepage.***

The Township of Upper website does a superb job of having flood related information posted under the Flood Information page. The Floodplain Information page includes information on Local Flood Hazards and Flood Safety, Flood Insurance, Property Protection, Flood Proofing, Natural Floodplain Functions, Drainage System Maintenance, and more. All of the information included on the Floodplain Information page is important and valuable information for the residents and property owners of Upper Township. However, the Township should consider providing the direct link to this page on the homepage of the Township website. Keeping the link in a consistent location on the Township website provides easy access to website users who include residents of the community.

The Township should also consider adding additional information to continue to strengthen and improve the information available on the webpage. For example, the section of the Floodplain Information page that has information on natural floodplain functions could also link to CRS approved outreach material like

[http://visitmonmouth.com/Documents/24/CRS\\_6.%20Natural%20Floodplain%20Benefits.pdf](http://visitmonmouth.com/Documents/24/CRS_6.%20Natural%20Floodplain%20Benefits.pdf)

which is a CRS supported document that Monmouth County Planning has posted on their

website for communities to use. For additional outreach brochures from Monmouth County visit <http://visitmonmouth.com/page.aspx?Id=4382>.

As mentioned in the previous recommendations having a PPI can increase CRS points for this category. A PPI could be responsible for this section of the website and would keep it updated to ensure eligibility for CRS credits in the Outreach section. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

### ***5. Create a hazard disclosure policy.***

Disclosure of known flood, erosion, or other coastal hazard risks at the time of property transfer is an important educational effort consistent with an NAI or No Adverse Impact (<http://www.floods.org/index.asp?menuID=460>) attitude. Some States (such as Florida and California) have disclosure requirements. If a disclosure is required for property in a flood or coastal hazard area, the seller is required to notify potential buyers of the risks and these risks can be factored into the purchase decision. If there is a shore protection structure on coastal property for sale, a disclosure policy could also require that prospective buyers be made aware of the issues surrounding such structures—their drawbacks, negative impacts, and the need for monitoring and maintenance. This type of policy can help sellers avoid transferring known adverse impacts that become unpleasant surprises to buyers.

Some lenders and real estate agents already disclose information about hazards associated with properties being considered for purchase. To ensure that this process continues and to establish congruence of methodology regarding these disclosures, a hazard disclosure policy could be established. The Township would then be able to dictate what information must be shared with potential buyers and set guidelines for the education of new residents concerning their flooding risk. Disclosing these risks to the public using various techniques also may result in CRS credits in the Outreach Projects and Hazard Disclosure sections. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. For more information on Hazard Disclosure credit requirements, visit page 340-2 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

### ***6. Upper Township should consider putting up High Water Mark signs to mark heights of past flooding events.***

While reviewing the draft version of this report there was interest expressed in the National Weather Service's High Water Mark signs. The National Weather Service began installing High Water Mark signs in 2006 to raise awareness of flood risks. FEMA also has a High Water Mark Initiative called "Know Your Line: Be Flood Aware". Posting High Water Mark Signs can achieve CRS credits in section 320 – Map Information Service, specifically MI6 – Historical/repetitive flood information. In addition, credits could also be possible under section 330 – Outreach Projects if the Township holds an event announcing the initiative and providing information about local flood hazards, flood insurance, protecting people and property, how to build responsibly, and why it is important to protect natural floodplain functions. For more information about the National Weather Service's High Water Mark Signs visit [http://www.nws.noaa.gov/os/water/high\\_water/](http://www.nws.noaa.gov/os/water/high_water/). For more information about FEMA's High Water Mark Initiative visit <https://www.fema.gov/about-high-water-mark-initiative>. For more information on the CRS Map Information Service – Historical/repetitive flood information credit requirements, visit page 320-14 of the CRS Coordinator's Manual. [http://crsresources.org/files/2013-manual/crs\\_manual\\_508\\_ok\\_5\\_10\\_13\\_bookmarked.pdf](http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf)

## **MITIGATION**

### ***7. Create a detailed mitigation plan for areas that experience repetitive loss.***

Repetitive loss properties can be a large burden on towns over time. By creating a mitigation plan for these areas, the Township may identify new strategies to tackle this issue, pinpoint at what point in time in the future that buyouts of these properties may be prudent, and achieve CRS credits in the Repetitive Loss Area Analysis section if CRS approved steps are taken. Furthermore, enacting mitigation for repetitive loss areas opens up a wide variety of CRS credits. The CRS requires separate reports for each specific area of repetitive loss with an additional reporting requirement. This plan can be included in the municipal annex section of the Cape May County Multi-Jurisdictional Hazard Mitigation Plan if those actions result in identifying projects that would reduce the risk of flooding or other hazards within the Township. This will allow for associated mitigation actions to be eligible for future funding. For more information on Repetitive Loss Area Analysis credit requirements, visit page 510-29 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

***8. Continue to work towards returning acquired and Township owned properties to natural floodplain functions.***

Natural floodplains can absorb runoff and mitigate flooding issues. This can be done utilizing a variety of techniques including wetlands restoration, planting natural vegetation, reducing sediment compaction, and creating a natural profile. Returning land to natural floodplain functions can achieve significant CRS credits in the Natural Functions Open Space (NFOS) section. Funding for mitigation projects like this could be available by applying for funding through the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) grant programs: Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM). For guidance on FEMA's Hazard Mitigation Assistance visit, [http://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA\\_Guidance\\_022715\\_508.pdf](http://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf). The U.S. Climate Resilience Toolkit provides information on funding opportunities on their website. These opportunities come from a range of government entities and private foundations offering financial and technical resources to advance local adaptation and mitigation efforts. To learn more about these funding opportunities visit, <https://toolkit.climate.gov/content/funding-opportunities>. For more information on Natural Functions Open Space credit requirements, visit page 420-13 of the CRS Coordinator's Manual. [http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

Upper Township has already designated a substantial amount of floodplain land as open space. These areas have a variety of owners from the local government to the state. The Township should continue to promote the use of open space in the floodplain, updating the Upper Township Conservation Plan, and making sure that the Township's Zoning and Master Plan reflect any changes.

***9. Upper Township should identify, map, and keep data on areas of coastal erosion and consider creating erosion protection programs or instituting higher regulations for building in areas subject to coastal erosion.***

Erosion can quickly become a problem in coastal areas. Areas that should be closely monitored could include any waterfront that is not bulkheaded and has experienced erosion. Factors that could amplify erosion (sea level rise, surge) should be defined. The Township has already identified the northern end of Strathmere as an area of concern due to erosion. Steps that the Township has taken in this area was highlighted in the introduction of this report. The Township should make an effort to identify, document, and quantify any additional areas of erosion. Identifying erosional hot spots and their potential impacts on homes and infrastructure can allow for mitigation actions that may prevent erosion from becoming a future problem. In the



same mindset, unwanted deposition from shoaling and runoff can also be problematic for storm water management near outfall pipes and navigation in waterways. Erosional hot spots could then be monitored for change, allowing for more ability to request funding for shoreline restoration projects. Keeping information on coastal erosion can result in CRS credit in the Erosion Data Maintenance (EDM) section, but currently does not include riverine shorelines. In addition, this information will be valuable to monitor the success of any mitigation projects instituted to reduce erosion. For more information on the Erosion Data Maintenance credit requirements, visit page 27 of Management of Coastal Erosion Hazards.

[http://www.fema.gov/media-library-data/20130726-1755-25045-9869/crs\\_credit\\_coastal\\_erosion.pdf](http://www.fema.gov/media-library-data/20130726-1755-25045-9869/crs_credit_coastal_erosion.pdf)

## **PREPAREDNESS**

### ***10. Continue working with Cape May County and Ocean City on sheltering options and agreements.***

Cape May County is responsible for sheltering county residents displaced by storms and evacuations. However, it is vital to have backup plans in the event that the primary county shelters are full, the county is unable to provide the necessary services at those shelters, or routes to those shelters are cut off. Upper Township already has agreements with Cape May County and Ocean City to provide shelter to the Township residents as well as Ocean City residents. Township officials identified that Upper Township shelters are outside of flood hazard areas and potential surge inundation areas. While going through Getting to Resilience Township officials identified the need and pursuit of attaining a mobile kitchen to be used at the shelter to promote further self resilience. In addition, the Township is interested in evaluating potential shelters from a structural standpoint to assure that they are built to withstand hazards. The Township should consider adding this evaluation to their actions within the Cape May County Hazard Mitigation Plan to potentially provide a funding source through Hazard Mitigation Grant Funds. Upper Township is doing a great job at providing shelters to residents and should continue to bolster shelter functionality.

### ***11. Back up all municipal planning documents and other critical materials.***

In the event of a disaster, important information and documentation that could be used to guide the Township to recovery needs to be available. In order to ensure this takes place, all municipal planning documents, outreach associated with disaster events, and other critical materials should be backed up at offsite locations or in “cloud” networks. Upper Township has done an exemplary job in hosting planning documents on the Township website. Many of the

plans can be found under Planning Board - Reports. The Township should continue to make future planning documents available.

***12. Continue to ensure that the Township and residents have a special needs database like NJ's Register Ready Program to Participate in.***

Upper Township has a link to NJ's Special Needs Registry, Register Ready, on the Upper Township Office of Emergency Management page, but there is no direct link from the main Upper Township webpage. It is important to identify residents that would need assistance during an evacuation and it is important that residents are able to navigate the Township's webpages to find this information in order to keep the list up to date and ensure resident safety.

***13. Continue pursuing designation as a StormReady Community with the National Weather Service.***

The National Weather Service has created a community preparedness program to assist towns as they develop plans for a wide variety of severe weather events. This program provides guidance on hazardous weather identification, warning systems, and creating public readiness. This guidance can in turn be used to help inform possible mitigation actions for Hazard Mitigation planning. For more information, visit <http://www.stormready.noaa.gov/howto.htm>. Upper Township has already prepared an application to become a StormReady Community and is currently waiting for the National Weather Service to begin accepting new applications. Becoming a StormReady Community results in CRS credits. For more information on the StormReady Community credit requirements, visit page 610-17 of the CRS Coordinator's Manual. [http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

***MUNICIPAL ORGANIZATION***

***14. Transfer personal knowledge, documents, and other records of coastal storm and flooding event damages to digital format and place on a shared Township computer drive with municipal planning documents to allow for access by multiple municipal departments.***

Memories of historical storm events, specifically ones that were not documented by state and federal agencies, are useful tools that can be used to plan for impending storms. However, it is vital that the information from these memories as well as all municipal plans be available for all municipal staff. This information can be gathered and documented from current municipal staff,

past municipal staff, and public input and may be very useful to identify past surge extents, conditions that caused amplification of storm damages, and vulnerable areas not shown by mapping.

The Cape May County Multi-Jurisdictional All Hazards Mitigation Plan contains information on historical occurrences of many types of hazards that have specifically affected Cape May County and Upper Township. Natural hazard events specific to the Township can be found on page 9.12-4 in Volume II of the Cape May County Multi-Jurisdictional All Hazards Mitigation Plan. Having this information in the Plan is an excellent start to making storm damage information available to municipal staff. In the 2014 Annual Progress Report - Floodplain Management Planning it was recommended that sections of the All-Hazard Plan be amended, amongst these sections is the section on specific natural hazards. The amendment for this section will add more recent storms, from 2009-2012, to the list of storms that the plan currently captures. This plan and supporting reports are an example of the information that should be made available to leaders and planners both in and out of the Office of Emergency Management, Public Works Department, Planning Department, Engineering Department, and so forth.

Hard copies of documents and other records should also be digitized for preservation and access. Having all storm and flooding related information on a shared drive will help educate the staff and allow for access without having to coordinate an exchange of information. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

***15. Have Township municipal officials participate in FEMA training courses.***

FEMA offers in person training and independent study programs. To find more information about in person training topics and dates please visit <http://training.fema.gov/> and <http://www.fema.gov/training-1> and for independent study programs please visit <http://training.fema.gov/is/>. Through the Coastal Training Program, the JC NERR offers free courses for municipal staff and elected/appointed officials. JC NERR is willing to work with the Township to understand training needs and provide relevant courses when possible. Having municipal officials trained on various topics and techniques can result in CRS credits in the Regulations Administration (RA) section though it may require SID codes. For more information on Regulations Administration credit requirements, visit page 430-40 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordination-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordination-Manual_2014.pdf)

***16. Utilize the Community Vulnerability Assessment Tool, Risk and Vulnerability Assessment Tool, Hazard Assessment Tool, and HAZUS-MH to identify potential hazards, risks, and vulnerabilities and keep mapping information on file.***

There are numerous hazard, risk, and vulnerability assessment tools available to municipalities. It is recommended that the members of the Township municipal staff are familiar with the use of these tools. The importance of identifying hazard, risk, and vulnerability cannot be overstressed. Use of these tools can be beneficial in the CRS, hazard mitigation planning, creating municipal plans, zoning, and writing construction codes.

- The Community Vulnerability Assessment Tool is used to conduct a community vulnerability assessment to a wide range of hazards. It is often used in conjunction with the Risk and Vulnerability Assessment.  
<http://csc.noaa.gov/digitalcoast/training/roadmap>
- The Risk and Vulnerability Assessment Tool is used to identify people, property, and resources that are at risk of injury, damage, or loss from hazardous incidents or natural hazards. <http://csc.noaa.gov/digitalcoast/training/roadmap>
- The Hazard Assessment Tool is a risk assessment process which will help identify hazards, profile hazard events, inventory assets, and estimate losses.  
<http://www.fema.gov/hazard-mitigation-planning-risk-assessment>
- HAZUS-MH is a software package that uses models and Geographic Information Systems (GIS) technology for estimating physical, economic, and social impacts from various hazards such as floods and hurricanes. <http://www.fema.gov/hazus>
- Additional non-regulatory tools are being developed by FEMA and can be accessed on [www.region2coastal.com](http://www.region2coastal.com). Included in these tools is a Coastal Flood Risk Assessment which provides estimates of potential flood damage based on the new coastal flood study results using FEMA's [Hazus loss estimation software](#). Draft versions of these tools are currently available by county at <http://www.region2coastal.com/flood-risk-tools>. Specifically the tools that are currently available can be found at [https://content.femadata.com/Public/Draft\\_Non\\_Regulatory\\_Flood\\_Risk\\_Products/Cape\\_May/](https://content.femadata.com/Public/Draft_Non_Regulatory_Flood_Risk_Products/Cape_May/). For more information about this and other non-regulatory tools please visit <http://www.region2coastal.com/flood-risk-tools/tool-descriptions>.

## **FEMA MAPPING**

### ***17. Continue to adopt the latest version of FEMA's flood maps as they are released and consider increasing freeboard requirements.***

Upper Township updated the local Flood Damage Control ordinance twice in 2013. With these updates the Township first adopted Advisory Base Flood Elevation maps for regulating construction and development before adopting the Best Available Flood Hazard Data language which allows the Township to enforce the most stringent requirement when maps overlap. Updates to the ordinance also included defining the term Flood Protection Elevation to include that the "elevation shall be measured to the lowest horizontal structural member and that said elevation is one (1') foot higher than the base flood elevation or advisory base flood elevation whichever is more restrictive."

(<http://www.uppertownship.com/images/PDF/Ordinances/2013/Ord.%20002-2013%20Flood%20hazard.pdf>) Using the language "Best Available Flood Hazard Data" should allow for change over time as FEMA's maps are redrawn regularly. While it had been decades since FEMA had remapped the FIRMs in our area, the remapping process was long overdue and can be anticipated to take place with higher frequency in the future.

Upper Township should consider amending the Flood Damage Control ordinance to also include some of the newer information coming out on FEMA's maps including the Limit of Moderate Wave Action (LiMWA). That information can also be used to enhance the building standards in the form of higher freeboard requirements (higher freeboard requirements in areas that are within the LiMWA areas). Both actions can result in a large amount of CRS points in the Higher Regulatory Standards section. It is also recommended that Upper Township consider exceeding the state's 1 foot freeboard requirement to provide better protection during storm events and to provide a buffer for expected sea level rise. Each additional foot of freeboard requirement will gain additional points in the Community Rating System, to as high as 500 points. The Freeboard credits are located in the section of Higher Regulatory Standards. For more information on the Higher Regulatory credit requirements, visit 430-2 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

### ***18. Continue to ensure the public is aware of any changes to FEMA's flood maps as they are updated and if those updates result in changes to the Township's building requirements.***

Ensuring that the information on the maps is understood by all municipal leaders and staff prior to discussions with the public is critical to ensure that the correct information is disseminated by the Township. For every release of a map update, the Township could make a public

announcement to its citizens and detail if any changes were made to the prior map, including if additional information such as the Limit of Moderate Wave Action has been added. Notifying the public of a new map product is an example of outreach that can be done by the Township's PPI, raising the potential for CRS points. Including information on what changes occur when new maps are released on the Township's Local Flood Protection Information webpage may help to alleviate questions the public may have as each map is updated, thereby reducing the workload on Township staff.

The new RISK map products from FEMA include a GIS layer depicting the "changes since last FIRM" which will help the city in describing the changes in flood zones on individual properties and for the city as a whole. In addition, FEMA is also developing a RISK map product called "Flood Depth Grids and Water Surface Elevation Change Grids" which shows the depth of the 1% annual chance flood for any given location within the study area. A description of this data set can be found at: <http://www.region2coastal.com/flood-risk-tools/tool-descriptions> and the new data layers are being developed as part of the preliminary FIRM process.

This data is in draft form now but will be released at the [www.region2coastal.com](http://www.region2coastal.com) website soon. The draft data for Cape May County can be downloaded from [https://content.femadata.com/Public/Draft\\_Non\\_Regulatory\\_Flood\\_Risk\\_Products/Cape\\_May/](https://content.femadata.com/Public/Draft_Non_Regulatory_Flood_Risk_Products/Cape_May/). The more familiar the citizens are with the maps, the more likely they will take appropriate actions.

***19. Continue to provide access to all flood maps on the Township website, at the Township Municipal Building, and at the local library.***

While going through GTR Upper Township officials identified that they have Flood Insurance Rate Maps (FIRMs) accessible on the Township website, at the local library, and at Town Hall. Locating the maps in all of these locations ensures that the maps are easy to find and bolsters the opportunity for residents to be informed. An additional benefit to continuing to locate the maps in those locations is that it allows for CRS credits in the Outreach section. Maintaining a link to FEMA's website, [www.region2coastal.com](http://www.region2coastal.com), on the City website is highly recommended. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual.

[http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

## ***SUSTAINABLE JERSEY***

Sustainable Jersey is a certification program for municipalities in New Jersey that want to go green, save money, and take steps to sustain their quality of life over the long term. Upper Township is registered for Sustainable Jersey certification and has 195 approved action points and Bronze certification. The following Sustainable Jersey recommendations are taken from the answers to the Getting to Resilience questionnaire.

### ***20. Climate Adaptation: Flooding Risk***

This Sustainable Jersey action, under the category of “Climate Adaptation,” is designed to help communities identify: 1) your community’s vulnerability to flooding impacts (both coastal and inland) and 2) ways to improve your community’s overall resiliency. This action focuses on the various causes of flooding that could impact a community, either now or in the future, including increased precipitation, increased frequency of heavy precipitation events, sea level rise and storm surge. Completion of this action item counts for a total of 20 Certification Points and as a Priority Action and will serve as a prerequisite for future companion Sustainable Jersey actions related to flooding and resiliency.

Upper Township has gone through the Getting to Resilience process with staff at JC NERR. This recommendation report is an in-depth look at the Township’s linkages to other programs (provided on [www.prepareyourcommunitynj.org](http://www.prepareyourcommunitynj.org) ) and the Township’s plans and ordinances. Documentation for this action needs to include a signed list of members of a Flooding Risk Team formed to focus on the town’s flooding risk issues, the maps viewed, and the town’s assessment. The team that worked on Getting to Resilience is listed in the methodology section of this report. As the maps in the appendix of this document were viewed at the first meeting while going through the Getting to Resilience questionnaire, and are comprised from the same data as the maps on NJFloodmapper, they may be submitted for documentation. The section of this report that is labeled Sea Level Rise and Surge Vulnerability may be used as the description of the town’s analysis of the use of the NJFloodMapper tool, as this section highlights many of the points talked about while going through Sea Level Rise maps of 1-3 feet and Storm Surge maps for Categories 1-3. The Township is however responsible for writing the 300 word summary of the discussion on the flood risk maps and risk to the community. For more information on this action please visit <http://www.sustainablejersey.com/actions-certification/actions/#/open/action/513>.



## ***21. Natural Resource Inventory***

The Natural Resource Inventory (NRI), also known as an Environmental Resource Inventory (ERI), serves as an index of natural resources and is a compilation of text and visual information about the natural resource characteristics and environmental features of an area. It provides baseline documentation for measuring and evaluating resource protection issues. The NRI is an important tool for environmental commissions, planning boards, and zoning boards of adjustment. A municipality will earn 20 points toward Sustainable Jersey certification for a Natural Resource Inventory completed from within 10 years of the June submission deadline or for an older Inventory that has been reviewed and updated from within 10 years of the June submission deadline.

Upper Township completed a Natural Resource Inventory in November of 2006 and it was reexamined in 2011. The Township can continue to receive credit for the NRI until 2021 and should consider continuing to attain this credit into the future.

## ***22. Open Space Plans***

An Open Space and Recreation Plan, OSRP, (also referred to as the Open Space Plan, OSP) is a comprehensive document that guides municipal, county, and/or regional open space protection and preservation. The Plan tells how and why open space will be protected and provides a framework for implementation. An OSRP identifies and examines open space, recreation needs and other resources that are important to the municipality, and lays out a plan of action to protect and maintain these places. A municipality will earn 10 points toward Sustainable Jersey Certification for having an Open Space and Recreation Plan.

In the 2006 Upper Township Master Plan Reexamination Report it was recommended on page 9 that the Township consider preparing a Recreation and Open Space Plan based on an update to the 1994 Recreation Facilities Plan. In the Master Plan recommendation the purpose of the Recreation and Open Space Plan is to be “submitted to NJDEP Green Acres to facilitate funding of acquisition and construction of parks and open space areas.” A bonus to this recommendation is the credit that can be achieved in Sustainable Jersey.

## ***23. Clustering Ordinance***

Adopting a municipal clustering ordinance provides potential protection for critical natural resources. A well-planned cluster development concentrates dwelling units on the most buildable portion of the site and preserves common open space for conservation, agriculture, recreation or public and semi-public uses. Through the protection of natural resources and the

inherent reduction in impervious coverage, cluster developments may result in the enhanced protection and sustainability of municipal and state-wide ecosystems, including drinking water, soil, and habitat quality.

The Clustering Ordinance action is one of four actions that can receive points as a Natural Resource Protection Ordinance for the Sustainable Jersey program. In general, Natural Resource Protection Ordinances are designed to provide municipalities with the ability to protect various resources within the community from possible harmful effects caused by development. Municipalities with Natural Resource Inventories (NRI) or Environmental Resource Inventories (ERI) should implement those ordinances that protect the vulnerable resources identified in the inventory. Ordinances are the body of public law that implement the goals of the local Master Plan and protect public assets like special environmental features identified in the Environmental or Natural Resource inventory. Completion of this action item will count for a total of 10 points and submissions for this action will not expire.

(<http://www.sustainablejersey.com/actions-certification/actions/#/open/action/65>)

In the 2006 Upper Township Master Plan Reexamination Report residential clusters and cluster options are mentioned numerous times. In the Summary Recommendations on page 9 it states,

*“The plan provides for greater protection of the Environs through adoption of environmental performance standards and limited development intensity and impervious coverage for lands outside of the Centers. Development tools including conservation residential cluster subdivision regulations to protect constrained lands and Density Transfer provisions into the proposed Town Center zones are recommended.”*

The recommendations around clustering in the Master Plan reflect similar requirements to the Sustainable Jersey Clustering Ordinance Action should be investigated and pursued for possible credit. For more Information on this action please visit

<http://www.sustainablejersey.com/actions-certification/actions/#/open/action/65>.

#### **24. The Municipal Blue Star Program**

In September 2014 Sustainable Jersey and Clean Ocean Action launched The Municipal Blue Star Program. The Municipal Blue Star Program focuses on water quality protection. The goal of the program is to inspire coastal towns to reap the benefits of achieving Sustainable Jersey Certification while also focusing on watershed-wide water quality improvements. For more information about Clean Ocean Action and Sustainable Jersey’s Blue Star Program visit,

<http://www.cleanoceanaction.org/index.php?id=811>.

## **PLANNING**

### ***25. Continue working to create a Continuity of Operations Plan for Upper Township.***

A Continuity of Operations Plan (COOP) is separate from an Emergency Operations Plan and ensures that primary essential functions continue to be performed before, during, and after a wide range of emergencies. It is developed and maintained to enable each department, agency, and other governmental entity to continue to function effectively in the event of a threat or occurrence of any disaster or emergency that could potentially disrupt governmental operations and services. A COOP can protect essential facilities, equipment, vital records, and other assets. It can reduce or mitigate disruptions to operations. It can facilitate decision-making during an emergency. Upper Township is in the process of developing a Continuity of Operations Plan. JC NERR is able to provide example COOP plans from the Borough of Avalon which can be found at [http://www.prepareyourcommunitynj.org/media/27952/Avalon\\_COOP\\_COG.pdf](http://www.prepareyourcommunitynj.org/media/27952/Avalon_COOP_COG.pdf). FEMA also provides a Continuity Plan Template (<http://www.fema.gov//media-library/assets/documents/90025>) that can be used as a starting point for local governments.

### ***26. Upper Township should identify sea level rise as a hazard in town plans.***

Upper Township will experience impacts due to sea level rise and like all potential hazard impacts, this risk should be identified in town plans to ensure proper response. Flooding, storm severity, storm frequency, and sea level rise are combined hazards. Historical rates of sea level rise should be defined as part of this action and future predicted sea levels should be taken into account when making land use decisions, construction standards, etc. The historical rate of sea level rise along the New Jersey coast over the past half century was 3-4 mm/yr (or 0.12 -0.16 in/yr), while projected future rates are expected to increase. In the recent paper entitled “A geological perspective on sea-level rise and its impacts along the U.S. mid-Atlantic coast” Miller and Kopp state that for 2050, the “best” estimate for sea level rise is 1.5 feet along the Jersey Shore. By 2100 the “best” estimate for sea level rise is 3.5 feet along the Jersey coast. “Best” refers to a 50% likelihood of that level of sea level rise occurring, meaning that actual sea levels may be lower or higher than the “best” estimates.

While sea level rise is a monumental challenge to coastal areas, the challenge cannot be tackled until it is properly identified. The Cape May County Multi-Jurisdictional All Hazard Mitigation Plan has identified Sea Level Rise as an exacerbating factor to many hazards such as Hurricanes and Nor’Easters in the future. Sea level rise appears many times throughout this document as a factor to different hazards as well as maps of vulnerability to sea level rise at

different meter increments. Having Sea Level Rise identified in the County plan sets an example that Upper Township could follow by incorporating it into the Township's own planning documents. This should include the recommended hazard disclosure policy. Disclosing these risks to the public using various techniques also may result in CRS credits in the Outreach Projects and Hazard Disclosure sections. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. For more information on Hazard Disclosure credit requirements, visit page 340-2 of the CRS Coordinator's Manual. [http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15\\_NFIP-Coordinators-Manual\\_2014.pdf](http://www.fema.gov/media-library-data/1406897194816-fc66ac50a3af94634751342cb35666cd/FIA-15_NFIP-Coordinators-Manual_2014.pdf)

***27. Examine municipal plans, strategies, and ordinances and consider rewriting sections to include the previous recommendations or reflect the risks, hazards, and vulnerabilities explored in the Getting to Resilience process.***

In order to fully embrace resiliency, municipal plans, strategies, or ordinances should incorporate resiliency recommendations and findings. These should include the Municipal Master Plan, All Hazards Mitigation Plan, Floodplain Management Plan, Evacuation Plan, Emergency Response Plan, Continuity of Operations Plan, Disaster Recovery Plan, Post Disaster Redevelopment Plan, Capital Improvements Plan, Economic Development Plan/Strategy, Coastal Plan, Shoreline Restoration Plan, Open Space Plan, Stormwater Management Plan, Historic Preservation Plan, Zoning Ordinance, Flood Damage Prevention Ordinance, and Building Code. If these plans, strategies, or ordinances do not currently exist, it is highly recommended the Township moves to create them. Further content regarding this recommendation can be found below in the section titled, "Coastal Hazard Incorporation in Planning". Rewriting certain planning documents such as Floodplain Management Plans, Evacuation Plans, Stormwater Management Plans could involve the creation of actions that in turn should be included in hazard mitigation plans.

## **Beginning the Long-term Planning Process for Sea Level Rise**

Upper Township, like most other coastal municipalities, will experience future impacts from sea level rise in the form of regular tidal flooding, heightened storm impacts, and saltwater intrusion of aquifers and freshwater systems, requiring mitigation actions. Upper Township's large size results in a large number of properties, facilities, and infrastructure that will eventually need to have a plan in place to mitigate or respond to these heightened flooding threats. With such a large area to cover, the need for careful planning and informed decisions cannot be understated. While smaller municipalities may have the capability to react to issues as they arise, Upper Township will need to do careful planning and make informed decisions.

There are a range of options, from buyouts to elevating properties to hardening techniques, but the use of these options must be weighed, discussed, and decided upon.

The Blue Acres program is currently being administered by the NJDEP throughout the state and other buyout programs are also available. It would be prudent to look into repetitive loss properties that will also be threatened by sea level rise in the future to determine if buyouts of these properties would be an effective way to plan for sea level rise. It is important to note that as sea level rises, the competition for buyout programs will be higher and funding may become more limited. If the Township feels that buyouts are not a good option, mitigation strategies should be investigated. However, not only will the individual mitigation options need to be examined, but the time frame of their effectiveness should be a factor. Cost-benefit analysis should accompany all mitigation projects to ensure that the lifespan of the mitigation and effectiveness when compared to rate of sea level rise is weighed against anticipated protection. In some instances, it may be determined that the cost of protecting already flood prone areas against sea level rise will be less effective than property acquisition. This may lead the Township to reconsider mitigation measures such as buyout programs. Again, these decisions will not be easy ones to make but it is critical that the decisions do take place.

### **Guilford, CT Example**

JC NERR recommends Upper Township consider learning from the resiliency planning process undertaken by Guilford, CT and described in “Town of Guilford Community Coastal Resilience Plan Report of Options to Increase Coastal Resilience”:  
(<http://www.ci.guilford.ct.us/pdf/Coastal%20Resilience%20Plan.%20Report%20&%20Options.pdf>).

The goal of their Coastal Resilience Plan was to address the current and future social, economic and ecological resilience of the Town of Guilford to the impacts of sea level rise and anticipated increases in the frequency and severity of storm surge, coastal flooding, and erosion. The Town has drafted the report of options for increased coastal resilience as a step toward developing a Community Coastal Resilience Plan.

The four basic steps of the Coastal Resilience Plan are:

1. Generate awareness of coastal risk;
2. Assess coastal risks and opportunities;
3. Identify options or choices for addressing priority risks and vulnerabilities (short term); and
4. Develop and implement an action plan to put selected options or choices into place (long term).

Similar to Upper Township, Guilford's coastal neighborhoods are diverse and it is likely that each will be faced with a combination of vulnerabilities to sea level rise and the increased incidence and severity of coastal storms. A combination of adaptation measures will therefore be necessary in each neighborhood in order to reduce risks and increase resilience. Likewise, neighborhood-scale resilience planning will likely be important. Steps should be taken to evaluate individual adaptation measures and determine how comprehensive solutions can be developed and implemented for building coastal resilience.

A comprehensive risk and vulnerability assessment for Upper Township should include the following municipal sectors:

- Social – Residents, business community, and visitors.
- Economic – Residential Properties, commercial/industrial businesses, municipal resources, tourism, and future development.
- Infrastructure – Roads, bridges, railroads, stormwater, tide gates, marinas, and municipal facilities.
- Utilities – Public and private water supplies, septic systems, telecommunications, and electricity.
- Emergency Services – Fire, police, medical, sheltering, evacuation/egress.
- Natural Systems – Tidal wetlands and other coastal landforms.

When considering options for coastal resilience, the following three types of adaptation responses are typically considered:

- **Accommodation** implies that people continue to use the land at risk but do not attempt to prevent the land from being flooded. This option includes erecting emergency flood shelters, elevating buildings on piles and elevating roadways.
- **Protection** involves hard structures such as sea walls and dikes, as well as soft solutions such as dunes and vegetation, to protect the land from the sea so that existing land uses can continue.
- **Retreat** involves no effort to protect the land from the sea. The coastal zone is abandoned and ecosystems shift landward. This choice can be motivated by excessive economic or environmental impacts of protection. In the extreme case, an entire area may be abandoned.

Examples of adaptation measures considered in Guilford's plan include management of coastal real estate and structures, shoreline protection and management of coastal and nearshore lands, roadway alterations, and protection or replacement of water supply wells and septic systems. All these adaptation measures are presented with a variety of options for consideration.

Upper Township may also gain some planning insight from the public participation process associated with Guilford's resiliency planning. Guilford found their public believes that physical changes are needed to address sea level rise and increase coastal resilience, but that there are societal and institutional obstacles. Common themes noted from the public comments included:

- Coastal resilience planning – and many of the solutions that are implemented – may be best accomplished at the neighborhood scale; and neighborhood planning groups may need to be organized to begin looking at appropriate solutions;
- The tax base associated with coastal properties would need to be preserved in the short term and then some of the tax base may need to be shifted in the long term;
- Education and technical assistance are needed and desired by homeowners, and education could also be accomplished in the schools;
- Comprehensive solutions will be needed such as: addressing water and wastewater at the same time in neighborhoods where these systems will struggle or fail; ensuring that roadway improvements in one location are effective because improvements are also made elsewhere in the transportation network; and working on coordinated roadway and railroad improvements.

In thinking of their own public participation in resilience planning, Upper Township could likely expect similar themes to emerge and could be prepared to offer the long-term planning options that may be under consideration by the municipality.

### **Salem, Massachusetts Example**

Additionally, Salem, Massachusetts recognized the importance of being prepared for climate change and produced a Climate Change Vulnerability Assessment and Adaptation Plan (Plan). The Plan investigates some of the most serious climate change impacts, the resulting stresses to different sectors in the City, and outlines project ideas to address some of the most critical issues. The goal for this plan was to identify immediate, actionable adaptation priorities, and incorporate these into existing and future projects and policies.

This Plan was intentionally designed to focus on four of the most critical climate change impacts on six sectors in the City, and to prioritize the vulnerabilities to help inform which actions will give the greatest benefit for Salem. The four key climate change impacts are extreme heat events, extreme precipitation events, sea level rise, and storm surge. The six sectors assessed in this Plan are critical building infrastructure, water, energy, stormwater, transportation, and vulnerable populations.



Highlights of Salem's approach included having a diverse stakeholder group involved and engaged in the planning process and engaging the public and business in the implementing of new projects and policies as a result of the plan. Additionally, section 4 of the plan lays out adaptation strategies to address Salem's priority vulnerabilities. The plan can be found at: <http://www.cakex.org/sites/default/files/documents/SalemClimateChangePlan.pdf>.

### ***NOAA's "Adapting to Climate Change: A Planning Guide for State Coastal Managers" Example***

Included in a 2010 NOAA's Office of Ocean and Coastal Resource Management manual titled, "Adapting to Climate Change: A Planning Guide for State Coastal Managers" is a thorough discussion of adaptation strategies and methods. (<http://coastalmanagement.noaa.gov/climate/docs/adaptationguide.pdf>). Upper Township could consider some of the options presented in this document for long and short-term resiliency planning. Many of these suggestions complement the suggestions provided earlier in this GTR Recommendations report:

#### **Impact Identification and Assessment**

- Research and Data Collection – Predict possible social and economic effects of climate change on communities. Calculate cost-to-benefit ratios of possible adaptation measures. Encourage adaptation plans that are tailored to specific industries.
- Monitoring – A comprehensive monitoring program that incorporates multiple tools and considers a variety of systems and processes can provide input to the vulnerability assessment and adaptation strategy.
- Modeling and Mapping – Map which areas are more or less susceptible to sea level rise in order to prioritize management efforts.

#### **Awareness and Assistance**

- Outreach and Education – Disseminate and make scientific fact sheets about climate change available to community members, visitors, elected officials, businesses and industries. Use multiple forms of communication such as news media, radio, brochures, community meetings, social networks, blogs and websites.
- Real Estate Disclosure – The disclosure of a property's vulnerability to coastal hazards enables potential buyers to make informed decisions reflecting the level of impacts they are willing and able to accept.
- Financial and Technical Assistance – Provide flood insurance discounts for properties that exceed floodproofing standards by one or two feet. Encourage hazard mitigation by providing grants to areas that implement adaptation measures.

## **Growth and Development Management**

- Zoning – Zoning can be used to regulate parcel use, density of development, building dimensions, setbacks, type of construction, shore protection structures, landscaping, etc. It can also be used to regulate where development can and cannot take place, making it an invaluable tool in efforts to protect natural resources and environmentally sensitive areas and guide development away from hazard-prone areas.
- Redevelopment Restrictions – Combining restrictions with acquisition/demolition/relocation programs provides safer options to property owners in the wake of the loss of or damage to their homes or businesses.
- Conservation Easements – A conservation easement is a legal agreement between a landowner and a land trust or government agency that can be used to restrict development in sensitive and hazard-prone areas.
- Compact Community Design – The high density development suggested by compact community design can allow for more opportunities to guide development away from sensitive and hazard-prone areas.

## **Loss Reduction**

- Acquisition, Demolition, and Relocation – The most effective way to reduce losses is to acquire hazard-prone properties, both land and structures, demolish or relocate structures, and restrict all future development on the land.
- Setbacks – Setbacks can protect structures from hazards by keeping the structures away from a property's most vulnerable areas.
- Building Codes – Building codes that regulate design, construction, and landscaping of new structures can improve the ability of structures in hazard-prone areas to withstand hazard events.
- Retrofitting – Existing structures can be protected from hazards through retrofitting.
- Infrastructure Protection – Infrastructure protection entails fortification against the impacts of climate change.
- Shore Protection Structures – Shore protection structures protect existing development allowing it to stay in place. They often damage or destroy other valuable coastal resources and create a false sense of security; nevertheless in some cases, for the purposes of protecting existing development, there may be no other acceptable or practical options.

## **Shoreline Management**

- Beach Nourishment – Beach nourishment is the process of placing sand on an eroding beach, typically making it higher and wider, to provide a buffer against wave action and flooding.
- Dune Management – Dunes may be restored or created in conjunction with a beach

nourishment project or may be managed as part of a separate effort.

- Sediment Management – Dredging and placing sediment, building shore protection structures and other structures that trap or divert sediment.
- Regulation and Removal of Shore Protection Structures – To protect the natural shoreline and the benefits it provides, regulations can be used to limit shoreline hardening as well as promote alternative forms of protection.
- Rolling Easements – Rolling easements are shoreline easements designed to promote the natural migration of shorelines. Typically, rolling easements prohibit shore protection structures which interfere with natural shoreline processes and movement, but allow other types of development and activities. As the sea rises, the easement moves or “rolls” landward, wetland migration occurs, and public access to the shore is preserved.
- Living Shorelines – Living shorelines can be effective alternatives to shore protection structures in efforts to restore, protect, and enhance the natural shoreline and its environment. Living shorelines use stabilization techniques that rely on vegetative plantings, organic materials, and sand fill or a hybrid approach combining vegetative plantings with low rock sills or living breakwaters to keep sediment in place or reduce wave energy.

### **Coastal Ecosystem Management**

- Ecological Buffer Zones – Ecological buffers are similar to setbacks (and may be included within setbacks) but are typically designed to protect the natural environment by providing a transition zone between a resource and human activities.
- Open Space Preservation and Conservation – Open space preservation and conservation can be accomplished through the management of lands dedicated as open space through a number of the measures previously discussed, such as zoning, redevelopment restrictions, acquisition, easements, setbacks, and buffers.
- Ecosystem Protection and Maintenance – In the context of coastal adaptation, ecosystem protection largely involves the protection of tidal wetlands and other ecosystems. The facilitation of wetland migration is an important aspect of this.
- Ecosystem Restoration, Creation, and Enhancement – Similar to the above, ecosystem restoration and creation can replace tidal wetlands that are lost to sea level rise.

### **Water Resource Management and Protection**

- Stormwater Management – Drainage systems may be ill-equipped to handle the amount of stormwater runoff that will accompany the more intense rainfall events expected in the future, and those in low-lying areas will be further challenged by losses in elevation attributed to rising sea levels.

- Water Supply Management – Climate change will negatively affect both water quantity and quality, and coastal populations will continue to grow, so water supply managers must be prepared to respond to associated challenges to water supply.

## **Coastal Hazard Incorporation in Planning**

Incorporation of coastal hazards into municipal planning is highly recommended to accurately reflect the risks of coastal living. Life in coastal towns largely revolves around weather and water conditions and planning should include consideration for current and future coastal hazards. While including information on coastal hazards in Emergency Response Plans and Evacuation plans is an easy connection to make, the path to incorporation of coastal hazards into documents such as a Master Plan may be more challenging to realize. However, to foster a community of resiliency, it is important to keep hazards in mind throughout all planning documents. The Master Plan should be used to catalogue and document the goals of all other planning documents. The following is an example of how identification of coastal hazards can be introduced to a Municipal Master Plan through the Floodplain Management section. This sort of language and related content can be utilized in various other planning documents and then re-discussed in the Master Plan under the corresponding sections.

### **Municipal Master Plan Example**

The following excerpts are adapted from a comprehensive plan for Worcester County in Maryland, the equivalent to a municipal master plan. This comprehensive plan incorporates coastal hazards throughout the entire document to form an integrated approach to resiliency. Coastal hazards are often identified in the document as “current and anticipated challenges”. Individual sections (such as the Floodplain Management section given in this example) identify objectives and recommendations that should be mirrored in individual plans (a Floodplain Management Plan in this example). In doing so, all municipal plans are organized under the master plan and share the same language and goals. If choosing to update the Floodplain Management Plan, it is highly recommended to do so by following the guidelines set in Section 510 of the CRS which can result in large CRS credits. Refer to the following link for the Worcester County Comprehensive Plan for more ideas and examples of a planning document drafted with resiliency in mind. <http://www.co.worcester.md.us/cp/finalcomp31406.pdf>

#### ***Sample Introduction***

*Realizing that air, water, and land could be overused and despoiled, the plans organized within this document increasingly moved toward resource protection. If such damage occurred, local residents’ quality of life and tourism, the economic linchpin, would suffer.*

*Preserving the Township's natural resources and character will therefore, continue to be this plan's main purpose.*

*The plan's purpose is to provide the following:*

- 1. An official statement of goals, objectives, policies and aspirations for future growth, development and the quality of life;*
- 2. A set of guidelines for the government and private sectors to maximize the Township's quality of life;*
- 3. A strategy addressing current and anticipated challenges ; and*
- 4. Sufficient policy guidance to effectively manage natural, human and financial resources.*

### **Sample Floodplain Management Section**

*Floodplains, lands along waterways subject to flooding, locally have low relief and sedimentary soils. Floodplains are defined by how often they flood. A 100-year floodplain has a 1% probability of flooding in a given year and is not tidally influenced. Local flooding can occur in major storm events. Many areas of Upper Township's 100-year floodplain are developed. Both residential and commercial uses exist within this floodplain. Most of the time a floodplain is available for use. However, during floods they can be dangerous. Superstorm Sandy reinforced this fact. Floods injure people physically and emotionally and cause economic damage. Beyond this, emergency personnel are put at risk when called upon to rescue flood victims. In Upper Township, flooding must be taken very seriously. To protect public safety and property, limiting future building in floodplains and stringent construction standards will help reduce injuries and property damage. Federal, state, and local policies should be consistent to implement this approach.*

### **Objectives**

*The Township's objectives for floodplain protection are:*

- Limit development in floodplains*
- Reduce imperviousness of existing and future floodplain development where possible*
- Preserve and protect the biological values and environmental quality of tidal and non-tidal floodplains, where reasonable and possible to do so.*

*Developed floodplains have a reduced capacity to absorb stormwater, resulting in increased flooding. For example, development results in new impervious surfaces (roads, sidewalks, roofs, etc.), which limit the effectiveness of the floodplain by reducing the land's absorption capacity. This increases the potential for flooding. It is therefore important that the natural floodplain character be maintained, wherever reasonable, to*

*promote public safety, to reduce economic losses, and to protect water quality and wildlife habitat.*

*Upper Township faces additional flooding issues. Several areas of the Township commonly flood during storms. Sea level rise will increase flooding hazards. New Jersey is particularly vulnerable to sea level rise. During this century, as sea level rises, shorelines could retreat significantly in parts of the Township. Narrow bay beaches and wetlands at low elevations, both important habitats, would be lost to even a modest rise in sea level and erosion of the oceanfront would increase. Currently, the state recognizes a right to protect shores with hard structures (e.g. riprap). As sea level rises, these hard structures will prevent “migration” of beaches and wetlands, and these natural features will be lost.*

### ***Programs and Policies***

*Flooding from coastal storms is a serious threat to life and property with the potential for extensive damage and disruptions. To reduce potential damage, the county is updating the hazard mitigation plan. This plan is the first step to provide guidance for pre-disaster activities. The second phase of addressing disasters is to develop a post disaster plan. Confusion and rapid decision-making follow a disaster. Advance planning can position the Township to reduce its exposure to future disasters and reduce the need for ad hoc decision-making. Superstorm Sandy has taught us that effective post-disaster planning is necessary for an effective recovery process.*

### ***Recommendations***

- 1. Work with federal and state agencies to regularly update the Township floodplain maps, with first priority being areas that are mapped as 100-year floodplain without base flood elevation established.*
- 2. Regulate new development and subdivisions in the floodplain.*
- 3. Promote uses, such as open space easements, natural areas, and recreational open space to reduce impervious surfaces in floodplains.*
- 4. Work to acquire properties in the lowest lying portions of the 100-year floodplain, and return them to a natural state.*
- 5. Reevaluate the effectiveness of the current floodplain protection regulations.*
- 6. Discourage the location of new homes and roadways in the “V” or wave velocity zone and the 100-year floodplain.*
- 7. Work with the county to complete a hazard mitigation plan for flooding, wildfire, and other natural hazards.*
- 8. Develop and implement a post-disaster recovery and reconstruction plan to facilitate recovery and to reduce exposure to future disasters.*

- 9. Participate in the Community Rating System to receive flood insurance premium credits.*
- 10. Consider code changes that will limit impervious surfaces.*
- 11. Develop a sea level rise response strategy (including the two foot freeboard requirement for properties exposed to flooding and discourage further shoreline hardening).*

## **Mapping**

The following maps can be found in the appendices of this document and were either requested by Township staff or recommended by JC NERR staff during GTR meetings. As part of updates to the Getting to Resilience website, [www.prepareyourcommunitynj.org](http://www.prepareyourcommunitynj.org), the site will host community profiles that include municipal mapping profile packets that will be available for future download. These maps can and should be used to help write and update the Municipal Master Plan, All Hazards Mitigation Plan, Floodplain Management Plan, Evacuation Plan, Emergency Response Plan, Continuity of Operations Plan, Disaster Recovery Plan, Post Disaster Redevelopment Plan, Capital Improvements Plan, Economic Development Plan/Strategy, Coastal Plan, Shoreline Restoration Plan, Open Space Plan, Stormwater Management Plan, Historic Preservation Plan, Zoning Ordinance, Flood Damage Prevention Ordinance, and Building Code.

### ***Sea Level Rise 1-3 feet with Critical Facilities***

Over the past hundred years, sea level has risen slightly higher than one foot in New Jersey. Due to a variety of factors including melting land ice and thermal expansion, it is anticipated that the rate of sea level rise will increase substantially in the future. While sea level rise poses it's own threat to coastal communities, it also will increase the severity of storm surge and erosion. By examining sea level rise maps, the Township can better understand future flooding risk and plan accordingly. As a portion of the Township is near current sea level, including some municipal property, Sea Level Rise maps should be utilized heavily for municipal planning documents.

### ***Storm Surge (SLOSH Category 1, SLOSH Category 2, & SLOSH Category 3)***

SLOSH or Sea, Lake, and Overland Surge from Hurricanes is a computerized model from the National Hurricane Program. SLOSH takes into account various factors to compute surge inundation above ground level or simple inundation. These factors include storm size, storm pressure, storm speed, storm path, wind speed, bathymetry, and topography. With this set of factors, SLOSH determines the worst surge impacts that can be expected from hurricanes according to category. SLOSH maps are vital tools for Emergency



Operations Center managers for making decisions about evacuation orders, timing of evacuation, and staging of emergency equipment prior to tropical weather systems.

### ***Marsh Migration 1-3 feet***

Marsh reaction to sea level rise has been mapped according to the Sea Level Affecting Marshes Model (SLAMM). Marshes provide various environmental and storm protection functions to communities and should be preserved. As sea level rises, many marshes will convert to open water or tidal mud flats. However, if suitable land is connected to current marshes, conversion of ecosystems may occur which could allow marshes to “migrate” further inland in balance with sea level. Upland areas that are deemed to be suitable marsh migration areas should be identified and preserved if possible and barriers to marsh migration should be eliminated. In doing so, the environmental and storm protection functions of marshes may persist despite sea level rise.

### ***Preliminary Flood Insurance Rate Map***

FEMA’s Preliminary Flood Insurance Rate Map (PFIRM) represents the current best available data for Upper Township concerning 1% and 0.2% flooding scenarios. Base Flood Elevations and wave modeling are established for the 1% flood. Flood Insurance Rate Maps should be used to assist in zoning and building code decisions. Additional mapping information about floodplain maps can be accessed off of FEMA’s [www.Region2Coastal.com](http://www.Region2Coastal.com).

### ***Sandy Surge Extent***

FEMA has mapped the limits of the storm surge caused by Superstorm Sandy. This map can be used as a reference for this historical flooding event.

## **Upper Township/Strathmere Historical Erosion Data**

Shorelines are constantly in a state of change, be it from tidal fluctuations or erosional and depositional forces. Shoreline change can create large scale shifts in risk. Erosion may move shoreline closer to buildings and infrastructure, reducing natural buffers and heightening impacts. Deposition that moves shorelines or near shore features such as sandbars may in turn reduce rates of flow of streams and stormwater management systems and cause greater risk of precipitation driven flooding. Deposition can also cause navigation hazards to waterways and navigation channels. Shoreline Change maps can identify trends and should be incorporated into appropriate municipal plans. Some shoreline change maps are available from USGS at <http://marine.usgs.gov/dsasweb/#>. (Can be found on page 51 of the appendix)

## **Other Suggested Maps**

### ***Repetitive Loss & Severe Repetitive Loss***

Repetitive Loss and Substantial Damage maps can be used to identify “problem” areas. Depending on the location and size of these areas, the Township can make decisions about how to prevent repetitive loss from occurring. These options can range from utilizing Blue Acres funding and returning the properties to a natural state to creating protective infrastructure projects in order to help protect from risk.

### ***Overlays of Hazards and Populations, Infrastructure, and Building Footprints***

Though it is the goal of this report to guide the Upper Township towards resiliency, risk will always exist. By overlaying hazards such as sea level rise and surge with population information, infrastructure, and building footprints, the Township will be able to identify areas of highest risk and plan accordingly.

### ***Natural Resources, Historical Resources, Cultural Resources, & Economic Resources***

Mapping of a community's resources is an extremely useful tool, not only for creating a catalogue of a community's strengths, but also for identifying areas that should be protected. Overlaying hazards such as sea level rise and surge may lead Upper Township to make decisions on protecting certain resources through retrofitting historical buildings or protecting natural resources by allowing for natural floodplain functions.

## **Additional Mapping Resources**

NJADAPT is a New Jersey-based website being built to host and apply climate science and impacts data. The objective of the NJADAPT platform is to provide communities with the ability to develop municipal profiles of various risks that may potentially impact their areas by making climate projection data for NJ more accessible. The initial development of the platform has been supported by the New Jersey Recovery Fund and NOAA.

The Flood Exposure Profiler is the first tool developed as part of the larger All Climate Hazards tools being developed through the NJADAPT initiative. The Profiler is broken into four major themes:

- Flooding (which shows the flooding hazards individually)
- Society (demographic data that shows information about populations, businesses, and employees)
- Infrastructure (provides information on facility and infrastructure locations that should be considered when planning for disaster events),

- Environment (data on coastal land use areas - marsh, open space, land use land cover).

Each of the profiles allow you to see the themed data and then overlay a hazard layer of your choice to see what the potential impacts may be. This tool allows you to create maps that you can then package and share links to or create pdfs from for further use.

## **Sea Level Rise and Surge Vulnerability**

Many areas of Upper Township are at or near current sea level, meaning fluctuations in sea level through surge events are of great significance. Although this report is not designed to be a true vulnerability analysis of sea level rise and surge events, mapping available to JC NERR staff has allowed for the composition of this introduction to sea level rise and surge vulnerability. Analysis of SLOSH maps show that as hurricane strength increases, potential surge impacts will increase in scope and severity as one would expect. SLOSH models indicate we should expect flooding on a similar scale of Sandy for powerful Category 1 hurricanes. The SLOSH models included in this report cover Categories 1-3 and are included in the appendix. The SLOSH model for a Category 1 storm has the potential of covering almost half of the Township with water depths above ground level ranging between 1-3 feet, 3-6 feet, and 6-9 feet. The SLOSH model for a Category 2 storm expand the horizontal boundary of the surge potential and increases the depth ranges to include 9+ feet. The Category 3 SLOSH model shows over half of the Township being inundated with surge and more than 50% of that surge being over 9 feet deep above ground level. It is important to note that in all SLOSH mapping for Category 1, 2, and 3, the critical evacuation routes of Garden State Parkway, Route 619 (Commonwealth Ave), Route 623 (Roosevelt Blvd), Route 631 (Tuckahoe Rd), Route 557 (Woodbine Rd), Route 50, and Route 49 are subject to either partial or complete flooding. As storm strength increases, the likelihood of safe use of these evacuation routes decreases. Although storms of this magnitude are very rare for our area, they remain a possibility that requires attention and planning.

Even the relatively low end scenario of one foot of sea level rise will require adaptation as areas along the bayside of Strathmere, Cedar Swamp Creek, and the Tuckahoe River will see fairly regular tidal inundation. In Strathmere the areas most susceptible to flooding at 1 foot of sea level rise are along Bayview Drive between Webster Ave and East Summer Ave and Taylor Ave. The evacuation routes of Route 631 (Tuckahoe Rd) and Route 50, as well as Tyler Road, are most vulnerable to 1 foot of sea level rise near Cedar Swamp Creek. Route 50, Route 49, and Marshallville Road are also vulnerable near the northern border of the Township by the Tuckahoe River.

Scientists anticipate the arrival of an additional one foot of sea level rise before 2050. As sea level rise is expected to accelerate this century, three feet of sea level rise is very likely before 2100. In the table below, the “low”, “high”, and “best” estimates for sea level rise projections for New Jersey for the years 2050 and 2100 are displayed. “Best” refers to a 50% likelihood of that level of sea level rise occurring.

	Sea-level rise (feet)		
	Global	Bedrock	Shore
<b>2030 central</b>	<b>0.5</b>	<b>0.7</b>	<b>0.8</b>
2030 low	0.3	0.5	0.6
2030 high	0.7	1.0	1.1
2030 higher	0.9	1.2	1.4
<b>2050 central</b>	<b>0.8</b>	<b>1.3</b>	<b>1.5</b>
2050 low	0.5	0.9	1.1
2050 high	1.3	1.8	1.9
2050 higher	1.6	2.1	2.3
<b>2100 central</b>	<b>2.5</b>	<b>3.1</b>	<b>3.5</b>
2100 low	1.4	2.2	2.5
2100 high	4.0	4.6	4.9
2100 higher	4.6	5.5	5.9
<b>2100 collapse</b>	<b>8.7</b>	<b>9.7</b>	<b>10.1</b>

NJ sea level rise projection ranges and best estimates. K.G. Miller, R.E. Kopp, B.P.Horton, J.V. Browning, and A.C. Kemp, 2013, A geological perspective on sea - level rise and its impacts along the U.S. mid - Atlantic coast. Earth’s Future 1: 3 - 18, doi:10.1002/2013EF000135

Two feet of sea level rise sees regular tidal flooding slowly impacting more and more of the areas mentioned above. In Strathmere a larger portion of Taylor Ave and Bayview Drive will see fairly regular tidal inundation, with flooding on Bayview extending past Webster Ave south to Sherman Ave, and from Randolph Ave to the southern end of Bayview Drive. Butter Road near Cedar Swamp Creek and Mosquito Landing Road near the Tuckahoe River also becomes vulnerable to inundation at two feet of sea level rise. In addition, the evacuation routes of Route 619 (Landis Ave) and Route 625 (John F Kennedy Blvd) in Sea Isle City and Route 619 (Bay Ave) and Route 623 (Roosevelt Blvd) in Ocean City are vulnerable to regular tidal inundation at two feet of sea level rise. While these routes are not within the Upper Township municipal boundary they are still critical evacuation routes that the Township should consider when creating evacuation plans for the Upper Township residents located in Strathmere.

Three feet of sea level rise will result in regular tidal inundation of portions of nearly every road in Strathmere. All of Taylor Ave and Bayview Ave, and large portions of their intersecting streets vulnerable as well. Three feet of sea level rise will also make evacuation Route 619 (Commonwealth Ave) susceptible to flooding throughout Strathmere and the neighboring communities of Sea Isle City and Ocean City. Other vulnerable evacuation routes include Route 631 (Tuckahoe Rd), Route 50, Route 49, Route 623 (Roosevelt Blvd), and the northbound lanes of the Garden State Parkway. Sections of roads in Beesleys Point (Harbor Rd and Cove Rd) and Marmora (Morris Ave) become vulnerable at three feet of sea level rise as well.

Four feet of sea level rise has the potential to affect every road in Strathmere with regular tidal inundation, with the exception of Neptune Dr. The evacuation Route 619 (Commonwealth Ave) in Strathmere, Sea Isle, and Ocean City can be expected to see regular tidal inundation. At four feet of sea level rise the Strathmere Fire Department may experience significant reductions in their ability to respond to emergencies and continue functioning at its normal capacity as every street surrounding the building will be vulnerable to tidal inundation at high tide. All of the evacuation routes vulnerable to three feet of sea level rise can be expected to have extended impacts due to tidal inundation. Additionally, it is at four feet of sea level rise that the mapping shows higher confidence that flooding along the Garden State Parkway will include both the north and southbound lanes.

Any level of inundation due to regular tidal flooding will have large scale impacts on emergency response and day to day operations of municipal staff and citizens. Sea level rise will also result in greater impact of storm events as a surge atop a higher sea level will be more dramatic than the same surge atop a lower sea level. Necessary adaptation to sea level rise and the associated exacerbation of other hazards such as surge must be taken into account when planning for the future.

### **CRS Sections That Likely Have Available Current Points**

The following sections of the Community Rating System may possibly contain credit points that are available for Upper Township based off of the answers given in our Getting to Resilience questionnaire, discussions with JC NERR staff, and reviews of the Master Plan and other documents. These sections represent the current state of the Township but also include planned projects, uncompleted projects, and recommended actions deemed to be within the Township's reach. However, these projects may need to be complete in order to be granted credit. It is likely that the Outreach Projects in Section 330 will be highly achievable and less costly than other sections within the CRS. The following sections do not represent guaranteed

points for the CRS but are likely achievable to a certain degree and should be investigated to determine the costs and benefits of the required actions when submitting to the CRS. When working with your CRS coordinator, we recommend inquiring about the following sections.

**Section 320: Map Information Service:** To provide inquirers with information about the local flood hazard and about flood-prone areas that need special protection because of their natural functions.

- **Basic Firm Information (MI1):** 30 points for providing basic information found on a FIRM that is needed to accurately rate a flood insurance policy. (GTR – 1.7, 2.5)
- **Additional Firm Information (MI2):** 20 points for providing information that is shown on most FIRMS, such as protected coastal barriers, floodways, or lines demarcating wave action. (GTR – 1.7, 2.5)

**Section 330: Public outreach:** To provide the public with information needed to increase flood hazard awareness and to motivate actions to reduce flood damage, encourage flood insurance coverage, and protect the natural functions of floodplains.

- **Outreach projects (OP):** Up to 200 points for designing and carrying out public outreach projects. Credits for individual projects may be increased if the community has a Program for Public Information (PPI). (Township website, GTR – 2.4, 2.7, 2.11, 2.14)
- **Flood response preparations (FRP):** Up to 50 points for having a pre-flood plan for public information activities ready for the next flood. Credits for individual projects may be increased by the PPI multiplier. (Township website, GTR – 2.4, 2.7, 2.11, 4.9)
- **Program for Public Information (PPI):** Up to 80 points added to OP credits and up to 20 points added to FRP credits, for projects that are designed and implemented as part of an overall public information program. (Township website, GTR – 2.4, 2.7)

**Section 340: Hazard Disclosure:** To disclose a property's potential flood hazard to prospective buyers before the lender notifies them of the need for flood insurance.

- **Disclosure of the flood hazard (DFH):** Up to 25 points if real estate agents notify those interested in purchasing properties located in the Special Flood Hazard Area (SFHA) about the flood hazard and the flood insurance purchase requirement. An additional 10 points are provided if the disclosure program is part of a Program for Public Information credited under Activity 330 (Outreach Projects). (GTR – 2.5.2)

**Section 350: Flood Protection Information:** To provide more detailed flood information than that provided by outreach products.

- **Flood protection library (LIB):** 10 points for having 10 Federal Emergency Management Agency publications on flood protection topics housed in the public library. (GTR – 2.5.1, 2.5.2, 2.15)

- **Locally pertinent documents (LPD):** Up to 10 points for having additional references on the community's flood problem or local or state floodplain management programs housed in the public library. (GTR – 2.5.1, 2.5.2)
- **Flood protection website (WEB):** Up to 76 points for providing flood protection information via the community's website. An additional 29 points are provided if the website is part of a Program for Public Information (credited under Activity 330 (Outreach Projects)). (GTR – 2.5.1, 2.5.2, 2.7, 2.11, 4.7, 4.9)

**Section 360: Flood Protection Assistance:** To provide one-on-one help to people who are interested in protecting their property from flooding.

- **Property protection advice (PPA):** Up to 25 points for providing one-on-one advice about property protection (such as retrofitting techniques and drainage improvements). An additional 15 points are provided if the assistance program is part of a Program for Public Information (credited under Activity 330 (Outreach Projects)). (GTR – 5.7)

**Section 420: Open Space Preservation:** To prevent flood damage by keeping flood-prone lands free of development, and protect and enhance the natural functions of floodplains.

- **Open space preservation (OSP):** Up to 1,450 points for keeping land vacant through ownership or regulations. (GTR – 5.9)
- **Special flood-related hazards open space (SHOS):** Up to 50 points if the OSP credited parcels are subject to one of the special flood-related hazards or if areas of special flood related hazard are covered by low density zoning regulations. (GTR – 5.9)
- **Open space incentives (OSI):** Up to 250 points for local requirements and incentives that keep flood-prone portions of new development open. (GTR – 5.9)
- **Natural functions open space (NFOS):** Up to 350 points extra credit for OPS-credited parcels that are preserved in or restored to their natural state. (GTR – 5.9, 5.12)
- **Natural shoreline protection (NSP):** Up to 120 points for programs that protect natural channels and shorelines. (GTR – 5.9)

**Section 430- Higher Regulatory Standards:** To credit regulations to protect existing and future development and natural floodplain functions that exceed the minimum criteria of the National Flood Insurance Program (NFIP).

- **Regulations administration (RA):** Up to 67 points for having trained staff and administrative procedures that meet specified standards. (GTR – 3.4.5, 3.6.1)
- **Freeboard (FRB):** Up to 500 points for a freeboard requirement. (GTR – 5.4, 5.5)
- **Protection of critical facilities (PCF):** Up to 80 points for protecting facilities that are critical to the community. (GTR – 4.7)



**Section 440: Flood Data Maintenance:** To make community floodplain data more accessible, current, useful, and/or accurate so that the information contributes to the improvement of local regulations, insurance rating, planning, disclosure, and property appraisals.

- **Additional Map Data (AMD):** Up to 160 points for implementing digital or paper systems that improve access, quality, and/or ease of updating flood data within the community. (GTR – 1.7, 2.5)
- **FIRM Maintenance (FM):** Up to 15 points for maintaining copies of all FIRMs that have been issued for the community. (GTR – 1.7, 2.5)
- **Erosion Data Maintenance (EDM):** up to 20 points for maintaining coastal erosion data. (Hazard Mitigation Plan, GTR – 1.3)

**Section 510: Floodplain Management Planning:** To credit the production of an overall strategy of programs, projects, and measures that will reduce the adverse impact of the hazard on the community and help meet other community needs.

- **Floodplain management planning (FMP):** 382 points for a community-wide floodplain management plan that follows a 10-step planning process. (GTR – 3.4, 3.4.1)
- **Repetitive Loss Area Analysis (RLAA):** Up to 140 points for a detailed mitigation plan for a repetitive loss area. (GTR – 1.11, 1.12, 1.13)

**Section 520: Acquisition & Relocation of buildings:** To encourage communities to acquire, relocate, or otherwise clear existing buildings out of the flood hazard area.

- Up to 2,250 points based on the number of buildings that fit the criteria and have been acquired or relocated. (Hazard Mitigation Plan, GTR – 1.11, 1.12)

**Section 530: Flood Protection:** To protect buildings from flood damage by retrofitting the buildings so that they suffer no or minimal damage when flooded, and/or constructing small flood control projects that reduce the risk of flood waters' reaching the buildings.

- **Flood protection project technique used (TU\_):** Credit is provided for retrofitting techniques or flood control techniques. Retrofitting technique used: Points are provided for the use of elevation (TUE), dry floodproofing (TUD), wet floodproofing (TUW), protection from sewer backup (TUS), and barriers (TUB) Structural flood control technique used: Points are provided for the use of channel modifications (TUC), and storage facilities (TUF). (GTR – 5.7)

**Section 540: Drainage System Maintenance:** To ensure that the community keeps its channels and storage basins clear of debris so that their flood drainage and storage capacity are maintained.

**Coastal Erosion Protection Maintenance (EPM):** Up to 100 points for maintaining erosion protection programs in communities with coastal erosion prone areas. (Hazard Mitigation Plan, GTR - 1.3, 5.12)

**Section 610: Flood Warning and Response:** To encourage communities to ensure timely identification of impending flood threats, disseminate warnings to appropriate floodplain occupants, and coordinate flood response activities to reduce the threat to life and property.

- **Emergency warning dissemination (EWD):** Up to 75 points for disseminating flood warnings to the public. (GTR – 2.11, 4.7, 4.9)
  - **EWD9:** 10 points, if all schools, hospitals, nursing homes, prisons, and similar facilities that need flood warning have NOAA Weather Radio receivers and at least one other automated backup system for receiving flood warnings. (GTR – 4.11)
- **Flood response operations (FRO):** Up to 115 points with 10 points awarded for maintaining a data base of people with special needs who require evacuation assistance when a flood warning is issued and for having a plan to provide transportation to secure locations. (GTR – 2.12, 4.8, 4.9, 4.9.6)
- **Critical facilities planning (CFP):** Up to 75 points for coordinating flood warning and response activities with operators of critical facilities. (GTR – 4.7, 4.9)
- **StormReady community (SRC):** 25 points for designation by the National Weather Service as a StormReady community. (GTR – 4.6)

## Appendix

### 1 foot of Sea Level Rise Upper Township

#### Legend

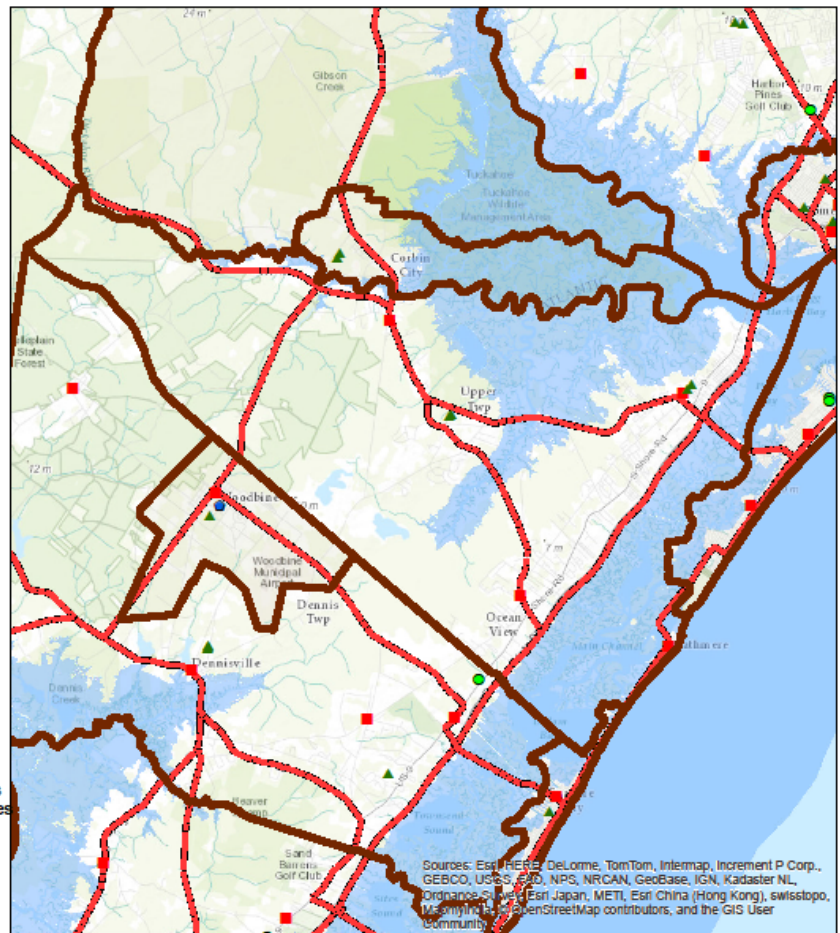
- Municipality
- ▲ Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 1ft SLR

0 1 2 4 Miles

Year 2010 Population: 12373

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts that sea level rise as well as the proceeding projections thereafter and is centered on target municipalities

Map Authors: Rachael Sacatelli and Bryan Serino  
Rutgers, New Brunswick  
Center for Remote Sensing  
and Spatial Analysis



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, ETO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, Mapbox, Swisstopo, OpenStreetMap contributors, and the GIS User Community

## 2 feet of Sea Level Rise Upper Township

### Legend

- Municipality
- ▲ Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 2ft SLR

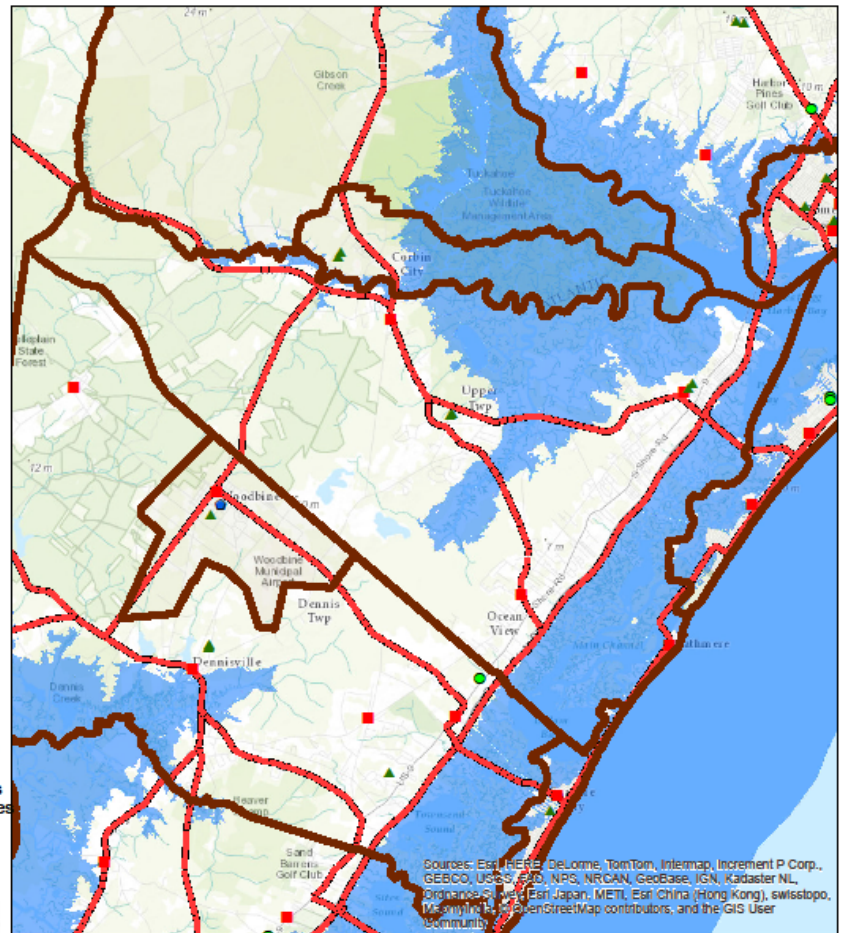
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and Spatial Analysis

CRSSA



Sources: Esri, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, ERI, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Mapbox, OpenStreetMap contributors, and the GIS User Community

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# **Category 1 SLOSH Model** **Upper Township**

## **Legend**

- Municipality
- ▲ Schools
- Assisted Living
- Law Enforcement
- Hospitals
- Fire Stations
- Evacuation Routes

## **Category 1 SLOSH**

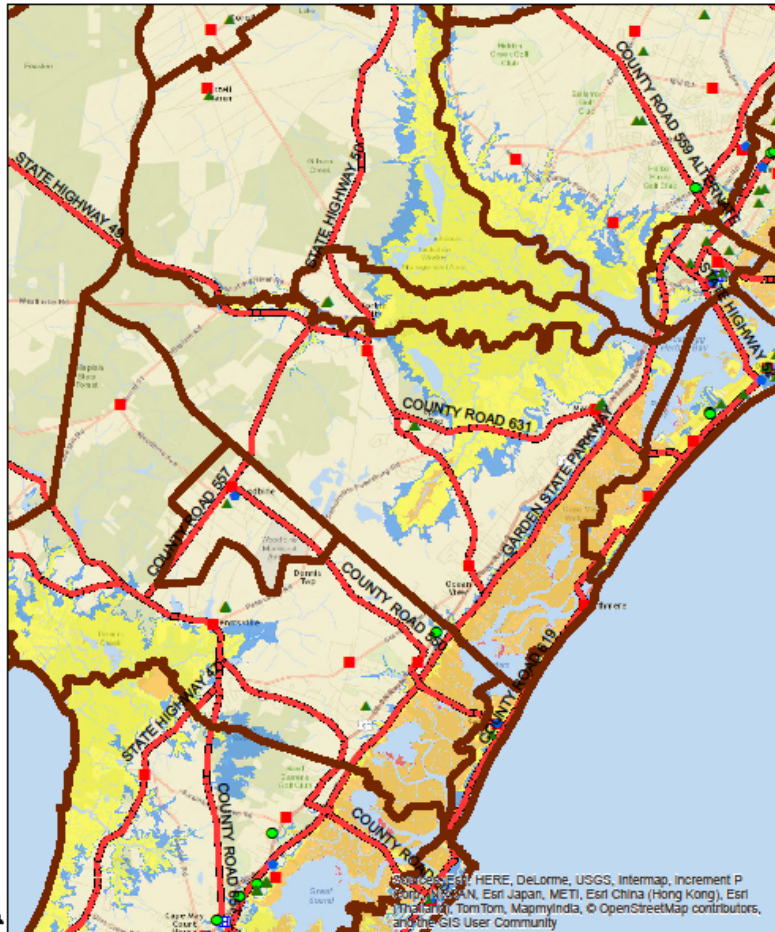
- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

0 2.5 5 Miles

Year 2010 Population: 12373

This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.

Map Authors: Rachael Sacatelli and Bryan Serino  
 Rutgers, New Brunswick  
 Center for Remote Sensing  
 and Spatial Analysis



## Category 2 SLOSH Model Upper Township

### Legend

- Municipality
- ▲ Schools
- Assisted Living
- Law Enforcement
- Hospitals
- Fire Stations
- Evacuation Routes

### Category 2 SLOSH

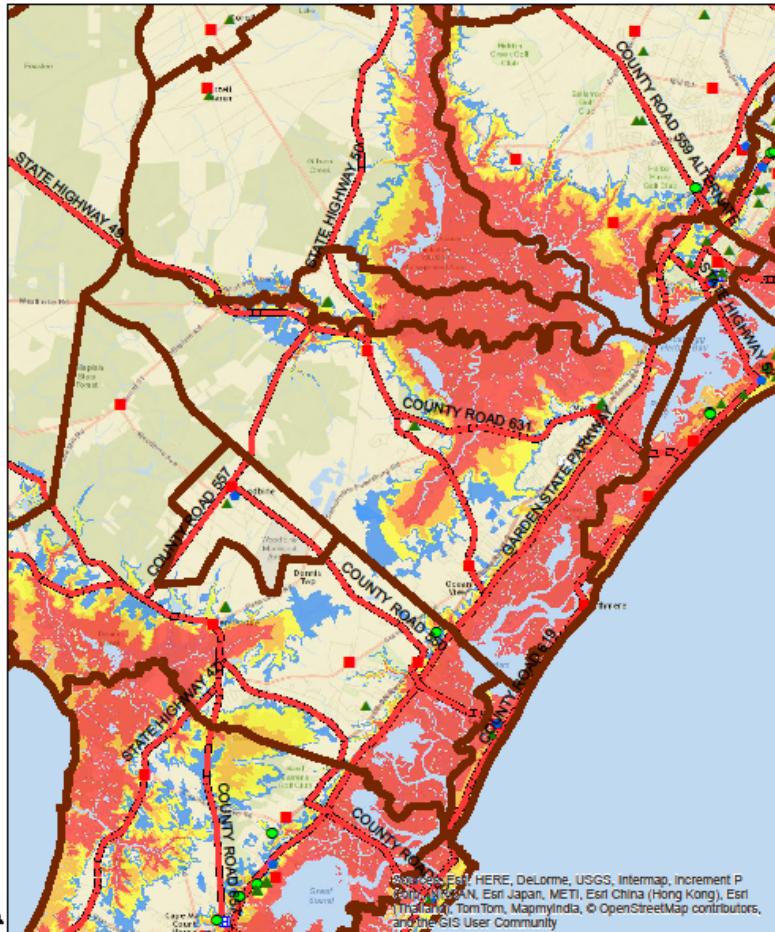
- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

0 2.5 5 Miles

Year 2010 Population: 12373

This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.

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Rutgers, New Brunswick  
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and Spatial Analysis





# **Category 3 SLOSH Model** **Upper Township**

## **Legend**

- Municipality
- ▲ Schools
- Assisted Living
- Law Enforcement
- Hospitals
- Fire Stations
- Evacuation Routes

## **Category 3 SLOSH**

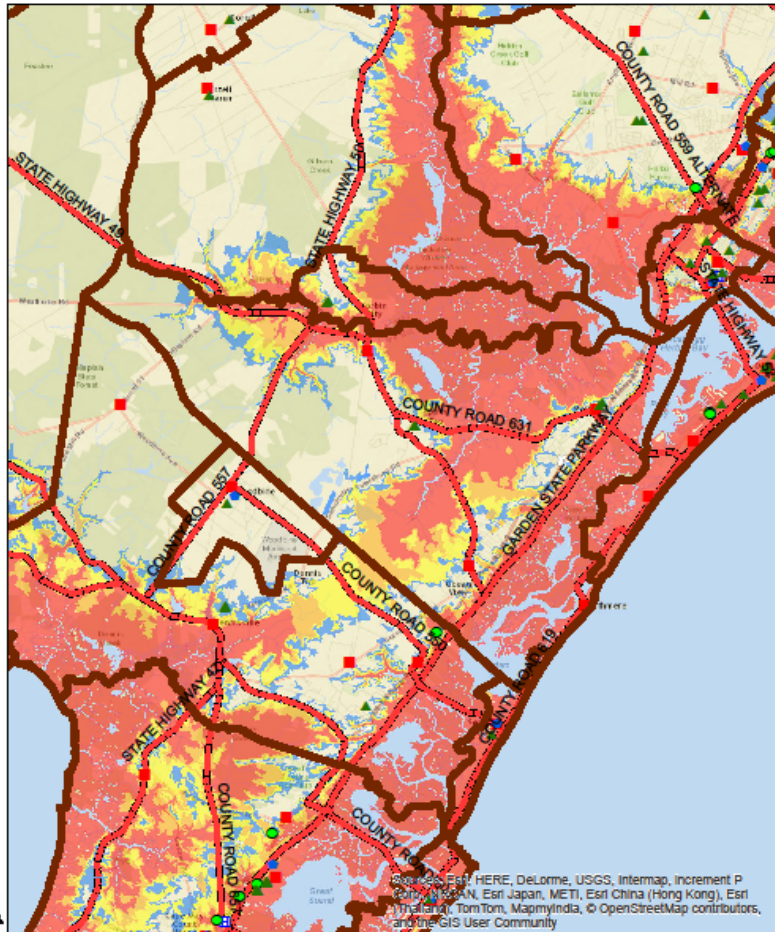
- 0 - 3 Feet Above Ground Level
- 3 - 6
- 6 - 9
- > 9

0 2.5 5 Miles

Year 2010 Population: 12373

This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.


Map Authors: Rachael Sacatelli and Bryan Serino  
 Rutgers, New Brunswick  
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 and Spatial Analysis





# **Marsh Retreat at 1 feet of Sea Level Rise Upper Township**

## **Legend**


 Municipality


 Schools

 Fire Stations

 Law Enforcement


 Assisted Living


 Hospitals

 Evacuation Routes


## **Marsh Retreat at 1ft SLR**

 Unimpeded Marsh Retreat Zone

 Impeded Marsh Retreat Zone

 Marsh Conversion: Unconsolidated Shore

 Marsh Conversion: Open Water

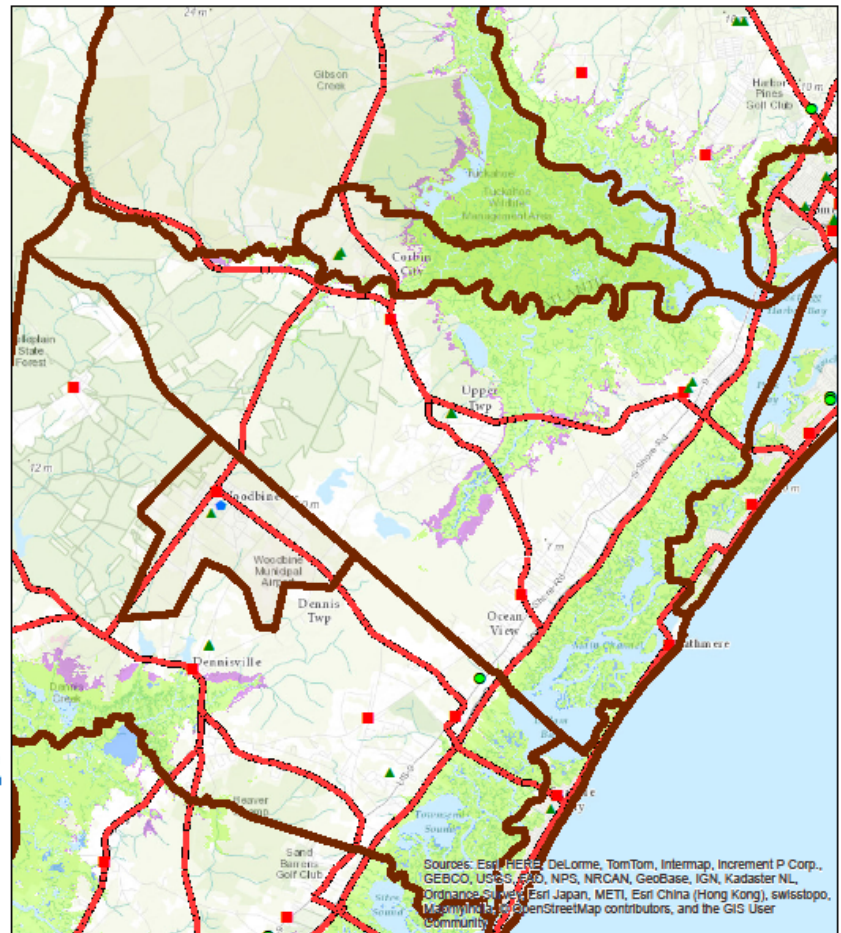
 Unchanged Tidal Marsh

0 1 2 4 Miles

Year 2010 Population: 12373

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts the marsh retreat caused by sea level rise centered on target municipalities.


Map Author: Rachael Sacatelli  
Rutgers, New Brunswick  
Center for Remote Sensing  
and Spatial Analysis





# **Marsh Retreat at 2 feet of Sea Level Rise Upper Township**

## **Legend**


 Municipality


 Schools

 Fire Stations


 Law Enforcement


 Assisted Living


 Hospitals

 Evacuation Routes


## **Marsh Retreat at 2ft SLR**

 Unimpeded Marsh Retreat Zone

 Impeded Marsh Retreat Zone

 Marsh Conversion: Unconsolidated Shore

 Marsh Conversion: Open Water

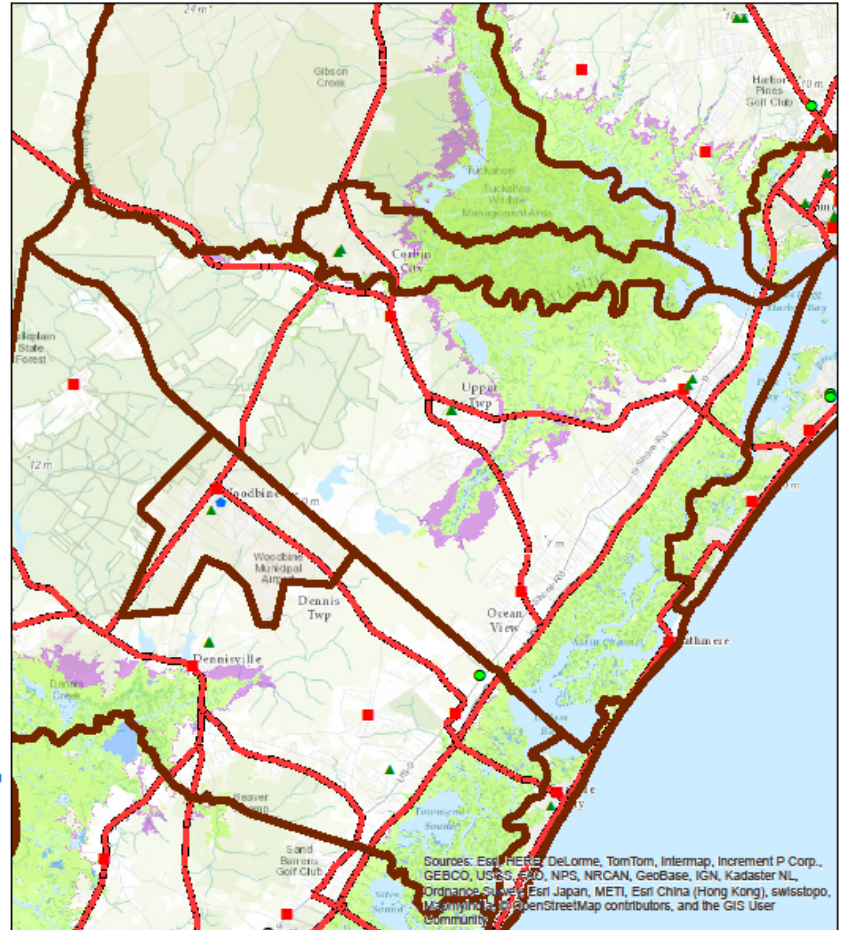
 Unchanged Tidal Marsh

0 1 2 4 Miles

Year 2010 Population: 12373

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts the marsh retreat caused by sea level rise centered on target municipalities.

Map Author: Rachael Sacatelli  
Rutgers, New Brunswick  
Center for Remote Sensing  
and Spatial Analysis








# **Marsh Retreat at 3 feet of Sea Level Rise Upper Township**

## **Legend**


 Municipality


 Schools

 Fire Stations

 Law Enforcement


 Assisted Living


 Hospitals


 Evacuation Routes


## **Marsh Retreat at 3ft SLR**

 Unimpeded Marsh Retreat Zone

 Impeded Marsh Retreat Zone

 Marsh Conversion: Unconsolidated Shore

 Marsh Conversion: Open Water

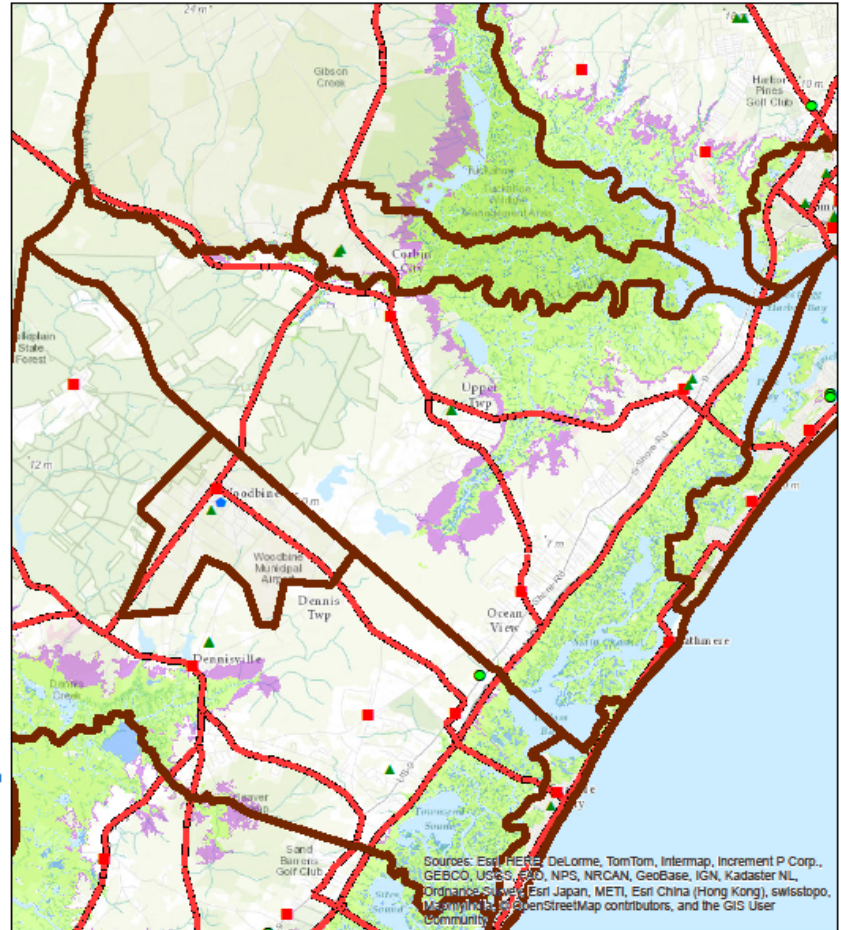
 Unchanged Tidal Marsh

0 1 2 4 Miles

Year 2010 Population: 12373

According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts the marsh retreat caused by sea level rise centered on target municipalities.

Map Author: Rachael Sacatelli  
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Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, Mapbox, Swisstopo, OpenStreetMap contributors, and the GIS User Community

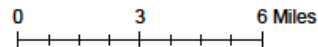
# **FEMA's PFIRM Flood Zones for New Jersey Upper Township**

## **Legend**

- Municipality
- ▲ Schools
- Assisted Living
- Law Enforcement
- Hospitals
- Fire Stations
- Evacuation Routes

## **PFIRM**

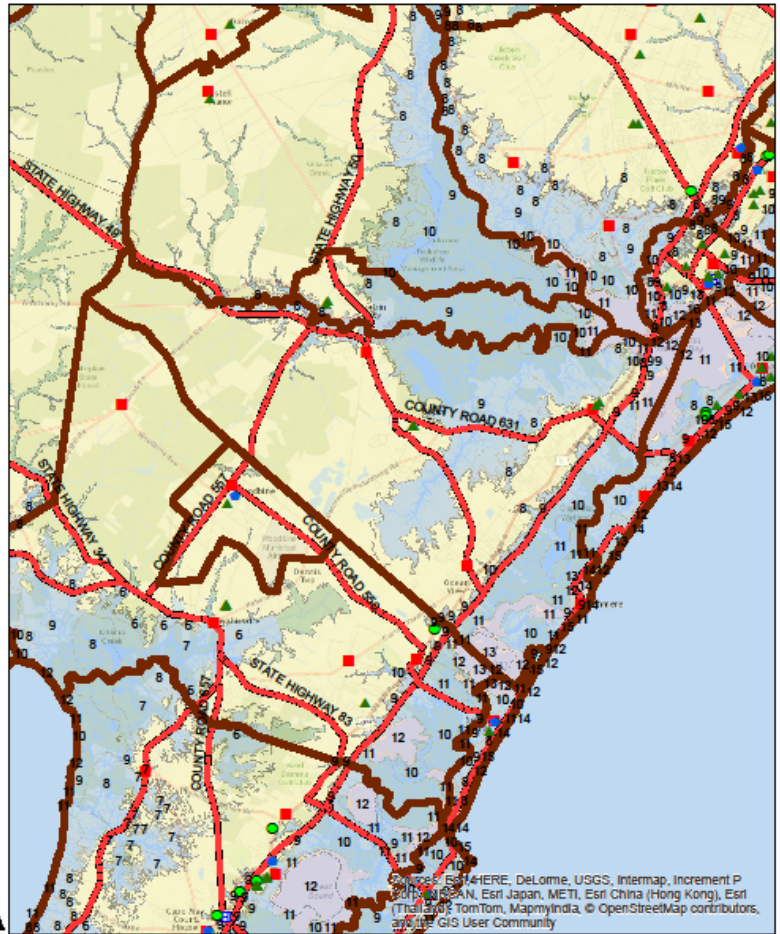
- Zone X - 0.2% Annual Chance
- A
- AE
- AO
- D
- VE



Year 2010 Population: 12373

This map shows the extents of FEMA's latest flood insurance rate maps for the state of New Jersey. The numerical label in the zones portrays the static ABFE zone. Please refer to the index for more information.

Map Authors: Rachael Sacatelli and Bryan Serino  
Rutgers, New Brunswick  
Center for Remote Sensing  
and Spatial Analysis



Sponsors: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, MNP, NGCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, Mapbox India, Swatch, General Map, © Swatch, and the GIS User Community

## **Upper Township/Strathmere Historical Erosion Data**

### **An Assessment of Cape May County Beaches at the New Jersey Beach Profile Network (NJBPN) Sites After Hurricane Sandy Related to (DR-NJ 4086)**

#### Introduction:

The Richard Stockton College of NJ Coastal Research Center (CRC) has initiated a post-storm survey and assessment of the New Jersey shoreline in response to severe beach erosion resulting from the impact and landfall of Hurricane Sandy October 29, 2012. Declared a Federal Disaster by President Obama on October 31, 2012, this information is being prepared to show the general trend of beach/dune loss between the Delaware Bay on the west shore of Cape May County around the Point, and up the coast to Ocean City. The analysis for the 31 survey sites starting at Reeds Beach, moving around Cape May Point and up the oceanfront to Ocean City, NJ was completed November 26, 2012. Beachfront clean up work was all but complete in most locations because all of Cape May County was south of the point of landfall for the storm. The consequence was that the second high tide was opposed by the southwest wind on the back side of the storm; therefore the surge was up to 10 feet lower than documented in Long Branch. This initial report is focused on the impact to municipal dunes and beaches from Hurricane Sandy. All of the Cape May NJBPN sites were surveyed earlier in the fall, so site was re-surveyed to wading depth to get as much information as fast as possible. In the spring of 2013, the normal long profiles will be run to see longer term comparisons with the spring of 2012 conditions.

#### Beach/Dune Damage Assessment by Municipal and Island Segment:

To measure the erosion, pre-existing New Jersey Beach Profile Network (NJBPN) monitoring sites were used to provide an accurate comparison and assessment of storm related shoreline and beach volume changes. Using the data from the fall 2012 NJBPN survey, completed in Cape May County by October 19, 2012, provides a good baseline for damages that occurred during the hurricane. Data collected at the 31 beach profile locations was done between November 12 and 26, 2012 using RTK GPS and extended from the reference location, across the dunes, beach and into the surf to wader depth. By Nov. 12th, it was clear that sand recovery was well under way as a berm had been deposited on the erosional surface generated by Sandy with a substantial offshore bar present in water less than 5 feet deep offshore. Very little sand in the oceanfront locations had been washed inland beyond the dunes. Exceptions were found in Ocean City, Sea Isle City, and at the Reeds Beach site. A gap in the dunes at the point where Cape May City borders the Nature Conservancy lands also saw wave damage to a few structures.

Profile Locations: The following sites were surveyed during September and October 2012 and post-Sandy by November 26, 2012 (Figure 1).

NJBPN 100 Reeds Beach, Middle Township NJBPN 115 35th St., Avalon  
NJBPN 201 Pacific Ave. Villas NJBPN 116 23rd St., Avalon  
NJBPN 102 Whitter Ave. No. Cape May NJBPN 216 9th St., Avalon  
NJBPN 103 Higbee Beach State Park NJBPN 117 80th St., Sea Isle City  
NJBPN 104 Lake Dr. Cape May Point NJBPN 118 57th St., Sea Isle City  
NJBPN 105 Nature Conservancy, Cape May NJBPN 119 25th St., Sea Isle City  
NJBPN 206 Broadway Ave. Cape May NJBPN 120 1st St., Sea Isle City  
NJBPN 107 Baltimore Ave. Cape May NJBPN 121 Williams Road, Strathmere  
NJBPN 108 Cape May Beach Club NJBPN 221 Corson's Inlet Park, Ocean City  
NJBPN 208 USCG Base, Lower Township NJBPN 222 59th St., Ocean City  
NJBPN 109 Raleigh Ave., Lower Township NJBPN 122 56th St., Ocean City  
NJBPN 110 Cresse Ave., Wildwood NJBPN 223 34th St., Ocean City  
NJBPN 111 15th Ave., North Wildwood NJBPN 124 20th St., Ocean City  
NJBPN 212 121st St., Stone Harbor NJBPN 125 6th St., Ocean City  
NJBPN 113 90th St., Stone Harbor NJBPN 225 Gardens Road, Ocean City  
NJBPN 114 70th St., Avalon

\*Below is a map showing the location of each profile.

Western Delaware Bay Shoreline of Cape May County;

Between Reeds Beach and Cape May Point, the western shoreline of Cape May County suffered from the backside of Hurricane Sandy after the storm made landfall on the New Jersey shoreline. The wind direction reversed and came across the storm-surge flooded Delaware Bay with 4-foot waves with very short periods. Due to the high water levels these waves pounded dunes and made low-lying areas subject to inundation, wave damage and loss of some structures. Reeds Beach was hit hard because there was no bluff, and a minimal dune system. The region is basically a narrow sand beach, low dune all as a barrier on and seaward of the salt marshes. Sand was pushed across the service road to Bidwell Creek and the majority of the dredge material pumped from the creek project two years ago was moved inland onto the salt marsh lying between Reeds Beach homes and the Cape May County mainland. To the south, the bluff of the county uplands is mantled with dune sand and made a better barrier. Erosion took some dune and moved the zero elevation position toward the bay because the beach/dune slope was reduced in gradient allowing sand to deposit on the terrace that extends over 1,000 feet into the Delaware Bay from Villas and North Cape May. This wide terrace is the geological result of long, slow erosion of the bluff by bay waves. Higbee Beach, a natural area, suffered bluff erosion and beach retreat, but on a minimal scale. Cape May Point had sand moved up



onto the highest parts of the dry beach and suffered minimal dune losses from the bay side around to the oceanfront beach.

#### Cape May City;

The approach direction of the ocean waves, deflected somewhat by Cold Springs Inlet jetties and the south, southwest orientation of the shoreline acted to pile sand from the beachface landward onto the backshore beach into the dune vegetation. The Cape May beaches all gained berm sand at the expense of beachface retreat. Only the short segment between the Third Avenue groin and the Nature Conservancy suffered inundation largely because building a decent sized dune was resisted by the adjacent property owners.

#### The Wildwoods;

The same process appeared to be working at 3 of 4 cross sections between the natural area and North Wildwood, with the 15th Street site not performing as did the Wildwood site at Cresse Avenue. The Cresse berm became 2 feet higher with a ridge over 100 feet wide created from beachface sand pushed up on top of the back berm region of the beach. At the 15th Avenue site in North Wildwood another signature result from Sandy appeared with the deposition of a sand ramp deposited up the seaward slope of the primary dune. It appears that when the dry beach is deeply flooded by a storm surge, the waves break on the submerged beachface slope, excavating abundant sand that the broken wave bores transport across the berm, and deposit it where they run up the dune slope. If the waves do not breach the dunes, they deposit beach sand as a ramp at the seaward toe of the dune. Where a hard structure presents an effective wave barrier, this ramp was likewise deposited and in some cases effectively enabled the waves to run-up and over the hard structure. The example of this was seen at the Sea Bright seawall in Monmouth County.

#### Avalon & Stone Harbor;

These two communities have been leaders in shore protection by having successfully managed to have Federal shore protection projects constructed and have for years, promoted wider, higher dunes with coordinated development of pedestrian access pathways that do not make a breach easier at street end access points. No instance of dune breaching occurred in either Borough; no waves washed sand into streets or under homes. Dune erosion did occur, but in some cases, the extraordinary width of the dune area allowed Sandy's wave energy to be absorbed within the swales and vegetation of the foredunes arrayed along the mid-section of the barrier island. Elsewhere a wide, relatively high primary dune blocked wave over-topping by just enough to be successful. A major hard structure improvement to the Townsend's Inlet shoreline in Avalon paid dividends by reducing the damage from Sandy to considerably less than was incurred during the December 1992 northeast storm. The worst wave damage occurred to the highway leading to the Townsend's Inlet draw bridge to Sea Isle City.

Sea Isle City & Strathmere;

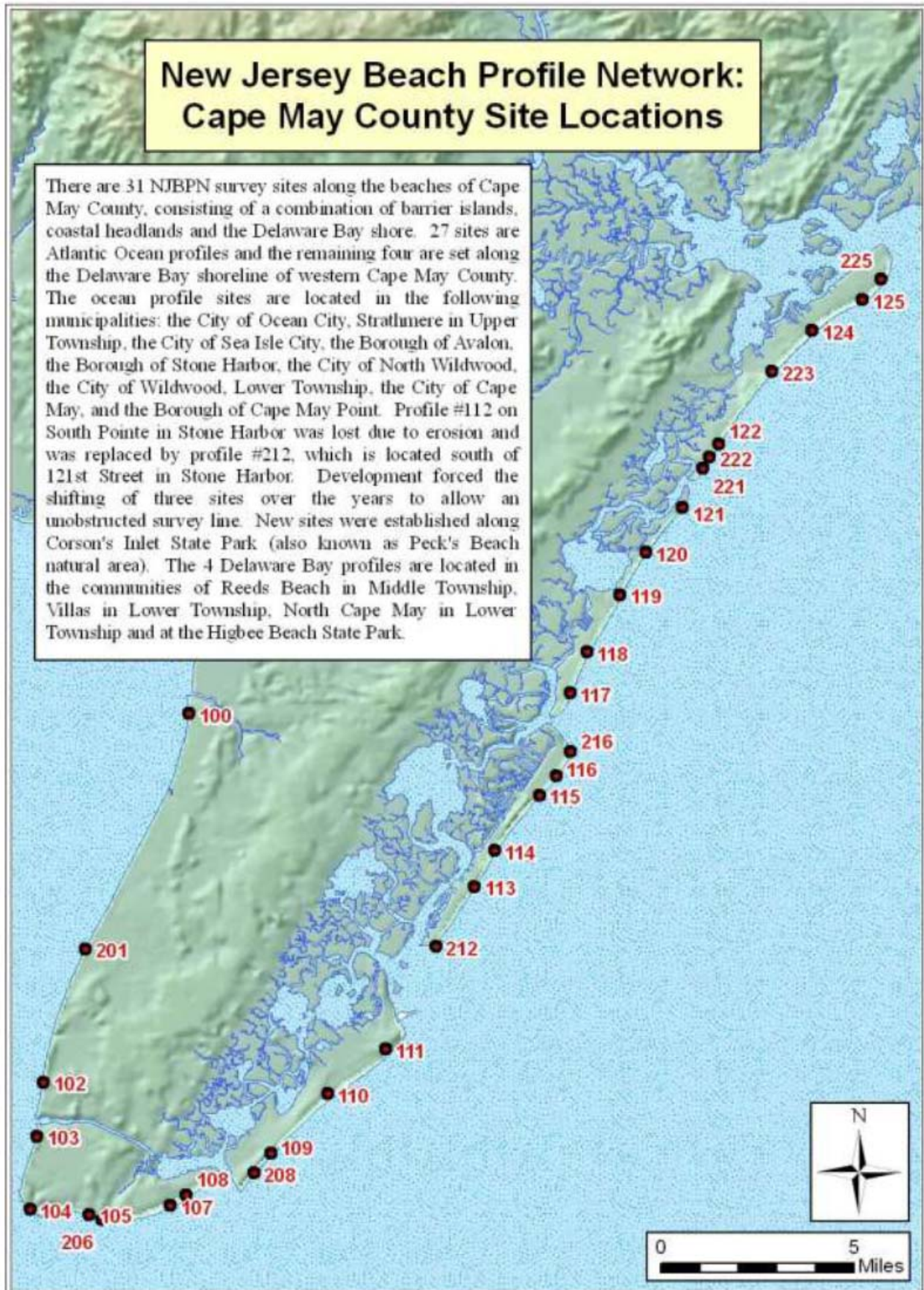
A 2009 NJ State and locally sponsored shore protection project saved these two communities substantial damage expense as well. Previous storms of far less intensity had made a shambles out of the Commonwealth Avenue highway leading through northern Sea Isle City into Strathmere. Sandy produced minor breaching and over-topping, but not nearly the extent of overwash seen previously (1998 for example). There were instances of dune breaching in Sea Isle City, extensive tidal flooding, but no catastrophic structural damage. The project protected Strathmere only allowing a couple of minor instances of waves cresting the dunes. The Corson's Inlet shoreline, a crisis situation in 2008, was un-damaged in spite of being flooded by tidal surge.

Ocean City;

The shore protection was a Federal project (Great Egg Inlet to 34th Street) and a local/State partnership (34th Street to the Corson's Inlet State Park). Two decades of sand redistribution produced results ranging from fantastic through fair to poor. The mid-section of the island had vegetation covering 450 feet of dunes before reaching the dry beach. These areas saw absolutely no wave damage with the storm's energy totally absorbed within the foredune region lying seaward of the primary dune. This was a welcome change from the October 1991 northeast storm where just the boardwalk suffered \$4 million in damage in the 15th to 20th Street region. There has been no damage to this structure since (the initial fill was completed in the summer of 1992 and resulted in no damage in December of 1992 when a worse event than 1991 hit Ocean City). To the north the recently maintained Federal project had a narrow beach between a dune system and the direct frontal assault of the northeast waves during Sandy. With little or no beach to break on, and roll across, the waves pounded with full fury on the dunes immediately. Eroding at rates up to 12 feet horizontally per hour, many sections lost the protection the dune afforded. Sand was washed into the streets; storm surge flooding was made worse by every wave crossing into the city. Structural damage occurred, but not at catastrophic levels. At the southern end of development, the beach had not been maintained as frequently and there was only one fairly narrow line of dunes protecting property. Sandy crossed this line easily and waves flowed against, around and beneath 10 blocks of homes. Damage was considerable with early clean-up focused on moving thousands of cubic yards of sand back to the beach in early November. The Corson's Inlet State Park shoreline south of development in Ocean City suffered dune loss of considerable magnitude. These losses were major increases in loss that had commenced in 2011 with the series of modest northeast storms that commenced in November 2009. The beach had been narrow with spring high tides reaching the near-vertical scarp in the dunes. This slow rate of retreat was greatly accelerated during Hurricane Sandy.

## New Jersey Beach Profile Network: Cape May County Site Locations

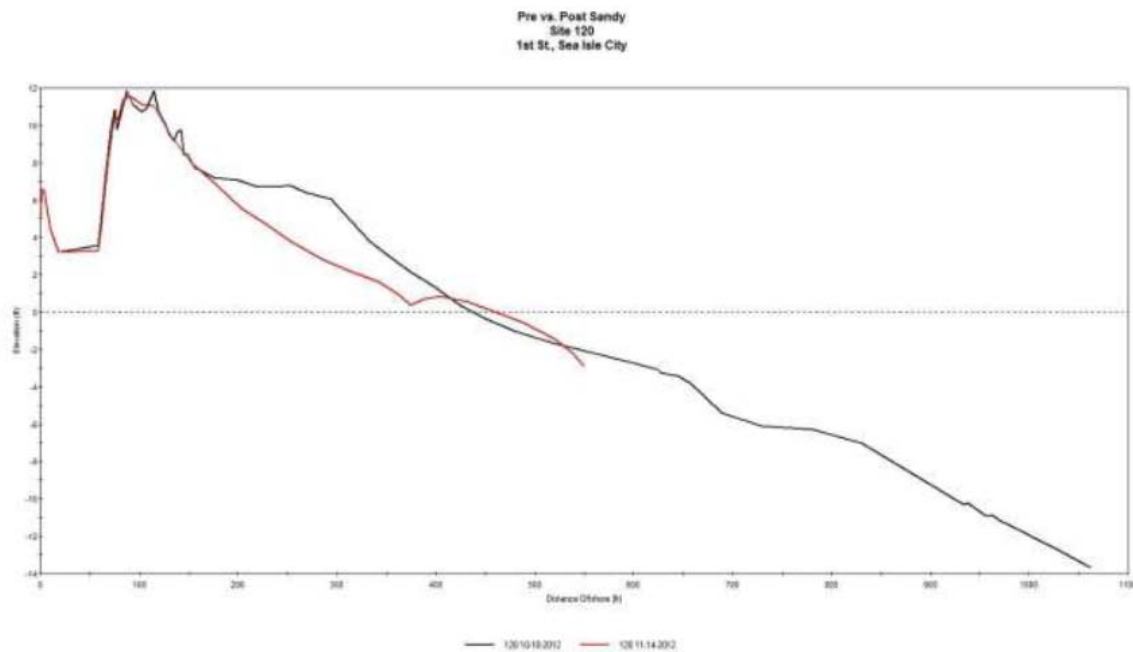
There are 31 NJBPN survey sites along the beaches of Cape May County, consisting of a combination of barrier islands, coastal headlands and the Delaware Bay shore. 27 sites are Atlantic Ocean profiles and the remaining four are set along the Delaware Bay shoreline of western Cape May County. The ocean profile sites are located in the following municipalities: the City of Ocean City, Stratford in Upper Township, the City of Sea Isle City, the Borough of Avalon, the Borough of Stone Harbor, the City of North Wildwood, the City of Wildwood, Lower Township, the City of Cape May, and the Borough of Cape May Point. Profile #112 on South Pointe in Stone Harbor was lost due to erosion and was replaced by profile #212, which is located south of 121st Street in Stone Harbor. Development forced the shifting of three sites over the years to allow an unobstructed survey line. New sites were established along Corson's Inlet State Park (also known as Peck's Beach natural area). The 4 Delaware Bay profiles are located in the communities of Reeds Beach in Middle Township, Villas in Lower Township, North Cape May in Lower Township and at the Higbee Beach State Park.



**1<sup>st</sup> Street, Sea Isle City, Cape May County, Site #120;**



This location is on the boundary between Sea Isle City and Strathmere along the main (and only) road parallel to the ocean. The sand transported into the dune by October 17, 2012 was washed across by Sandy as seen on the left picture on November 14, 2012. Some minor breaching occurred along Commonwealth Avenue, but the dune remained relatively in tact.



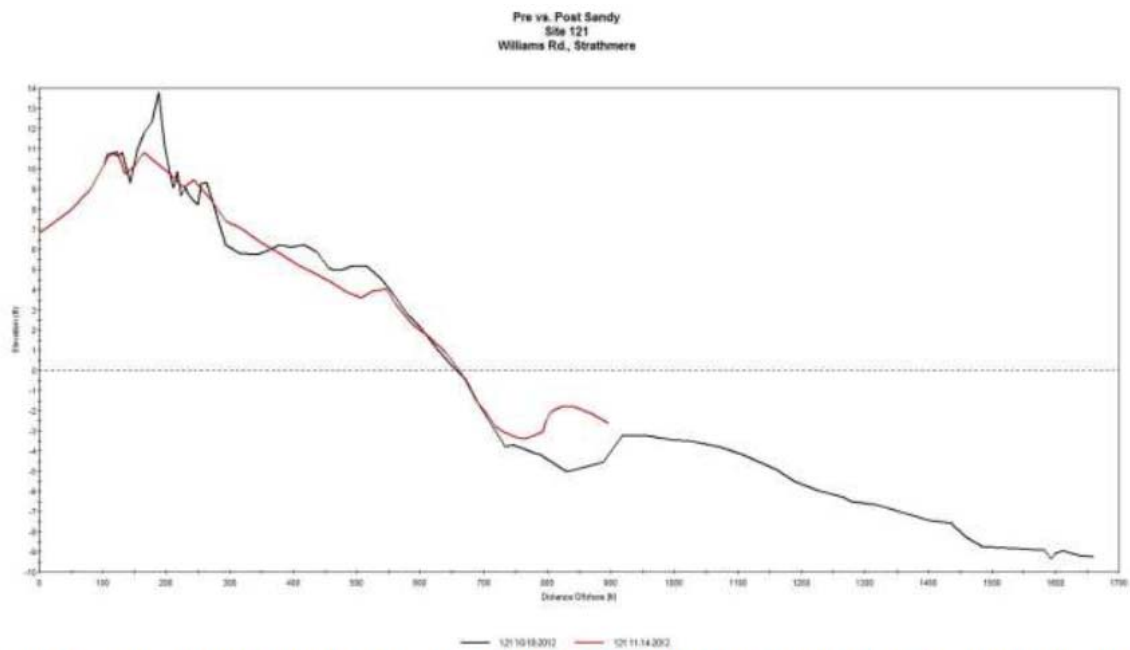
**Figure 24.** The beach was scoured, removing the berm and a large amount of sand that was transported offshore and carried south along the coast. The dunes were just high enough to withstand the wave onslaught without failure.



**Williams Road, Strathmere, Cape May County, Site #121;**



The left picture was taken October 17, 2012 looking across the wide dune zone area seaward of the primary feature. On November 5, 2012 the same view following Sandy shows that the area was flooded by waves that knocked down the highest primary dune, but did not flood the immediate landward area. The beach was flattened by the storm surge. The dune removed was only three feet higher than the post-storm feature however.



**Figure 25.** The cross sections do show the transport of sand offshore as well as the extensive flattening of the beach surface all the way into the dunes. The graph is extremely vertically exaggerated and the dune removed was only 3 feet higher than the surroundings.

### **Summary of Cape May County's Sandy impacts:**

Cape May County's good fortune was greatly assisted by being located south of where the center of Sandy's rotation came ashore in New Jersey. The "eye" passed over northern Atlantic County about 9pm Monday night and produced a rapid change in the wind direction from the north-northeast to southwest. This acted to blunt the impact of the second high tide and reduce the wave height somewhat. Values of the elevation for wave run up on dunes were between 13.5 and 14.5 feet NAVD 88 elevation. This was ten feet lower than similar measurements made in Long Branch, Monmouth County. In addition, many of the Cape May communities had been participants in the Philadelphia Army Corps Shore Protection projects starting in 1989 in Cape May City. Wide beaches with in-depth dune protection provided all the storm-stopping power needed to prevent wave damage and the flooding of the oceanfront streets with sand. A few places suffered mostly due to narrow beaches unable to limit wave impacts on the dunes. The horizontal erosion rates during Sandy were sufficient to cut through and produce overwash into Ocean City in spots, Sea Isle City in a few places, and in Wildwood where there was no dune to stop the water in spite of having the widest municipal beach in New Jersey. In 2009 a dune was incorporated into a beach restoration design for a NJ State – locally sponsored project with the City of North Wildwood. This dune served to demonstrate the difference in wave damage dunes yield even for a community with an extremely wide natural beach.

The table below shows the sand volume change between either the earlier fall survey at each site or the spring 2012 survey (natural sites) and the post-Hurricane Sandy survey.

<i>Cape May County Post-Sandy Site Volume Changes</i>				
Site Location and Number	NJBPN Site #	Site Sand Volume Change (cu yds/ft)	Dune Failure (Y or N)	Date of Recent Beach Fill
Ocean City	225	-31.39	Y	2010
Ocean City	125	-37.19	Y	2010
Ocean City	124	-15.25	N	2010
Ocean City	223	-18.24	N	2010
Ocean City	122	-27.45	Y	1995
Ocean City	222	-40.81	Y	1995
Corson's Inlet S Park	221	26.11	Y-Partial	Never
Strathmere	121	5.70	N	2012
Sea Isle City	120	-16.46	N	2012
Sea Isle City	119	-29.57	N	2012
Sea Isle City	118	-31.43	Y-partial	2009
Sea Isle City	117	-33.99	N	2009
Avalon	216	-26.79	N	2011
Avalon	116	-21.38	N	2012
Avalon	115	-6.95	N	Never
Avalon	114	-15.26	N	2011
Stone Harbor	113	-24.37	N	2011
Stone Harbor	212	-17.41	N	2011
North Wildwood	111	-18.94	N	2011
Wildwood	110	-1.34	No Dune	Never
Lower Township	109	-10.83	N	Never
Lower Township	208	29.08	N	Never
Cape May City	108	22.47	N	2010
Cape May City	107	15.34	N	2010
Cape May City	206	-3.34	N	2010
Cape May Nature Con	105	-16.04	N	2011
Cape May Point	104	-5.08	N	2010
Higbee Beach S Park	103	3.91	N	Never
North Cape May	102	-8.74	N	Never
Villas	201	3.57	N	Never
Reeds Beach	100	-3.56	Y	2010

*Cape May County Post Sandy Volume Changes*

MUNICIPALITY	NJBPN Site#	Vol Change cu yds per ft	Average of Sand Loss Between Adjacent Sites (cy/ft)	Dune Failure	Recent Beach Fill	Distance Between Sites (FEET)	Vol Change - Cubic Yards Between Profiles (South to North)	Cumulative Volume Change Cubic Yards (South to North)
Ocean City	225	-31.39	To Inlet	Y	2010	1,006	-31,578	-31,578
Ocean City	125	-37.19	-34.29	Y	2010	3,820	-130,997	-162,576
Ocean City	124	-15.25	-26.22	N	2010	8,108	-212,591	-375,166
Ocean City	223	-18.24	-16.74	N	2010	7,885	-132,027	-507,193
Ocean City	122	-27.45	-22.85	Y	1995	12,271	-280,328	-787,521
Ocean City	222	-40.81	-34.13	Y	1995	2,264	-77,287	-864,808
Corson's Inlet S Park	221	26.11	-7.35	Y-Partial	Never	1,739	-12,786	-877,593
Strathmere	121	5.70	15.90	N	2012	1,241	19,733	-857,861
Sea Isle City	120	-16.46	-5.38	N	2012	7,961	-42,834	-900,694
Sea Isle City	119	-29.57	-23.02	N	2012	6,824	-157,057	-1,057,752
Sea Isle City	118	-31.43	-30.50	Y-partial	2009	9,078	-276,889	-1,334,641
Sea Isle City	117	-33.99	-32.71	N	2009	6,087	-199,107	-1,533,747
Avalon	216	-26.79	-30.39	N	2011	500	-15,195	-1,548,942
Avalon	116	-21.38	-24.08	N	2012	3,921	-94,442	-1,643,385
Avalon	115	-6.95	-14.16	N	Never	3,482	-49,314	-1,692,699
Avalon	114	-15.26	-11.10	N	2011	9,780	-108,606	-1,801,305
Stone Harbor	113	-24.37	-19.81	N	2011	5,633	-111,605	-1,912,910
Stone Harbor	212	-17.41	-20.89	N	2011	9,833	-205,405	-2,118,315
North Wildwood	111	-18.94	-18.17	N	2011	3,582	-65,099	-2,183,414
Wildwood	110	-1.34	-10.14	No Dune	Never	9,987	-101,239	-2,284,653
Lower Township	109	-10.83	-6.08	N	Never	11,296	-68,718	-2,353,371
Lower Township	208	29.08	9.12	N	Never	3,638	33,198	-2,320,174
Cape May City	108	22.47	25.78	N	2010	5,757	148,387	-2,171,787
Cape May City	107	15.34	18.91	N	2010	2,667	50,424	-2,121,363
Cape May City	206	-3.34	6.00	N	2010	9,470	56,841	-2,064,522
Cape May Nature Con	105	-16.04	-9.69	N	2011	1,736	-16,819	-2,081,341
Cape May Point	104	-5.08	-10.56	N	2010	8,393	-88,616	-2,169,957
Higbee Beach S Park	103	3.91	-0.58	N	Never	9,934	-5,801	-2,175,758
North Cape May	102	-8.74	-2.41	N	Never	7,008	-16,914	-2,192,672
Villas	201	3.57	-2.58	N	Never	19,154	-49,484	-2,242,156
Reeds Beach	100	-3.56	0.01	Y	2010	35,265	282	-2,241,874

Figure 33. This table illustrates the changes in sand volume for the 31 Cape May County beach sites with the sand volume for the beach/dune part of the profile in cubic yards of sand per foot of shoreline at that site. The distance between sites (not counting inlets) allows an estimate of sand volume lost between profile locations that are compiled for the entire county in the right-hand column. Local site sand volumes in RED denote locations where Sandy added sand to the beaches and dunes.



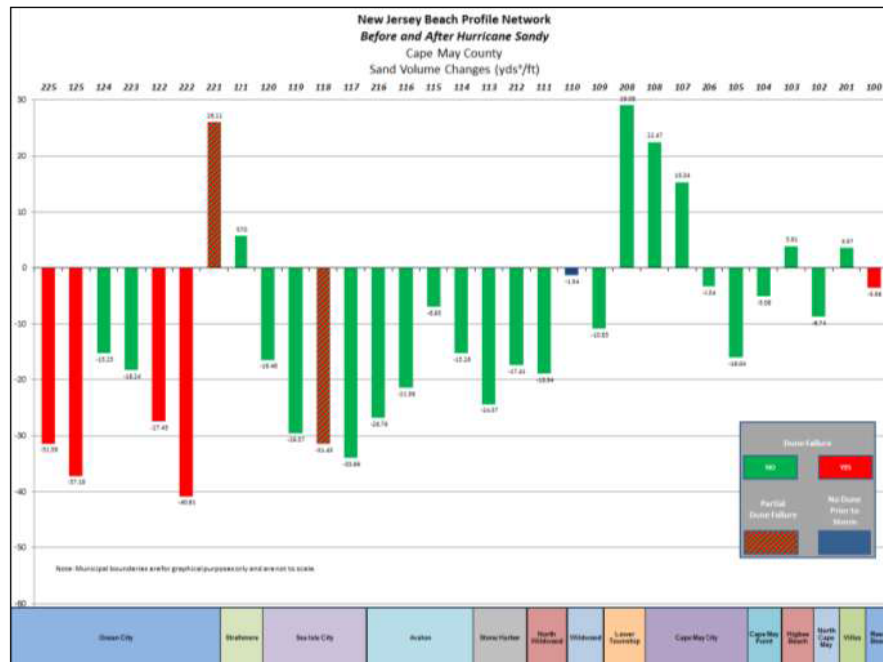


Figure 34. This graphic shows the sand volume loss figures for each of the communities within the developed sections of the Cape May County shoreline. Federal shore protection projects have occurred along this portion of the New Jersey shoreline in Ocean City, Strathmere, Sea Isle City, Avalon, Stone Harbor, North Wildwood, Cape May City, and Reeds Beach. The engineered beach and dune systems have been maintained by the USACE recently and withheld the storm generated waves from breaching the dunes. All sites experienced berm erosion and dune losses except for site 221 Corson's Inlet State Park, which is undeveloped, site 121 in Strathmere, which recently completed a beach nourishment project, sites 208 Cape May National Wildlife Refuge, sites 108 and 107 in Cape May City, where the orientation of the storm and location of landfall actually created long period swell waves that built up the beach. There were also moderate gains at site 103 in Hightstown Beach State Park and site 201 in the Villas, which is located in the Delaware Bay. True dune failures occurred in Ocean City, where the greatest sand volume losses also occurred and overwash of waves transported sand landward of the beach.

## **Cape May County 25 Year Report**

### **CAPE MAY COUNTY -- SUMMARY**

Hurricane Irene was the first hurricane to cross the NJ coastline since 1903 (not counting Hurricane Gloria in 1985 that passed from west to east). A post-storm re-evaluation of the wind field showed that Irene's maximum sustained winds had just dropped below 75 MPH as she crossed the shoreline, making her a Tropical Storm at the point of coastal transit. While the storm impacts were less than everyone anticipated, evacuation efforts were instituted for all of Cape May County residents with 90% compliance. Beach damage was evident, but confined to the summer berm and dry beach and some dune toe loss, but no breaches or overwash occurred.

Hurricane Irene had some impact on Cape May County beaches, but not nearly as severe as the winter northeast storms of 2009 and 2010. A storm in November 2009 started a series of events leading to three Federal disaster declarations, and when two major NJ State and locally sponsored beach restoration projects became eligible for Category "G" disaster assistance funding. In fact the 2009 project in the City of North Wildwood was not quite finished when the November 2009 storm occurred. The other site was the Strathmere and Sea Isle City shoreline on Ludlam Island. Several blocks in the Borough of Avalon also qualified for damage relief for dune loss. FEMA funds are not allowed for any of the federally authorized shore protection projects, so Ocean City, most of Avalon and Stone Harbor, and Cape May City were not eligible for FEMA disaster relief funds.

The US Army Corps found funds from several Coastal Recovery sources to return to their projects in Ocean City, Avalon, Stone Harbor, and Cape May City to add sand between 2009 and 2012. The Corps also completed a reconstruction of the Avalon Townsend's Inlet seawall in the past 5 years. The State provided assistance for the Hereford Inlet seawall in the City of North Wildwood.

Many of the beach changes in the past 18 months were positive in Cape May County with the average profile sand volume change amounting to 15.37 yds<sup>3</sup>/ft. and a shoreline average change of a 34.5-foot advance seaward for the zero elevation position. These changes result from the placement of sand in Ocean City (ACOE maintenance), Upper Township & Sea Isle City (NJ State/local maintenance with FEMA reimbursement), Avalon (sand back-passing), Stone Harbor (ACOE emergency maintenance), North Wildwood (FEMA reimbursed restoration from Hurricane Irene damage as back-passing) and in Cape May City as emergency ACOE maintenance. This nearly county-wide work effort shows in the averages for the entire shoreline.

Beach nourishment derived from inlet shoals, truck-haul from quarries or offshore borrow sites has resulted in Cape May County having the most highly modified coastline along the New Jersey coast. There are five coastal projects involving Federal cooperation with the State of New Jersey and the local municipality. These are Ocean City (northern two thirds of the island), Avalon, Stone Harbor, Cape May City, and Cape May Meadows/Cape May Point. The balance of Peck's Beach (Ocean City) is a NJ State/local project. The State also concluded beach nourishments in the City of North Wildwood, the Township of Upper, and Sea Isle City in 2009. Reeds Beach on Delaware Bay was a State project creating beach restoration as a side benefit from a navigation improvement at Bidwell Creek. The Federal Cape May western shoreline project (29,000 feet Villas & Vicinity) is an ecological restoration project primarily to benefit migratory shorebirds and horseshoe crab egg-laying with a one-time beach restoration. This project continues to wait for sufficient funding.

Storm damages inflicted on the Cape May County shoreline between October 2009 and March of 2010 were addressed with restoration projects in North Wildwood, Avalon, Sea Isle City and Upper Township (Strathmere). Hurricane Irene impacts were remedied with two novel efforts at back-passing surplus sand from zones where accretion dominates the processes in the Borough of Avalon and the City of North Wildwood. Avalon acquired permits to move 63,000 cubic yards of sand from two segments of the island between 70th and 31st Streets with a substantial exclusion zone between two sites where permits allowed excavation. The exclusion zone was required by the US Fish & Wildlife service to preclude any impact on nesting or foraging by piping plovers, an endangered species both State and Federally. The City of North Wildwood cooperated with the Borough of Wildwood Crest (by agreement with the City of Wildwood) to excavate up to 96,000 cubic yards of sand from the berm along the Borough oceanfront and truck this surplus north through Wildwood and deposit it within a footprint where Hurricane Irene-generated erosion had produced that quantity of documented loss. Ninety-three thousand (93,000) cubic yards of sand were moved by mid-May 2012 and graded into a dune toe deposit and a wider recreational beach between 3rd and 7th Avenues. The North Wildwood project required permits from the Army Corps plus modifications to State permits held by the two municipalities allowing beach nourishment and surplus sand removal to the dunes. The permit modifications revolved around an alternative sand source and means of placement (trucks) in North Wildwood and an alternative disposal site in the case of Wildwood Crest (moving it to North Wildwood instead of into the dune system in Wildwood Crest).

Two new survey sites were established in Cape May County to improve the oceanfront coverage. They were placed in the Peck's Beach natural area, known as Corson's Inlet State Park to follow changes to the southern mile of the barrier island shore. (Site #'s 222 and 221 were located south of the fishing pier (#222) and closer to Corson's Inlet (#221)). These sites

have not been included in the long-term trend analysis since only two years of record exist thus far.

Other notable municipal projects include the efforts by the Borough of Avalon which completed a 650,000 cubic yard restoration of the beach between 10th and 28th Streets using Townsend's Inlet sand. Sand was pumped onto the Ocean City beaches in 2009. In early 2011 450,000 cubic yards of sand was distributed among the City of Cape May (120,000 cy), Cape May Meadows (165,000 cy), and 50,000 cy for two beach cells in the Borough of Cape May Point. This laundry list of projects makes this county the most varied and diverse in the State in terms of beach restoration and maintenance. Most of the sediment supply comes from four of the five tidal inlets in Cape May Co., with the offshore supplying Cape May City and Cape May Point.

The US Army Corps of Engineers returned to Cape May County twice during 2010 and provided maintenance beach sand on the shorelines of Cape May City (120,000 cu. yds.), Cape May Meadows (165,000 cu. yds.) and Cape May Point (55,000 cu yds.). Ocean City received 1.4 million cubic yards of additional sand by March 2010. The passage of a new Water Resources Development Act in 2007 included authorization for the continuation of existing projects and the implementation of two new ocean beach projects in Cape May County, but Congress did not appropriate the money to fund the work in FY 08, FY 09, or FY 10, which ended September 30, 2010. "Stimulus money" cannot be spent in FY 10 for beach restoration work without special Congressional budgetary "Add-ons" for such work. The ACOE has funding to continue monitoring of existing projects and to up-date studies (Limited Re-evaluation Report) of designs, costs and benefits for proposed projects. In 2011 the Corps added 625,000 cubic yards of sand to the Avalon and Stone Harbor project. As the chart below indicates, this effort since 1989 has produced a net gain of over 16.5 million cubic yards of sand along the Cape May County shoreline.

The success of using large-capacity, off-road trucks to haul sand from zones of documented surplus to more erosional sections of the coast has made this a new idea worthy of regional application. The mobilization for the job is less than a tenth of that for an ocean dredge and distribution pipeline. The sand hauling cost is equal to or less than the pumping rate from recent dredge projects (\$8.50/cubic yard). The borrow area impacts to the sea bed are eliminated. The issues appear to revolve around apprehension on the part of reviewers concerned with possible impacts to endangered species using the dry beach for nesting and the swash zone for foraging. The Borough of Avalon was required to repetitively sample the sand prior to and subsequent to the 2012 backpassing effort across the two borrow sites and the exclusion zone to see if any detriment came to the prey the endangered species feed on. The project received questions of concern from a small number of beachfront homeowners worried about impacts to the quality of the resulting beach and the impact of taking sand from in front

of their property would have on potential storm damage. Work was included in both the biological review and beach recovery surveys to address both of these issues for future use of this “sand recycling” methodology.

The 25-year assessment for Cape May County finds that the multiple episodes and variety of beach restoration projects has had a significant improvement on the quality, shore protection value and recreational use of the county beaches. The commercial boardwalk segment of Ocean City has undergone a major economic renaissance since 1992 with vast improvements to shore protection extending all the way to 56th Street. The profile site at 20th Street has seen the high tide line shifted from landward of the boardwalk in 1991 to over 600 feet seaward (450 feet to the toe of the dune vegetation) over the past 21 years.

The community of Strathmere was saved from serious structural loss in 2009 with the NJ State and local project and an extremely narrow and vulnerable shoreline section (Whale Beach) was reinforced with a much wider beach and dune system. Sea Isle City received sand from Corson’s Inlet in 2009 and as a restoration effort in 2011.

The Borough of Avalon continues a 25-year history of beach management employing multiple innovative concepts since the 1993 installation of a beach-saver reef system and inlet geo-textile submerged breakwaters. Cape May City is another example where the Federal project restored a shoreline to far greater economic stability and prosperity than existed in 1989. The Baltimore Avenue beach consisted of water at the seawall at low tide with no usable beach at all. Today there is a 350-foot wide beach and dune system the length of the City oceanfront. North Wildwood, with a 1,000-foot wide dry beach in 1994 found that erosion has many sources and forms, applied for and received NJ State assistance from the Shore Protection Act funds and restored approximately half the sand lost to the communities to the south and into Hereford Inlet. Very recent studies of Hereford Inlet indicate that significant changes to the main tidal channels cutting through the ebbtidal delta system could have profound impacts on the adjacent island shoreline associated with inlet processes. The traditional main ebb channel has competition from a new channel that exists between Stone Harbor’s South Point and a highly variable sand island locally called Champaign Island. If the new channel becomes dominant, the North Wildwood inlet shoreline and northern oceanfront beach will experience major sand accumulation in the next 18 months.

The Cape May Point 227 experimental reef project continued to have a positive impact on the shorelines of those cells where the concrete structures were placed between groins defining the two cells. Work for the Borough of Cape May Point has verified the sand retention properties of these structures in that type of installation. Sand has also migrated westward to

the two groin cells not involved in either breakwater installation or direct sand placement. This has been very beneficial for the Borough.

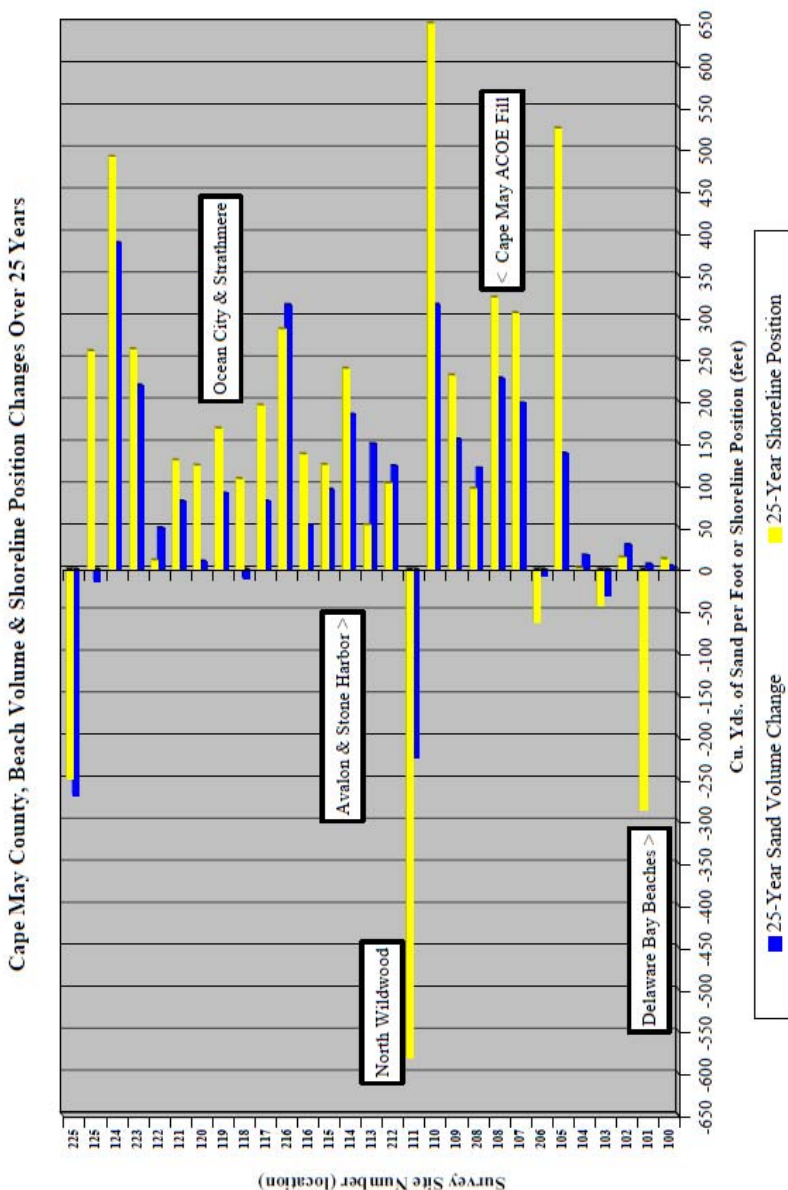


Figure 304.

Summary of 25 years of beach research in Cape May County. The sites located on the north end of each barrier island have an erosional tendency (especially #111 in North Wildwood). Multiple beach nourishment projects have given Cape May County a strong positive change value in both sand volume and shoreline position. The 5 Delaware Bay cross sections have much smaller magnitude change rates.

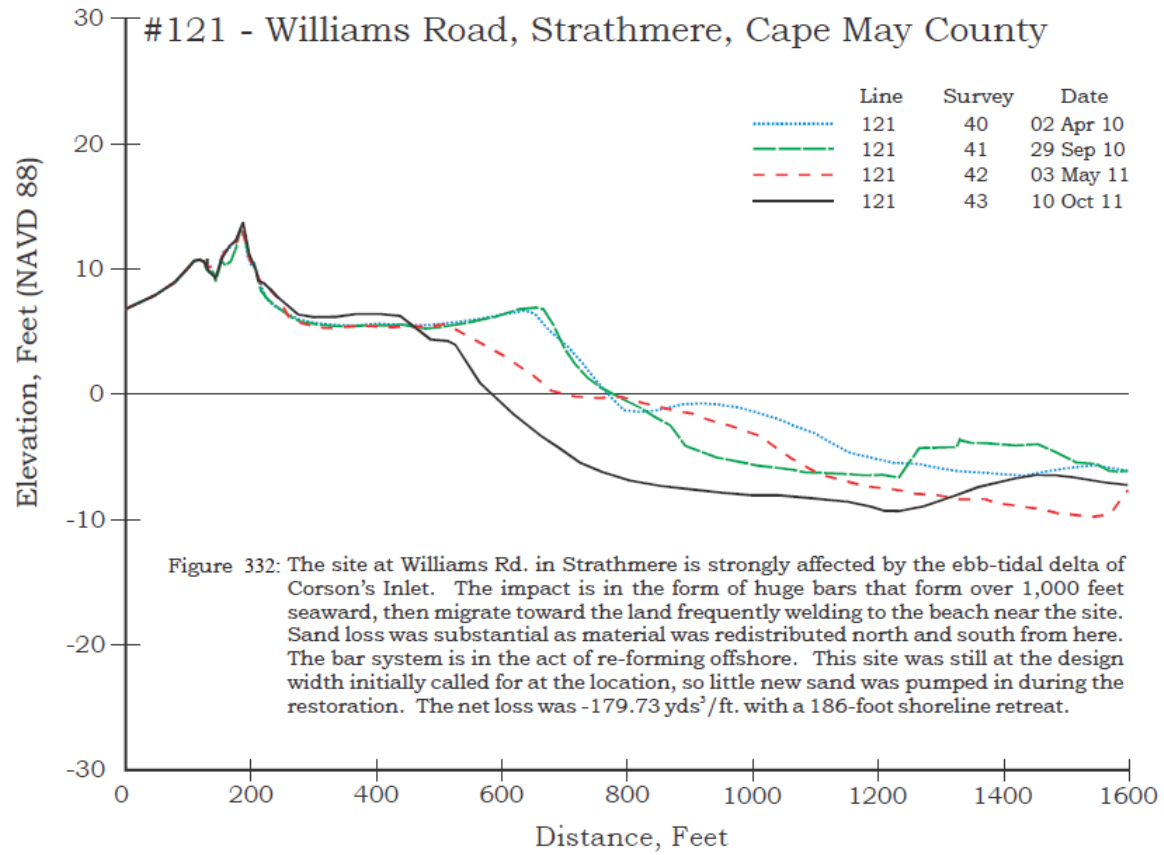
**Site 121, Williams Road, Strathmere, NJ – May 3, 2011**



**Figure 331. North view of the northern portions of the Strathmere beaches along the seaward dune slope.**



## New Jersey Beach Profile Network



## WILLIAMS ROAD, STRATHMERE – SITE 121

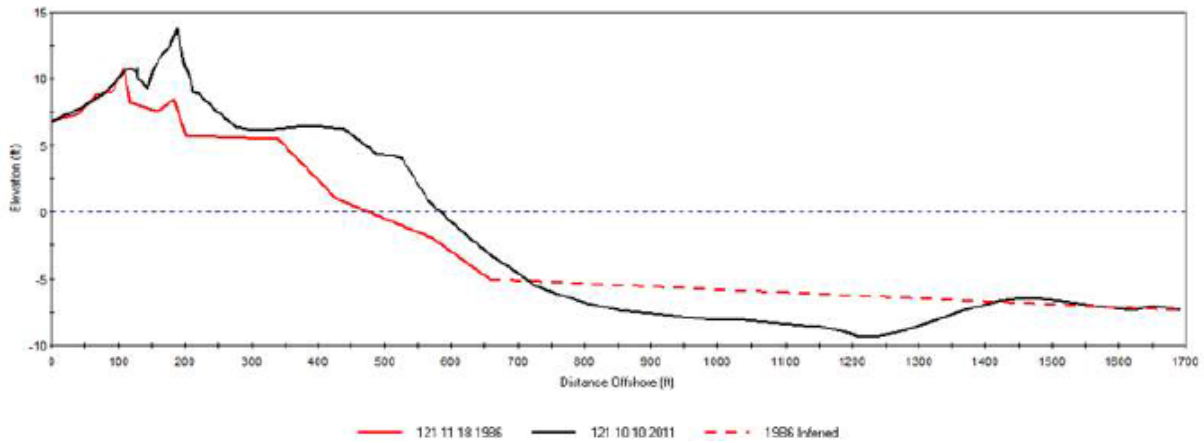


Figure 333: There have been three State/locally sponsored projects in Strathmere (1984, 2001, and 2009) that have enabled dune and beach growth for the 25 year period. Overall cumulative sand volume gains of 61.49 yds<sup>3</sup>/ft and a shoreline advance of 109 feet were recorded. Photo on left taken in 1988. View to the north. Photo on right taken October 10, 2011. View to the north.



# 25-Year Coastal Changes at Site 121, Williams Road, Strathmere, Cape May Co.

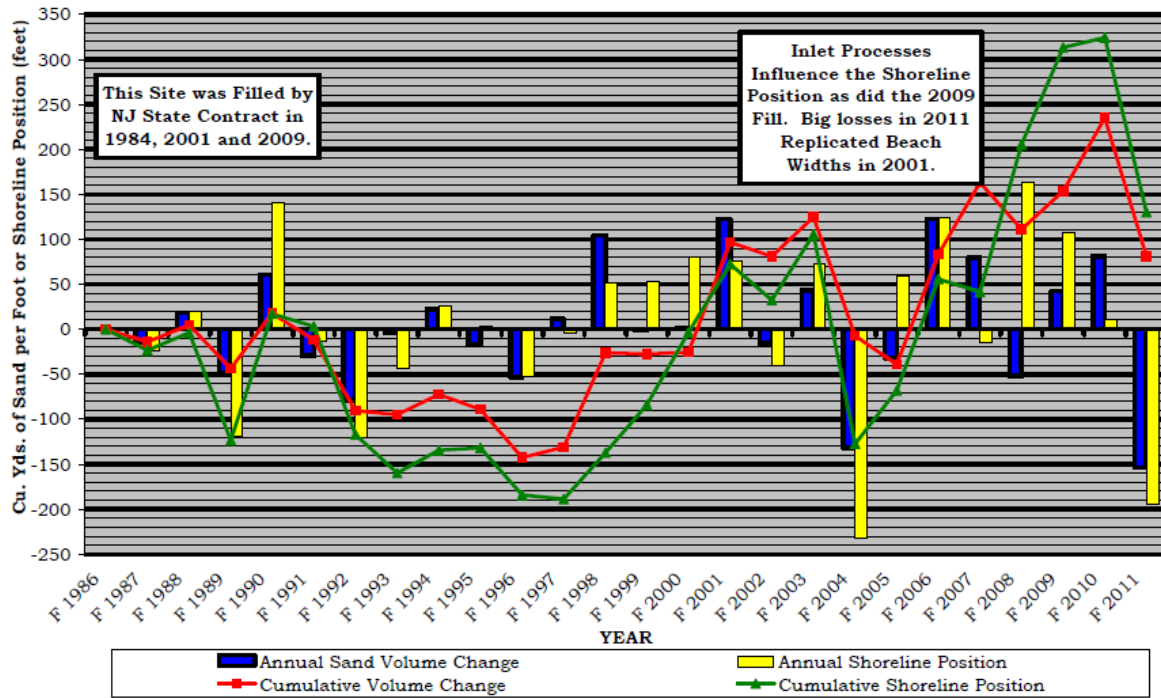
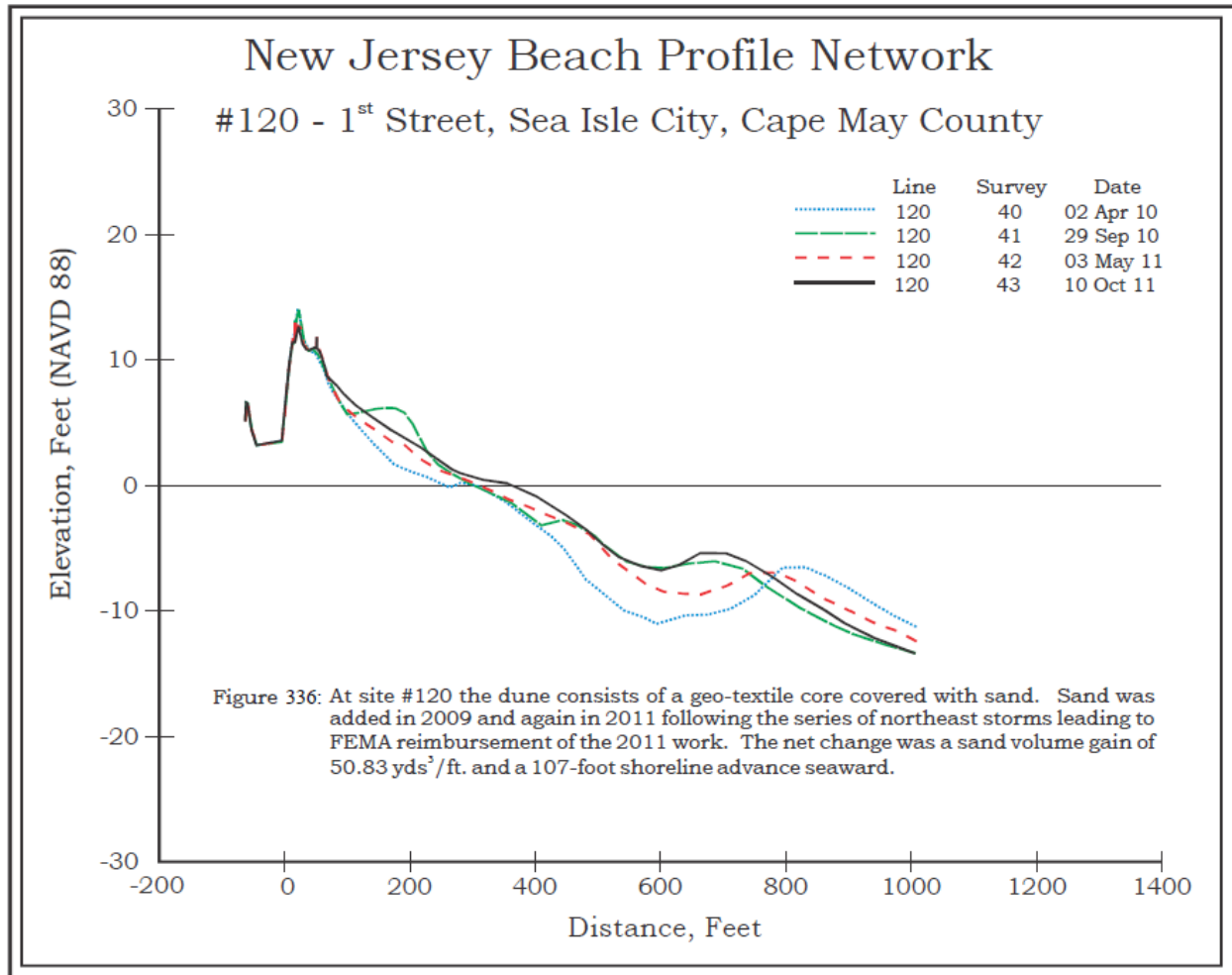


Figure 334. Very large magnitude changes occur at the northern shoreline of Ludlam Island. There have been three State/locally sponsored projects in Strathmere (1984, 2001, and 2009 plus repair in 2012). A shoreline position variation of 500 feet is due to enormous sand volumes within the Corson's Inlet ebb-tidal shoals which periodically migrate onto the beach. The spikes in 2001 and 2009 were fill related, but the loss in 2011 was due to sand transfer toward the inlet.



Figure 335. View to the south along the dune crest along Sea Isle City beach.



## 1<sup>st</sup> STREET, SEA ISLE CITY – SITE 120

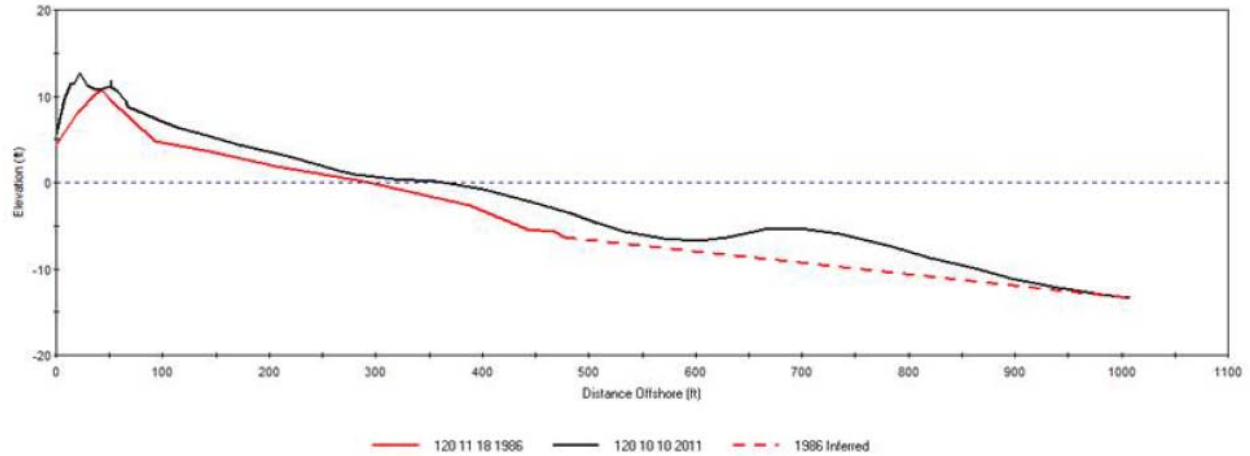


Figure 337: Historically, this site is known for its low elevation and narrow beach. The gradual decline in sand volume is evidence for a limited supply reflecting this low, narrow part of the barrier system. However, the 2009 replenishment sand has added 70 feet of shoreline as well as 32.95 yds<sup>3</sup>/ft of sand.

Photo on left taken October 4, 1991. View to the north.

Photo on right taken October 10, 2011. View to the north.



# 25-Year Coastal Changes at Site 120, 1<sup>st</sup> Street Sea Isle City, Cape May Co.

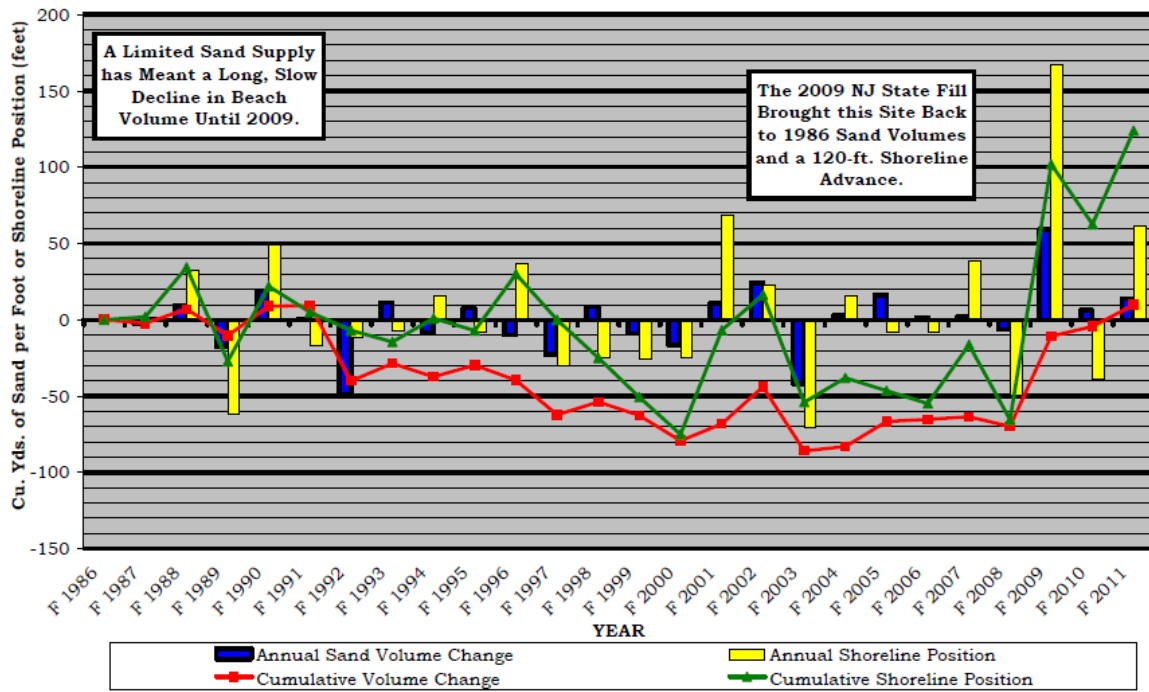


Figure 338. This site is located in the middle of Whale Beach, part of Ludlam Island known for its low elevation, narrow beach and minimal width. The gradual decline in sand volume is evidence for a limited supply reflecting this low, narrow part of the barrier system. The 2009 beach restoration plus the 2011 restoration of the storm losses in 2009 & 2010 have replaced the lost material seen following the 2008 survey.



### ***USGS Historical Shoreline Data***

For a longer look back at shoreline data for the Strathmere portion of Upper Township, the USGS has compiled a listing of the shoreline data for our area. You can access these different surveys at <http://marine.usgs.gov/dsasweb/#>

Zoom in on Strathmere and analyze the different shorelines. You can click on each for information about when that shoreline position was sampled. The earliest data appears to be for 1842. As you will see, the shoreline position has moved slowly over time, beginning roughly 500 feet further offshore than the present location. Over time, the shoreline has generally retreated further landward, reaching a minimum in 2000 at the southwest end of town and in 1977 in the northeast end of town. Replenishment projects have since helped to stabilize the shoreline.

Corson's Inlet appears to have migrated substantially over time. In 1842, the inlet was furthest southwest. If this position was to reestablish, several homes would be underwater. By 1852, the inlet had migrated over 2,000 feet to the northeast, an incredible shift in only a 10 year period. In 1885, it had reversed this trend again and nearly had returned to the 1842 position. The trend again reversed and the inlet migrated northeast to the point where in 1936 the south shore of the inlet was identical to the current northern shore. Yet again, the trend reversed to take the shoreline back to further southwest of the current shoreline until, predictably, the process reversed yet again after 1970. The 1977 shoreline mapping is closest to the current inlet location. However, Corson's Inlet has made it clear over the years that it is one of the most dynamic and unpredictable inlets in New Jersey and that dramatic shifts of shoreline can be expected.