TOWNSHIP OF MAURICE RIVER

DRAFT STRATEGIC RECOVERY PLANNING REPORT

MAY 2015

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The original of this document was signed and sealed in accordance with New Jersey Law.

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NOTE: ***The figures and tables presented in this report have been developed for Planning Purposes only and should be used exclusively for Planning Purposes only.***

Acknowledgments

In developing this report New Jersey Future received invaluable assistance from many individuals who contributed to its preparation. **Nicholas Graviano** of the Graviano Design Group. who also served as the Local Recovery Planning Manager to Maurice River and Commercial Township, was the principal author of several of the report chapters. **Stacy Perrine Krause**, Senior Research Associate; **Jennifer Rovito-Whytlaw**, GIS Manager; and **Veda Truesdale**, Senior Research Associate, all of the Environmental Analysis and Communications Group of the Edward J. Bloustein School of Planning and Public Policy at Rutgers University, provided mapping and data analysis supporting the risk assessment. **John J. Reiser**, GISP, and **Connor Hornibrook** of Rowan University refined the Cumberland County parcel assessment database, which was a critical first step in performing the detailed, parcel-based mapping analysis that serves as the foundation of Chapter 3, Risk Assessment. **Christiana L. Pollack**, GIS Specialist of Princeton Hydro developed the GIS analysis procedures used to conduct the Chapter 3 Risk Assessment.

Introduction

This Strategic Recovery Planning Report (SRPR) serves as a blueprint for use by the Township of Maurice River to address conditions created or exacerbated by Hurricane Sandy. It is intended to identify specific recovery and rebuilding strategies the Township can take to help ensure that the community will be more resistant to damage from future storm events, and encourage sustainable economic growth. Accordingly, the report:

1. Evaluates Hurricane Sandy's impacts on community features;

2. Addresses conditions that Hurricane Sandy created or exacerbated;

3. Describes the existing and potential vulnerabilities that the Township faces from significant storm events, and sea-level rise; and,

4. Articulates planning goals, strategies, and actions to improve public safety, develop resistance to future storms, and stimulate economic recovery.

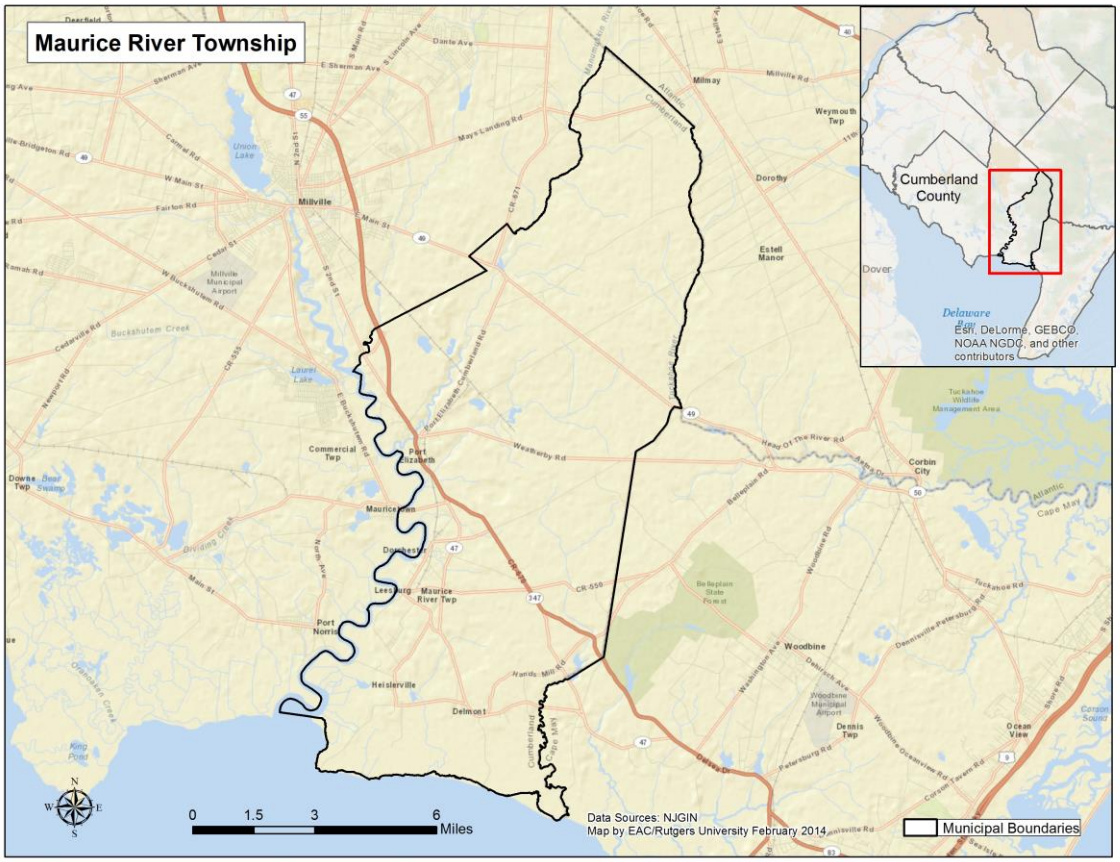
In the course of preparing this SRPR, the Township participated in the Getting to Resilience (GTR) process, developed by the New Jersey Department of Environmental Protection and adapted and enhanced by the Jacques Cousteau National Estuarine Research Reserve (JCNERR). Through this process, the Township was able to identify specific actions that will enhance long term resiliency in the town. These recommendations are integrated into this Report.

This Report was prepared by staff of New Jersey Future.

Chapter 1 Background/Context

Figure 1 shows that Maurice River Township is located in eastern Cumberland County, stretching from the County's northern border with Atlantic County to the Delaware Bay. The area of the Township is 95.7 square miles, and it is the largest municipality in the County. The northern section of the Township is predominately wooded and undeveloped; the southern portion is primarily comprised of extensive wetlands and natural areas. The Maurice River forms the western boundary of the Township and the eastern boundary borders Cape May County. The Township's population is mostly located in the villages of Bricksboro, Cumberland, Delmont, Dorchester, Heislerville, Leesburg, and Port Elizabeth.

Figure 1: Regional Location



Demographics

Maurice River has a population of 7,976 people, 4,405 of which are inmates at the Southern State Correctional Facility and the Bayside State Prison[1]. A total of 1,506 housing units are located in the Township, 1,364 of which are occupied and 142 are vacant. According to 2010 Census data, a total of 40 of the Township's housing units are seasonal or recreational dwellings. Of these, nearly 84% are owner occupied and approximately 16% are renter occupied. A total of 86.4% of the Township's housing units are single family detached, 0.9% of the units are single family-attached, 0.9% are 2-unit structures, 1.7% are multi-family structures with three to nine units, and 0.7% are multifamily with 10 or more units[2]. It is estimated that there are 151 mobile homes in the Township. The median value of all owner occupied units is $173,500[3].

[1] Source: 2010 Census
[2] Source: 2013 American Communities Survey
[3] Source: 2008-2013 American Communities Survey

Land Use and Zoning

Maurice River is a sparsely developed municipality. Residential development is primarily concentrated in the historic villages. Limited commercial development serves these areas.

Table 1 reveals that developed land uses comprise only 4% (2,491 acres) of the Township's land area. The predominant land use is forested land, accounting for 32,737 acres, or roughly 54% of the total land area. Wetlands comprise roughly 33% (20,071 acres) of the Township's land area. Agricultural land uses account for 1,275 acres, or roughly 2% of the Township's land area. Water bodies occupy roughly 3,600 acres or 6% of the Township's land area.

Figure 2: Generalized Land Use

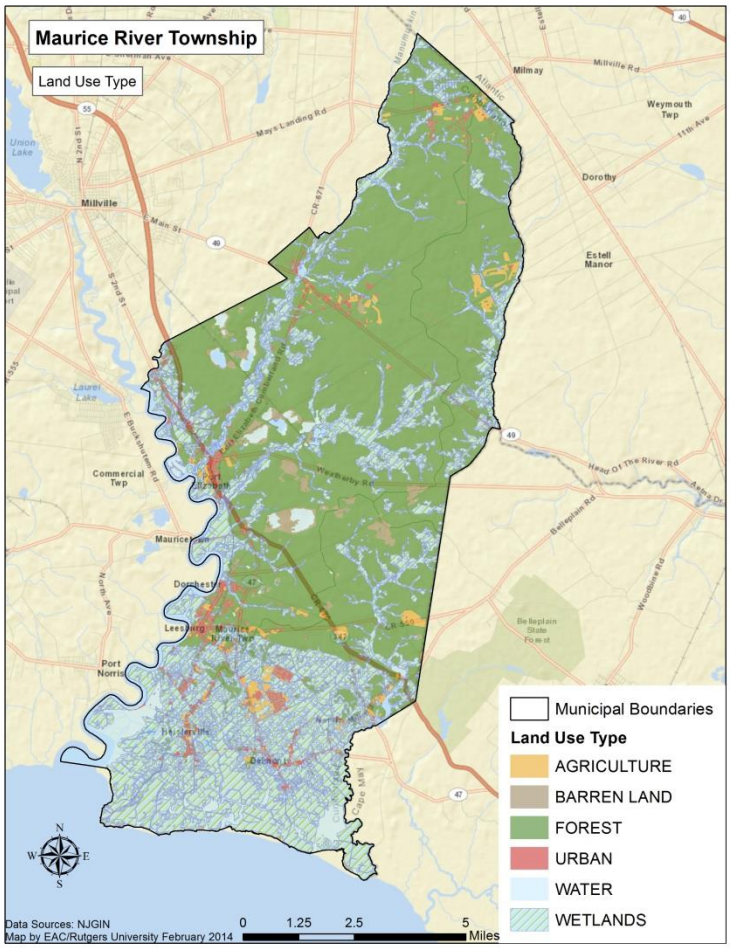
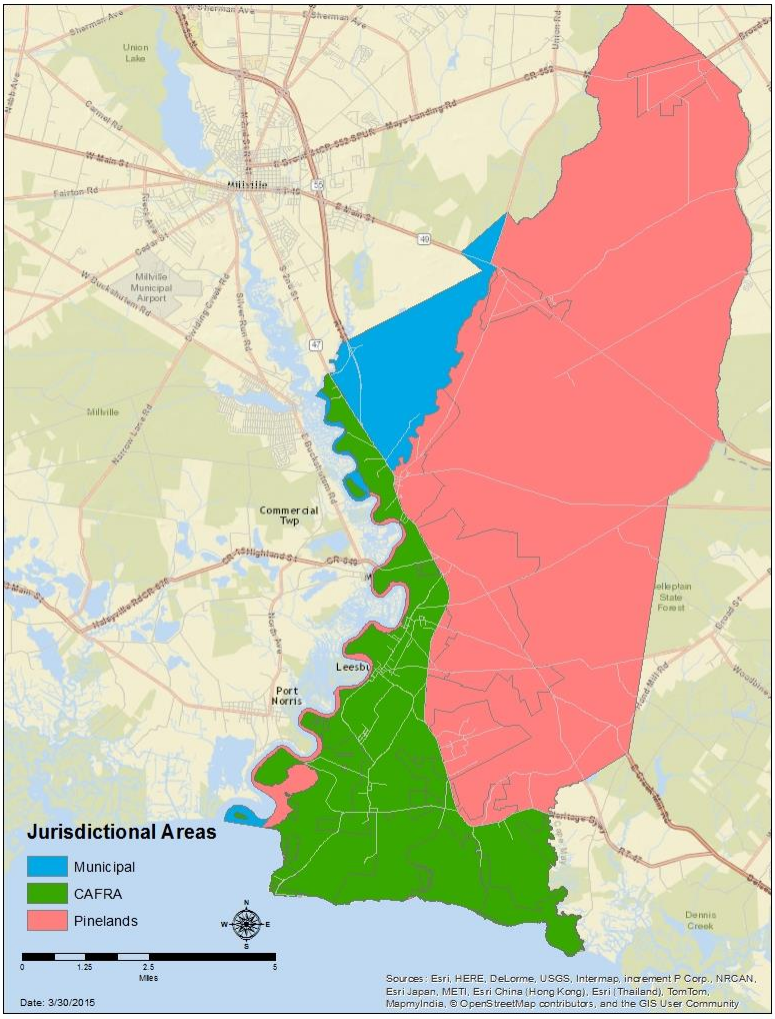


Table 1: Land Use Types

LU Type	Area (acres)	% Total
Agriculture	1,276	2%
Barren Land	736	1%
Forest	32,738	54%
Developed	2,491	4%
Water	3,600	6%
Wetlands	20,072	33%
Total	**60,911**	**100%**

Figure 3 illustrates that approximately 70% (42,400 acres) of the area of Maurice River lies within the Pinelands National Reserve (PNR). Consequently, any land use within this area must comply with the Pinelands Comprehensive Management Plan and land use regulations. The PNR, established under the National Parks and Recreation Act of 1978, is approximately 1.1 million acres and spans portions of seven counties and all or part of 56 municipalities. The reserve occupies 22% of New Jersey's land area and it is the largest body of open space on the Mid-Atlantic seaboard between Richmond and Boston. The New Jersey Pinelands Commission administers the Pinelands Comprehensive Management Plan, which is specifically intended to maintain the region's unique ecology while permitting compatible development. All municipal zoning plans that apply to any lands within the Pinelands must be reviewed and approved by the Pinelands Commission.

Figure 3: Jurisdictional Areas



Approximately 22% of the area of the Township (13,612 acres) is subject to New Jersey's Coastal Area Facility Review Act (CAFRA). CAFRA regulates development within the state's coastal areas and is intended to protect ecologically sensitive and fragile coastal resources. The rules of the Act regulate almost all residential, commercial, or industrial development, including construction, relocation, and enlargement of buildings or structures; and all related work, such as excavation, grading, shore protection structures, and site preparation. As ***Figure 3*** illustrates, all development near coastal waters

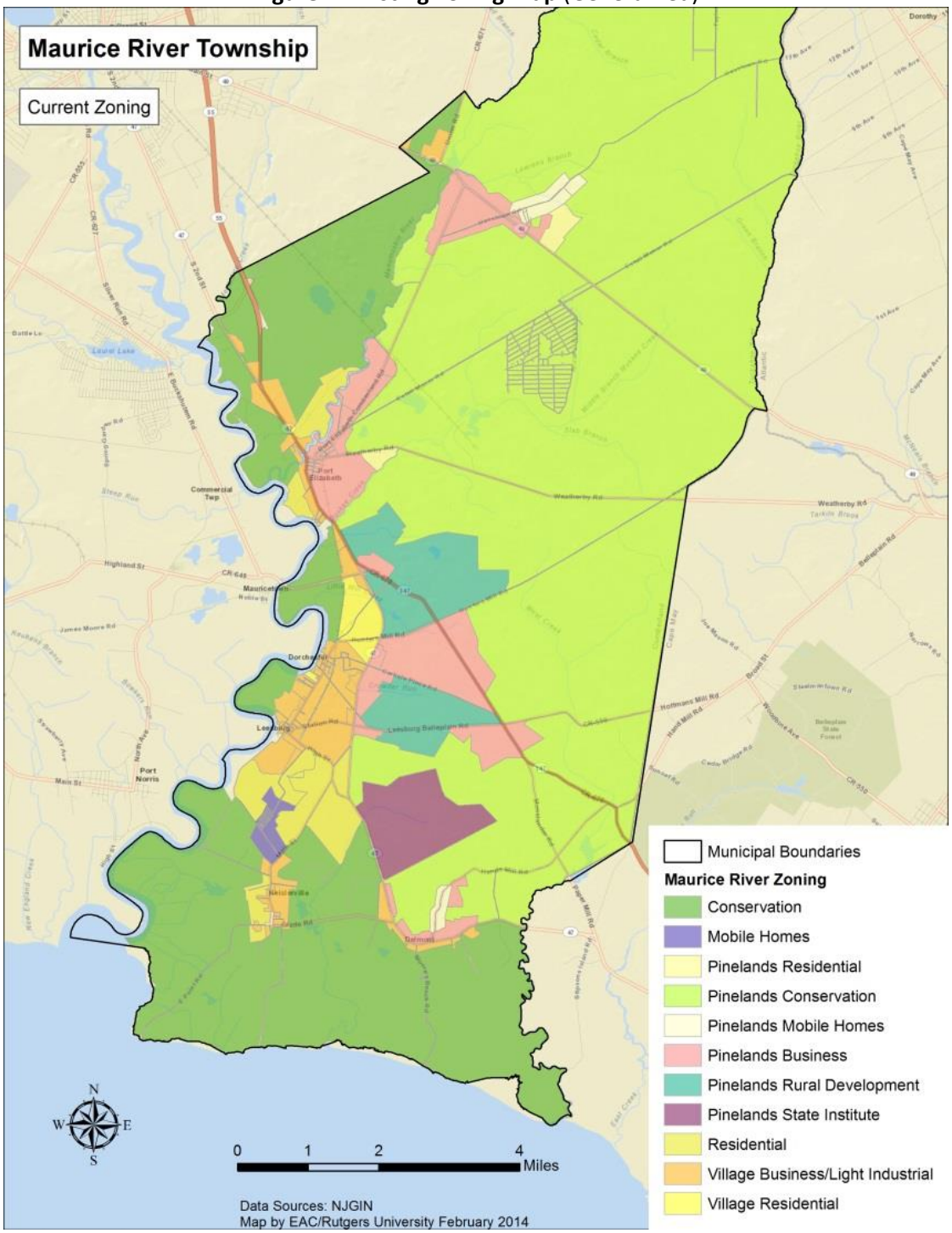
(Delaware Bay) in the southern part of the Township, particularly in areas covered by coastal wetlands, and along the Maurice River, is subject to CAFRA controls.

Approximately 8% of the Township (4,900 acres) is subject solely to locally determined zoning controls. CAFRA and Pinelands zoning regulations protect many of the Township's sensitive environmental areas. The Township's zoning districts that permit the most intensive commercial and residential development are concentrated in the existing villages and along Routes 47, 49 and Rt. 347. Environmentally sensitive areas along the Delaware Bay and Maurice River are located in conservation zones.

Table 2: Zoning Districts and Land Area

ZONE CODE	ZONE NAME	ACRES	% of Total
C	CONSERVATION	13,159	22%
C15	CONSERVATION	970	2%
MH	MOBILE HOME	189	0%
PB	PINELANDS BUSINESS	894	2%
PC	PINELANDS CONSERVATION	33,069	56%
PMH	PINELANDS MOBILE HOM	290	0%
PPHB	PINELANDS PLANNED HIGHWAY	317	1%
PR	PINELAND RESIDENTIAL	789	1%
PRDAC	PINELANDS RURAL DEV.	1,163	2%
PRDAR	PINELANDS RURAL DEV.	1,004	2%
PSI	PINELANDS STATE INSTITUTION	1,069	2%
PVB	PINELANDS VILLAGE BUSINESS	89	0%
PVC3	PINELANDS VILLAGE CENTER	862	1%
PVC5	PINELANDS VILLAGE CENTER	1,365	2%
PVHB	PINELANDS VILLAGE HWY BUSINESS	135	0%
R10	RESIDENTIAL	592	1%
R5	RESIDENTIAL	634	1%
RS	RESIDENTIAL	27	0%
VB	VILLAGE BUSINESS	182	0%
VC	VILLAGE CENTER	866	1%
VHB	VILLAGE HIGHWAY BUSI	401	1%
VLI	VILLAGE LIGHT INDUST	323	1%
VR	VILLAGE RESIDENTIAL	323	1%
Total		**58,711**	**100%**

Figure 4: Existing Zoning Map (Generalized)



Chapter 2 Initial Impacts Assessment

As a result of Hurricane Sandy, Maurice River Township faced a variety of devastating impacts that had to be addressed immediately following the storm. These impacts included:

- Roads that were blocked with debris and downed power lines, specifically: River Road; Alexander Road; Main Street – Leesburg; Mauricetown Causeway Road; Glade Road; East Point Road; Matt's Landing Road.
- A breached dike caused substantial flooding that destroyed major portions of Matts Landing Road, rendering the marinas and homes off this roadway inaccessible.
- Localized flooding, extensive electrical outages, and blocked roads caused hazardous conditions and threatened public health and safety throughout the Township.
- The historic East Point Lighthouse was flooded and the shoreline adjacent to the lighthouse was severely compromised.
- Sandy exacerbated shoreline erosion and deterioration at the mouth of the Maurice River and the Delaware Bay.
- 43 residential dwellings were damaged by the storm, two (2) of which were completely destroyed, 14 dwellings sustained major damage and 27 had minor damage. Six (6) commercial businesses experienced storm damage, four (4) suffered major damage and two (2) had minor damage.

Flooding

High intensity rainfall events, coupled with high tides, high stormwater velocities, and head conditions resulted in flooding in low-lying areas of the Township along the Maurice River and marshes of the Delaware Bay. Frequent flooding restricts access to homes in the area, causes economic losses to businesses, and results in extensive property and roadway damage. The southern area of the Township - including Heislerville, Leesburg, East Point, Delmont, Dorchester and Leesburg - are subject to frequent flooding.

During Sandy, villages within Maurice Rover Township experienced severe coastal flooding due to storm surge. Water levels monitored by National Oceanic and Atmospheric Administration (NOAA) tide gages in Delaware Bay show that on October 29, 2012, when Hurricane Sandy made landfall in New Jersey, water levels in the region ranged from three to eight feet above mean higher high water levels.

From October 30, 2012, through November 8, 2012, heavy rains and straight-line winds that accompanied Sandy occurred at the same time as extreme high-tides. The Township's storm records indicate that the resulting floodwaters breached three earthen levies that where the responsibility of Maurice River Township. The first of these breaches occurred at River Road, one (1) mile south of Leesburg, where a 300 foot by ten-foot wide section was washed away. The second breach occurred at East Point Road, 1.6 miles South of Heislerville, a 100-foot section was washed away. The third breach location was on Bay Avenue in East Point, one-tenth (0.1) of a mile east from the terminus of the East Point Road, where a 220-foot by ten-foot section washed away.

The Township's labor force spent approximately 400 hours to remedy issues resulting from the storm, and dedicated approximately 300 hours to equipment operation. Approximately 670 cubic yards of fill was transported into the Township to make permanent repairs at River Road. The Township replaced 333 cubic yards of material on East Point Road and 89 cubic yards of material on Bay Avenue.

The Township arranged to have an operator take emergency calls from 6:00 a.m. on October 29, 2012 until 2:00 p.m. on October 30, 2012. The phones were staffed by a member of the Office of Emergency Management services, volunteer firefighters and Township employees. These staffers took calls from the public and dispatched emergency vehicles. 28 cubic yards of sand was stockpiled for use by residents to fill sandbags. Over 300 hours of labor were dedicated to this effort.

Damages to Buildings

Historic/Cultural Buildings - The East Point Lighthouse (EPL), located at the mouth of the Maurice River and the Delaware Bay, was placed on the State Register of Historic Places in 1995. The facility is identified by the NJDEP Historic Preservation Office as ID #2801. It was placed on the National Register in 1995 (Reference #95001047). This building sustained substantial damage during Hurricane Sandy. Floodwater measured 24 inches at the foundation of the building.

Residential Structures – The Maurice River Township Construction Official's records indicated that there were 43 dwellings damaged by Hurricane Sandy. The damage occurred in the following locations: Bay Avenue in East Point; East Point Road in East Point; Glade Road in Heislerville; Matts Landing Road in Heislerville; Menhaden Road in Heislerville; Moores Beach Road in Delmont; Quillan Avenue in Delmont; Schoolhouse Lane in Heislerville; Thompson's Beach Road in Heislerville; Water, Front, Market, and Union Streets in Port Elizabeth; and Route 47 in Delmont. Two dwellings were entirely destroyed.

Commercial Properties – Six (6) commercial properties were damaged by the storm, five (5) of which are commercial marinas in Matts Landing, a key location of commerce in the Township. A commercial boating marina on River Road also sustained damage in the storm.

Impacts on Households and Most Vulnerable Households

An analysis conducted in October 2013 by Rutgers University revealed that Maurice River Township lost power for two (2) days following Hurricane Sandy. The analysis also described the impact of Sandy on the community's most vulnerable households (defined as "those working families that do earn enough to afford a basic household survival budget", or so-called ALICE[4] households). Maurice River Township was among the top 50 municipalities in the state for Sandy's impact on these households, scoring within the 61-70 range out of 100 on the hardship index.[5] While the sparse development pattern of Maurice River limited the absolute number of dwellings and families affected by the storm, those that were affected had limited resources to rebuild and recover.

Post-Storm Issues

Hurricane Sandy created and exacerbated several issues. The storm reaffirmed the Township's vulnerability to flooding and storm surge from the Delaware Bay and Maurice River and its tributaries, and highlighted the vulnerability of Township infrastructure including its roads, electric transmission, natural gas and telecommunications systems. Extensive infrastructure damage, especially along Matts Landing Road, inhibited post-storm recovery efforts. Low-lying areas of Route 47 remain vulnerable and can severely restrict roadway travel within the Township and the region.

The mouth of the Maurice River has suffered the effects of extensive erosion in recent decades and has lost meanders and acres of saltmarsh. Many acres of wetlands (within the river and along the Bayshore) have suffered erosion, inundation or conversion to open water/tidal mud flats thereby reducing the

[4] ALICE - Assisted Limited Income Constrained, Employed

[5] Halpin, Stephanie Hoopes; The Impact of Hurricane Sandy on New Jersey Towns and Households; Rutgers School of Public Affairs and Administration; n.d

habitat value and the protection typically provided by healthy saltmarshes. Hurricane Sandy was the greatest and most recent assault to the river, adjacent wetlands and developed communities. The sustained winds and storm surge combined with lunar high tides had a catastrophic effect on this already imperiled system. Siltation from the continued erosion of the riverbank is threatening the centuries-old shipbuilding and ship repair industries within the Township, some of which are vital not only to the economy but national security (the United States Coast Guard repairs vessels at Maurice River Township repair facilities).The Maurice River villages of Dorchester and Leesburg are experiencing, on a regular basis, adverse impacts from storm susceptibility to the fishing economy, water and transportation infrastructure, ports and maritime industry, residential housing and commercial development.

The damaging effects of the flooding from Hurricane Sandy and the current pace of beach erosion have imperiled the East Point Lighthouse (EPL). The soft brick and mortar that was used in 19th century buildings like the EPL will not survive repeated flooding events. In 1908, the lighthouse was reported to be 460 feet from the high-tide-line. Due to erosion and the rising level of the Delaware Bay, post-Sandy measurements now place the lighthouse approximately 120 feet from the high-tide-line.

The Township economic development and employment opportunities are presently stagnant. Economic growth is limited by the lack of water, sewer, telecommunications, and high-speed internet infrastructure. No public water or sewer facilities are available within the Township. The Township seeks context sensitive solutions, in appropriate locations, to meet these infrastructure needs in key areas along Routes 47, 49, and 347 as well as its existing villages.

Long-Term Recovery Efforts

The State of New Jersey invited FEMA's Long-Term Community Recovery team to assist four communities along the Delaware Bayshore - Downe, Commercial, Greenwich and Maurice River Townships to complete a recovery plan, which involved thousands of volunteer hours by residents, business owners, and partners. These efforts resulted in the creation of the "Cumberland County Delaware Bayshore Recovery Plan" issued December 2013[6]. This Plan recommends tourism and economic development, infrastructure, shoreline protection and coastal management projects that are intended to revitalize these municipalities and help residents and business owners recover from the impacts of flooding. In addition, the Township is collaborating with Cumberland County in the development of a county-wide Multi-Jurisdictional Hazard Mitigation Plan. The Township has also entered into an agreement with New Jersey Future, a state-wide non-profit planning organization, which has provided a Local Recovery Planning Manager who has worked directly with Township staff and elected officials for up to 18 months to assist the community to plan, manage and implement recovery strategies.

[6] http://www.mauricerivertwp.org/pdfdocs2014/RecoveryPlanFEMAfinal.pdf

Chapter 3 Risk Assessment

Introduction

Over the past nine years New Jersey has experienced eleven flood-related events that were declared Federal Disasters by the President of the United States. Currently there is consensus among numerous scientifically-based studies that the state can expect to experience an increasing rate and intensity of storms in the foreseeable future[7]. Given New Jersey's settlement patterns, with extremely high-density residential and commercial development along its coastal fringe, and in light of the economic return the state depends upon from tourism at the shore – approximately $35.9 billion of state GDP in 2013, or 6.9% of the state's economy[8] - it's particularly important to evaluate the ***potential*** risk and vulnerabilities inherent in exposure to such storms. The extent of vulnerability has considerable consequences for the health of the state's residents, ecosystems, natural and built environments, and understanding risk is particularly important in guiding rebuilding and recovery strategies and financial investment.

The purpose of a risk assessment is to evaluate vulnerability to hazards a community is likely experience. The vulnerability assessment can then serve as a framework for identifying and prioritizing those actions that most effectively reduce or avoid future losses. The technical definition of the term "***risk***" is expected future losses; ***vulnerability*** is the tendency of something to be damaged when exposed to a hazard and ***exposure*** is the value of structures and number of people exposed to hazards. This assessment is intended to provide a basis for Maurice River Township's recovery and mitigation strategies by evaluating vulnerability and quantifying exposure.

One of the more prominent hazards that Maurice River Township faces is riverine and coastal flooding caused by extreme rainfall events, storm surge and sea level rise. Flooding events are likely to be accompanied by coastal erosion - particularly along unprotected, bayside coastal areas - which will exacerbate flood hazards. Consequently, this Risk Assessment focuses on Maurice River Township's vulnerability to flood hazards and evaluates the types, number and value of structures within the Township that are exposed to flood and storm surge events as well as projections of sea-level rise.

1. Vulnerability

In this section, various factors of vulnerability with respect to flooding from future storm events are examined, including:

- The extent of the Township's flood zones;
- The amount of Federal disaster recovery assistance that has been made available to the municipality and individual property owners to address damage from prior storm events the Township has experienced;
- Impacts of current and projected sea level rise and inundation on the Township's marshes and wetlands;
- The relationship of the location of the Township's community facilities and infrastructure to the its flood zones; and
- The relationship of the Township's zoning districts to its flood zones.

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[7] See "What We Know, The Realities, Risks And Response To Climate Change", American Association for the Advancement of Science, 2014. "Climate Change 2013, The Physical Science Basis" Intergovernmental Panel on Climate Change. Climate Change 2014, Impacts, Adaptation and Vulnerabilities", Intergovernmental Panel on Climate Change. "State of the Climate, New Jersey", 2013, Rutgers Climate Institute.

[8] The figure represents direct, indirect and induced impacts. Source: "*The Economic Impact of Tourism in New Jersey, Tourism Satellite Account, Calendar Year 2013*", Tourism Economics

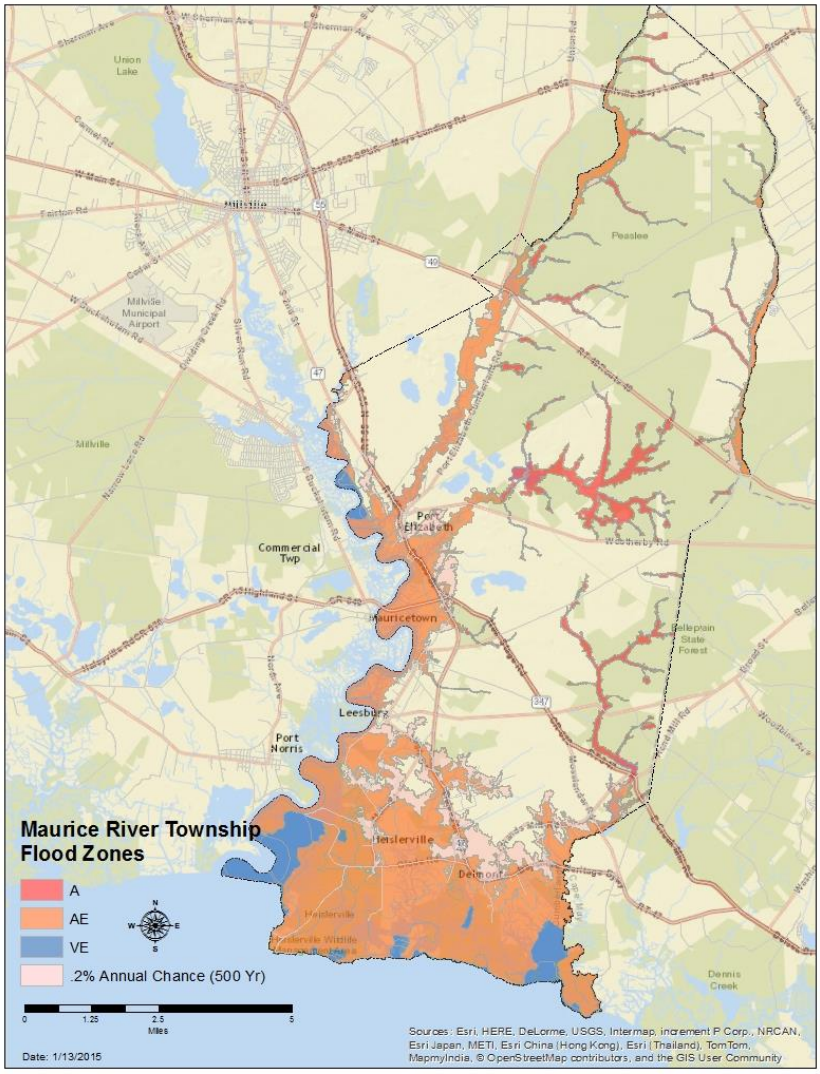
A. Flood Zones

The Federal Emergency Management Agency (FEMA) defines flood zones as geographic areas subject to varying levels of flood risk and types of flooding. These zones are delineated on Flood Insurance Rate Maps (FIRMs) and Flood Hazard Boundary Maps (FHBMs). FEMA delineates four different flood hazard areas:

- Special Flood Hazard Areas – High Risk;
- Coastal High Hazard Areas – High Risk;
- Moderate and Minimal Risk Areas; and
- Undetermined Risk Areas.

Each of these areas has an associated series of flood zones defined by FEMA and included in the ***Flood Zones Table*** provided in ***Appendix 1*** of this report: March, 2014 Preliminary Flood Plain maps currently available for Maurice River illustrated in ***Figure 5*** below, show that a total of 19,858 acres, or 32.6% of the area of the Township is located within one of four FEMA Flood Zones.

Figure 5: Flood Zones



A/AE Zones

Special Flood Hazard Areas (SFHA) have a 1% annual probability of being inundated by flooding and structures located in these zones have a 26% chance of flooding within the life of a standard 30-year

mortgage. These are areas of highest vulnerability to flooding inundation. The A and AE zones, which have the same flood risk, encompasses 25.6% (15,610 acres) of the total area of the municipality and 35% of the Township's developed area.

VE Zone
The VE Flood Zone encompasses 2.4% (1,461 acres) of the area of the Township. The VE Zone is a Coastal High Hazard Area, which has a 1% annual probability of being inundated by flooding and is subject to high velocity wave action. As with properties within the SFHA, structures within Coastal High Hazard Area zones have a 26% chance of flooding within the life of a standard 30-year mortgage.

.2 Percent Annual Chance
The .2% Zone, also referred to as the 500 year flood plain, defined as a Moderate Risk Zone encompasses 4.6% (2,786 acres) of the area of the Township. According to FEMA, buildings in Moderate and Minimal Risk zones can be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems.

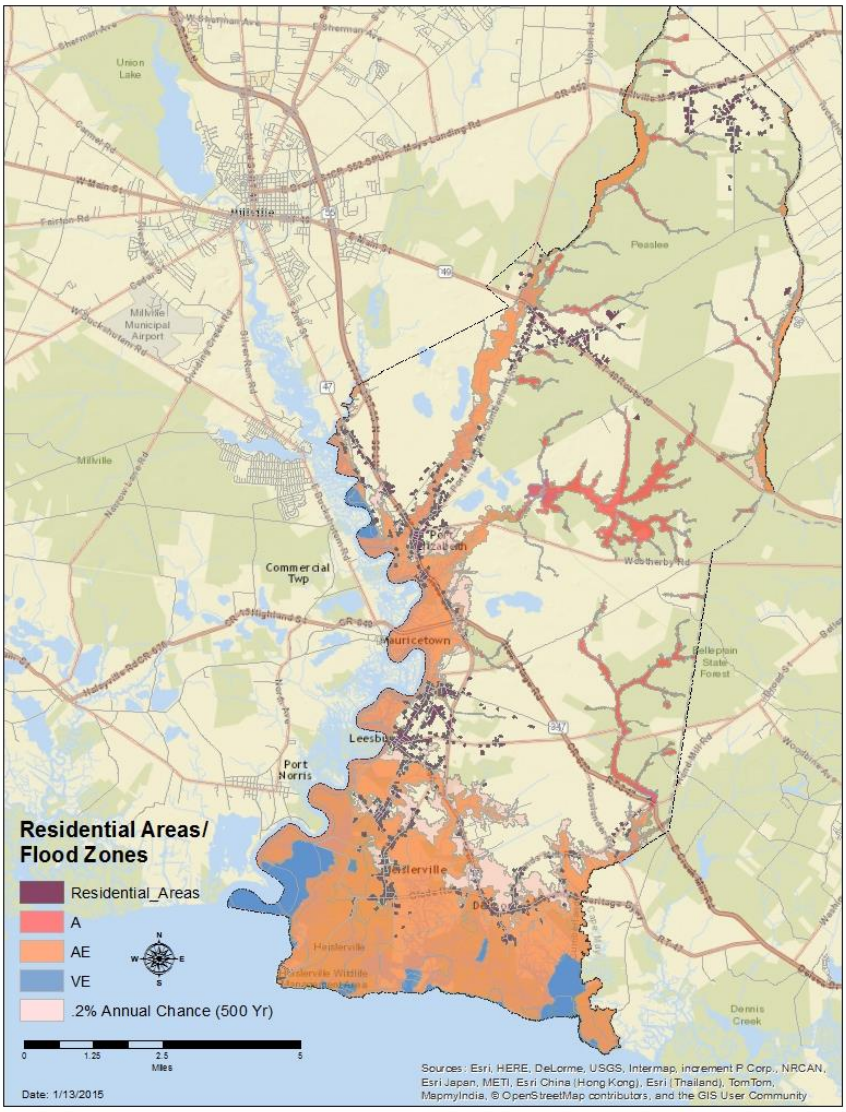
X-Unshaded Zones
The entire area of the Township is included within a FEMA flood zone. The areas of the Township ***outside*** the SFHAs, CHHAs and the areas with a .2 Percent Annual chance of flooding, are areas of minimal risk, also referred to as the X-unshaded Zone. These areas encompass 67% (41,053 acres) of the area of the Township, mostly the northerly portion of the municipality.

Table 3: Land Use Type by Flood Zone

Land Use Type	Total Area (acres)	A	AE	VE	.2 Pct. Annual Chance	Outside Risk Areas
Agriculture	1,276	0	125	0	199	952
Barren Land	736	5	6	15	2	709
Forest	32,738	331	567	2	635	31,203
Developed	2,491	7	396	2	328	1,758
Water	3,600	127	1,754	1,074	3	642
Wetlands	20,072	1,733	10,560	368	1,620	5,791
Total	**60,911**	**2,203**	**13,408**	**1,461**	**2,786**	**41,053**
% of Total	**100%**	**4%**	**22%**	**2%**	**5%**	**67%**
Residential	**1,392**	**0**	**231**	**2**	**201**	**958**

Table 3 shows that 16% (404 acres) of the developed area of Maurice River Township is located in the A, AE or VE FEMA flood zones. As noted above, these zones have the highest vulnerability to regular flooding inundation. These areas have a one percent chance of flooding in any given year. For homeowners in this area, this means that they will be required to have flood insurance if they have a mortgage and they have a 26% of experiencing a flood over the course of a thirty year mortgage. Almost 56% (1,392 acres) of the developed area of the Township is occupied by residential uses. ***Figure 6*** illustrates that almost 17% (233 acres) of the Township's residential area is within the A, AE or VE flood zones. The remaining 83% (1,159 acres) of residential areas in Township is located with areas with a .2 percent annual flood probability or outside areas at risk of flooding.

Figure 6: Residential Areas/FEMA Flood Zones



B. Federal Recovery Assistance

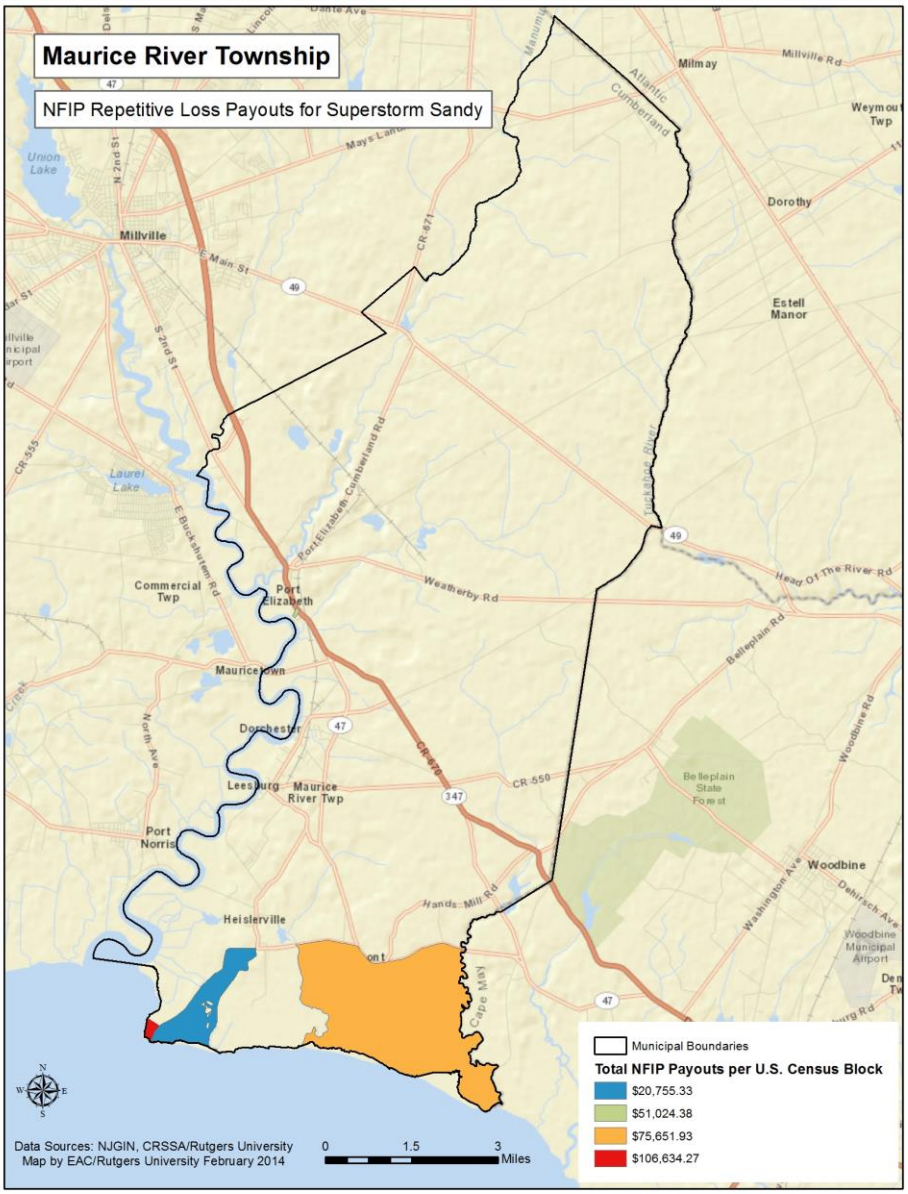
There are three principal sources of Federal assistance available to municipalities and individual property owners for disaster recovery: National Flood Insurance Program (NFIP), Public Assistance (PA), and Individual Assistance (IA). It's important to note that all payout figures quoted below are provided at the census block group or tract level to ensure data anonymity.

1. National Flood Insurance Program (NFIP)

The NFIP offers flood insurance to homeowners, renters, and business owners if their community participates in the program. Participating communities agree to adopt and enforce ordinances that meet or exceed FEMA requirements to reduce the risk of flooding. FEMA defines a Repetitive Loss (RL) property as "any insurable building for which two or more claims of more than $1,000 were paid through the NFIP within any rolling ten-year period, since 1978." A Severe Repetitive Loss (SRL) is defined as "a single family property (consisting of 1 to 4 residences) that is covered under flood insurance by the NFIP and has incurred flood-related damage for which four or more separate claim payments have been paid under flood insurance coverage, with the amount of each claim payment

exceeding $5,000 and with cumulative amount of such claims payments exceeding $20,000; or for which at least 2 separate claims payments have been made with the cumulative amount of such claims exceeding the reported value of the property. The two claims must have occurred within any 10-year period and must be greater than 10 days apart.

Figure 7: NFIP Payouts



According to the information on NFIP payouts in the Repetitive Loss database held by the New Jersey Department of Environmental Protection for Hurricane Sandy, there were a total of 6 claims payments in Maurice River for a total of $254,000 made to properties located with the Township's 4 census block groups.

2. Public Assistance (PA)
FEMA's Public Assistance (PA) Grant Program provides assistance to State, Tribal and local governments, and certain types of Private Nonprofit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President. This program provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.

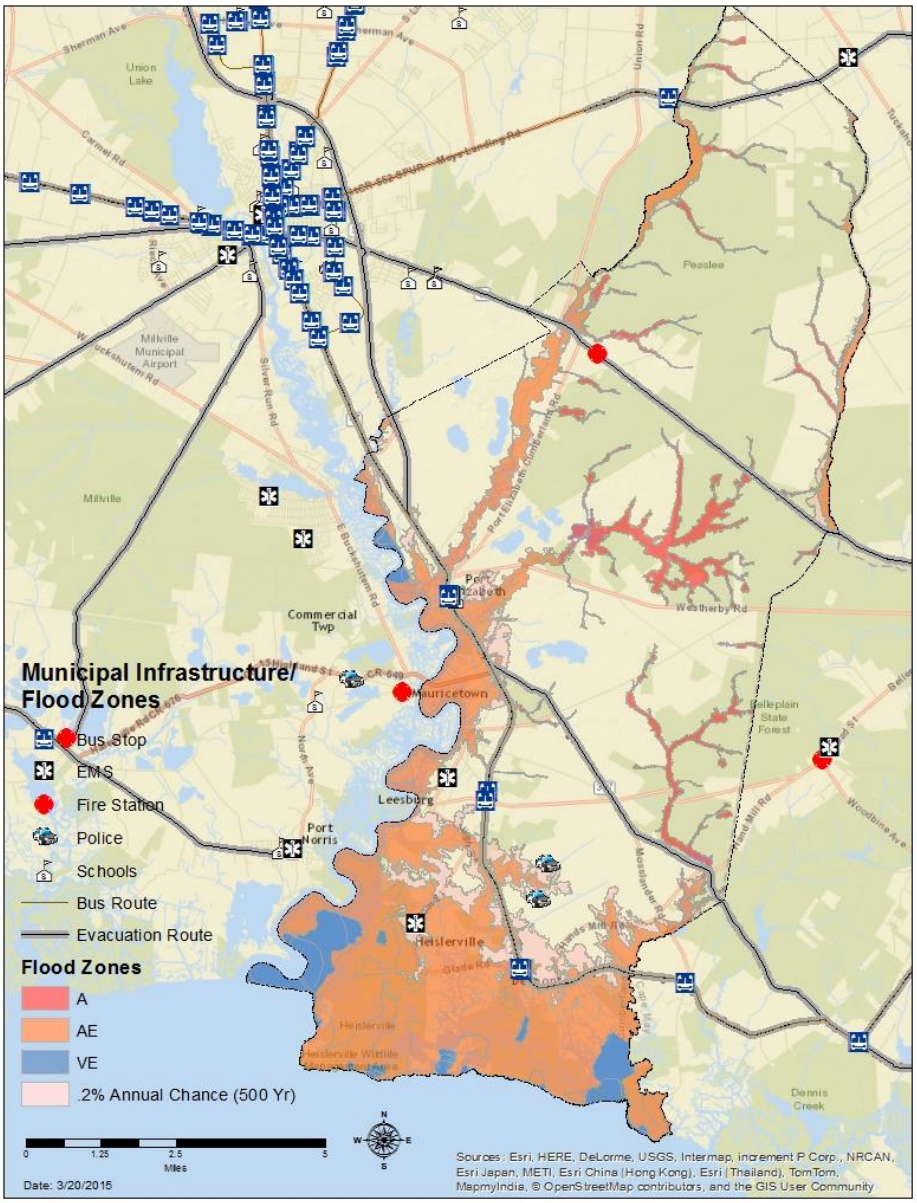
In 13 New Jersey counties affected by Hurricane Sandy, many volunteer groups and faith-based organizations came together to form long-term recovery groups (LTRGs), and Federal Disaster Recovery Coordination (FDRC; regionally referred to as Federal Interagency Regional Coordination (FIRC)) connected these groups to the Federal Emergency Management Agency. FEMA Voluntary Agency Liaisons (VAL) supported the LTRGs as they addressed unmet needs of individuals, in contrast to FIRC's emphasis on communities as a whole. Along with investigating the issues communities are facing during recovery, FIRC coordinated information and resources to affected survivors, so they could determine where help was available. The Township of Maurice River and the Maurice River Township School District Commercial Township and the Commercial Township School District received $114,017 through FIRC for projects such as: debris removal; protective measures; road and bridge repair; public building repairs; and remediation to recreational/public facilities.

3. Individual Assistance (IA)
FEMA Individual Assistance (IA) program provides financial or direct assistance to individuals and families whose property has been damaged or destroyed as a result of a federally-declared disaster, and whose losses ***are not*** covered by insurance. It is meant to help meet critical expenses that cannot be covered in other ways. This assistance provides for temporary housing, repair or replacement of a primary residence that is not covered by insurance. Following Sandy, a total of 40 individual assistance payouts were made to qualifying individuals and families living in Maurice River Township, amounting to $415,611.98, or $10,390.29 per claim.

D. Critical Services and Infrastructure
Maurice River's capacity to respond to severe storms and flooding events is, to a large extent, predicated on the extent to which these events are likely to impact critical infrastructure - such as evacuation routes – and emergency services – such as police and fire services. ***Figure 7*** shows the location of critical facilities throughout the Township and their proximity to areas of probable inundation in the event of future inundation.

Figure 8 shows that the A, AE and VE Special Hazard Flood Zones extend inland through the southern portions of the Township crossing Route 47 in several locations, potentially impeding accessibility during flooding events. This is significant because this major roadway serves as Maurice River's principal north/south evacuation route and the primary bus route serving the villages that lie along the Townships river boundaries and any development in the southern areas of the community. In addition, four bus stops (Rt-47 At Glade Rd inbound and outbound and RT-47 At Cumberland-Port Elizabeth Rd inbound and outbound) and one fire company/EMS facility (Heislerville Volunteer Fire Company at 164 Main Street) are located within these high-risk areas. Inundation of emergency response facilities will compromise local capacity to respond to residents' needs during and after a storm event.

Figure 8: Services and Infrastructure Impacts



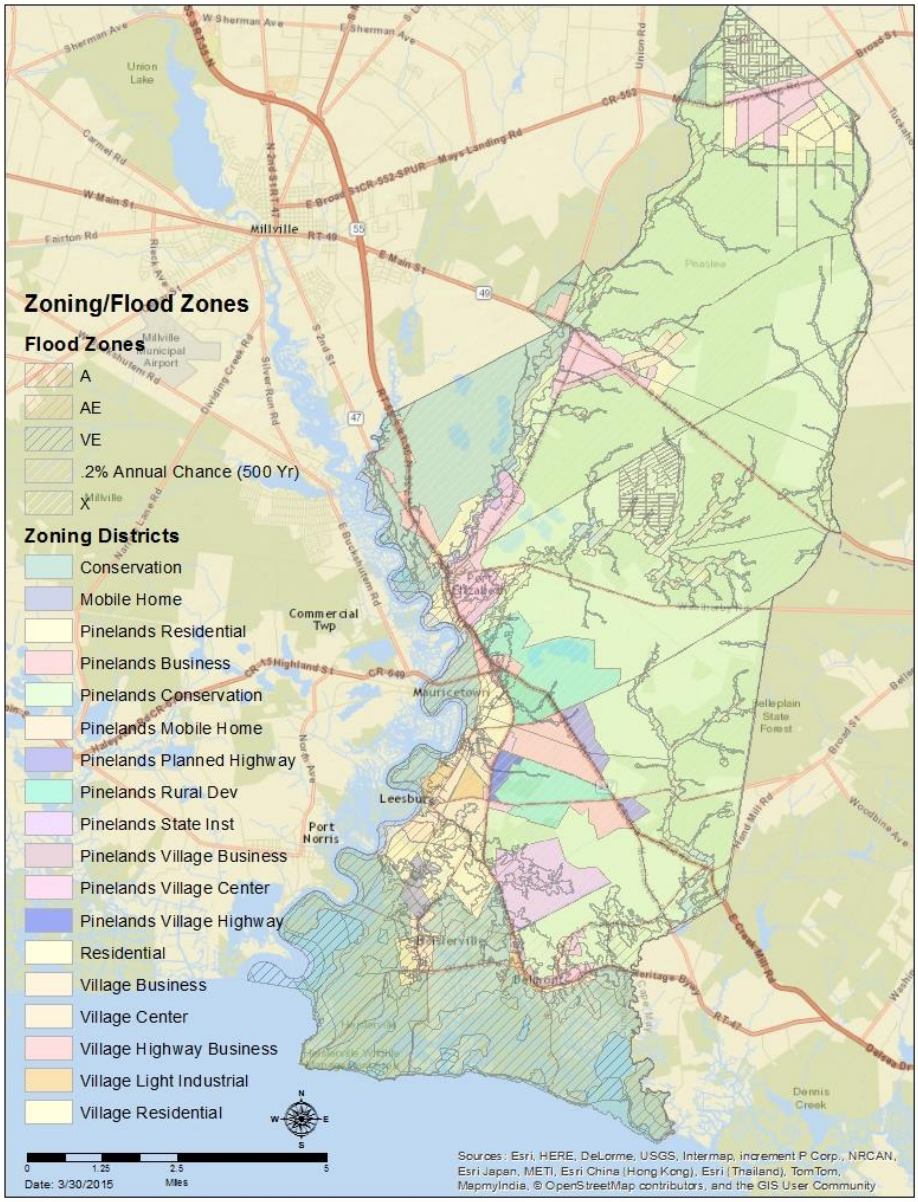
E. Zoning and Land Use

A municipality's zoning regulations determine where certain land uses will occur, and how buildings will be configured on lots within a range of use zones. For generations New Jersey's coastal communities have permitted relatively dense residential and commercial development patterns within close proximity to coastlines to take advantage of the attractive and unparalleled natural resource of the state's shore areas. This development has largely occurred without regard to exposure to storms and flooding. However, as sea levels rise and the probability of more intense and frequent storm events increases, it will be necessary to evaluate the extent to which these historic development patterns put people and property in increasing jeopardy and consider alternatives to minimize or avoid such risk.

Figure 9 and ***Table 4*** reveal that 32% (18,478 acres) of Maurice River Township's zoning districts are located within FEMA flood zones. More than 10% (6,044 acres) of zoned areas in the Township are

designated for some form of residential use. A total of 1,669 acres, or 28% of areas zoned for residential uses are located the A or AE zones, which has a 1% annual chance of flooding annually or a 26% chance of flooding within the term of a thirty-year mortgage. Almost one third of the Township's conservation districts as well as small portions of several other districts are also located in the A, AE or VE zones.

Figure 9: Zoning and Flood Zones



In addition, to flood risk, areas within the VE Zone are subject to storm-induced velocity wave action. Only 8%, or 1,155 acres, of the Township's Conservation district is located within this zone, as shown in ***Table 4***.

Table 4: Zoning Districts by Flood Zones

Zoning District	Total	A	AE	VE	.2 Pct. Chance	Outside Risk Areas
Conservation (C)	13,657	8	8,755	1,155	476	3,263
Mobile Home (MH)	170		118		42	10
Pinelands Residential (PR)	841	11	27		4	799
Pinelands Business (PB)	845	8	9		31	797
Pinelands Conservation (PC)	33,120	2,110	1,568		875	28,567
Pinelands Mobile Home (PMH)	259	5	3		32	219
Pinelands Planned Highway Business (PPHB)	459	2				457
Pinelands Rural Development Area (PRDA)	2,151	24	40		131	1,956
Pinelands State Institutional (PSI)	1,069		144		249	676
Pinelands Village Business (PVB)	71		18		32	21
Pinelands Village Center (PVC)	2,143	10	324		193	1,616
Pinelands Village Highway Business (PVHB)	135	2				133
Residential (R)	1,494		774		347	373
Village Business (VB)	239		163		52	24
Village Center (VC)	807		229		119	459
Village Highway Business (VHB)	410	0	86		43	281
Village Light Industrial (VLI)	317		77		45	195
Village Residential (VR)	330		101		36	193
Total	**58,517**	**2,180**	**12,436**	**1,155**	**2,707**	**40,039**

F. Wetlands Impacts

A comparison of ***Figures 1***, ***11***, and ***12*** illustrate that by 2050 a considerable portion of the protective marsh areas that currently buffer vast extents of Maurice River Township's coastal areas will be inundated and will not provide protection for more inland-developed areas. ***Table 3*** on Page 11 indicates that over 63% (12,661 acres) of the Township's wetlands areas are in the A, AE or VE flood zones. The extent to which these areas are vulnerable to future storm events or flooding as a result of Sea Level Rise is an important factor for the community to consider as it evaluates its adaptation strategy options. These tidal wetlands serve several critical functions; they furnish essential spawning, foraging, and nesting habitat for fish, birds, and other wildlife. They function as the ecosystem's "kidneys," filtering contaminants, nutrients, and suspended sediments, allowing for higher water quality than would otherwise occur. Important finfisheries and shellfisheries are supported by tidal wetlands. They sequester more carbon than any other habitat in the watershed. And importantly, they represent our first line of defense against storm surge and flooding. Acre for acre, tidal wetlands likely provide more ecosystem services than any other habitat type in the watershed.[9]

Salt marsh vegetation is adapted to tidal flooding. If permanently inundated marshlands risk die- off and conversion to open water. Consequently, tidal wetlands are particularly susceptible to sea level rise. As a report from the Partners for the Delaware Estuary indicates, "*Tidal marshes maintain an elevation relative to sea level by the gradual accumulation of dead plant matter and sediment. Whether marshes keep pace with sea level rise or not depends on many factors, such as their productivity, sediment supply from other areas, nutrient loadings, wave and current energies, and the rate of sea level rise.*"[10] Marsh survival, therefore, depends on a balance between erosion and drowning and marshland accretion. Although it appears that accretion has slowed inundation within the Township's coastal areas somewhat, it's unclear whether the rate of future accumulation will keep pace with rising sea levels. And some reports suggest that it's not likely that the balance can be maintained.[11]

[9] "Climate Change in the Delaware Estuary", Partners for the Delaware Estuary, June 2010, p.29, http://delawareestuary.org/sciencereports
[10] ibid
[11] Atlantic Sea Level Rise, Lagoonal Marsh Loss and Wildlife Habitat Implications, Erwin, Michael R., University of Virginia, USGS, http://www.pwrc.usgs.gov/resshow/erwin1rs/erwin1rs.htm

2. Inundation Impacts

A report published by Kenneth Miller and Robert Kopp, of Rutgers University indicates that over the past century, sea levels along the New Jersey coast have risen at a rate of approximately 3.8 mm (.15 inches)/year, roughly half of which is attributable to coastal subsidence. This rate has gradually accelerated into the current century.[12] According to Kopp, 70,000 more people were affected by Hurricane Sandy in the NY/NJ area due to sea level rise (SLR) than would have been the case had there been no such increase[13]. Rising sea levels will likely result in permanent inundations of areas that currently are frequently flooded and frequent inundation of areas that only episodically flood currently.

Permanent inundation from sea level rise is only one of the hazards that climate change presents to New Jersey's coastal property and infrastructure. Higher average sea levels lead to higher storm surges and increased flooding risks[14], even if the intensity or frequency of storms remains unchanged[15]. Kemp and Horton (2013) found that, while the record 13.9-foot storm tide in New York Harbor during Hurricane Sandy was primarily due to the coincidence of the strongest winds with high tide, SLR driven by historical climate change added more than one foot to that 13.9 foot total[16]. The impact of climate change on flooding during coastal storms is greater and more immediate than the impacts of inundation from gradually rising sea levels[17]. Potential damage of flooding from hurricanes and Nor'easters is projected to increase by 14%-36% in New Jersey by 2030, due to sea level rise.

Changing climate conditions are also predicted to drive increasing storm intensity. Recent research indicates that New Jersey is receiving more of its annual precipitation from intense storms than it has in the past[18]. This increases the risk of flash floods, urban flooding, and coastal flooding, which are all closely tied to heavy precipitation events[19].

In order to assess the extent to which the Maurice River Township is exposed to flood inundation and storm surge it is necessary to evaluate the probable impacts of near-term sea-level rise for the community. An evaluation for the year 2050 is particularly informative because of the extent of possible impacts of predicted sea-level elevations by that time period. ***Figure 11*** illustrates that these impacts will occur primarily within vicinity of the more developed areas of the Township - the villages that front on the Township's river and bayside coasts, Delmont, Heislerville, Leesberg, Mauricetown, Port Norris and Port Elizabeth.

Exposure Analysis Procedure

This section of the analysis estimates the value of properties potentially exposed to flooding and sea level rise for 2050 sea level rise projections. ***It's important to stress that the data presented herein are intended for planning purposes only.*** In estimating the extent of the Township's future exposure to flood inundation it was necessary to perform a detailed geographic analysis of the community. This analysis began with a determination of the current mean higher high water (MHHW) tide levels at the

[12] "*A Geological Perspective On Sea-Level Rise and Its Impacts Along the U.S. Mid-Atlantic Coast*", K. G. Miller, R.E. Kopp, B.P. Horton, J.V. Browning, A. C. Kemp, AGU Publications, Department of Earth and Planetary Sciences, Rutgers University, 5 Dec. 2013
[13] Robert Kopp interview, WHYY "Radio Times" interview, July 1, 2014
[14] Frumhoff et al. 2007
[15] Frazier et al. 2010
[16] American Climate Prospectus, Economic Risks in the US, 2014
[17] Ibid
[18] "State of the Climate: New Jersey, 2013"; Broccoli, Kaplan, Loikith, Robinson; Rutgers Climate Institute
[19] American Climate Prospectus, Economic Risks in the US, 2014

Township's coast. MHHW is a measure of the higher of the two high tides that occur each day, averaged over a 19-year period.[20] Once the MHHW was established, it was necessary to determine the extent to which areas within the Township would be subject to flooding under various future scenarios – for the purpose of this assessment, predicted sea-level rise for the periods 2030, 2050 and 2100 were considered, consistent with the Miller et al. report.[21] However, as noted above, ***this analysis focused on projections to 2050***.

The next step of the risk assessment was to evaluate specifically which parcels within the Township were likely to be affected under the two scenarios: Mean Higher High Water Level and FEMA 1% Storm given an increase in sea-level rise for 2050 as projected by Miller et al. This was accomplished by analyzing and mapping the predicted inundation extent for each scenario. The predicted extent was then overlaid with 2012 MOD-IV property tax information published by the New Jersey Division of Taxation. Parcels with 10% or more inundation were included in this parcel-level calculation, under the assumption that if a parcel was less than 10% inundated it is not likely to experience significant structural damage. Parcels were also eliminated from the calculation if the structure did not overlap with the inundation extent.

Evaluating property tax information and the inundated parcels in tandem enabled an assessment of probable damage at the parcel level, under the 2050 sea-level rise scenario[22] https://mail.google.com/mail/u/0/?tab=8m - 14aeef1c8cf548ea__ftn1, by comparing the predicted depths of inundation throughout the Township. The scenarios were modeled using 1-meter Digital Elevation data derived from LiDAR (Light Detection and Ranging - remote sensing technology) collected in 2006. The output from this comparison was further refined through the application of depth damage curves, which are used to estimate the percentage of structural damage based on relative flood depths.[23]

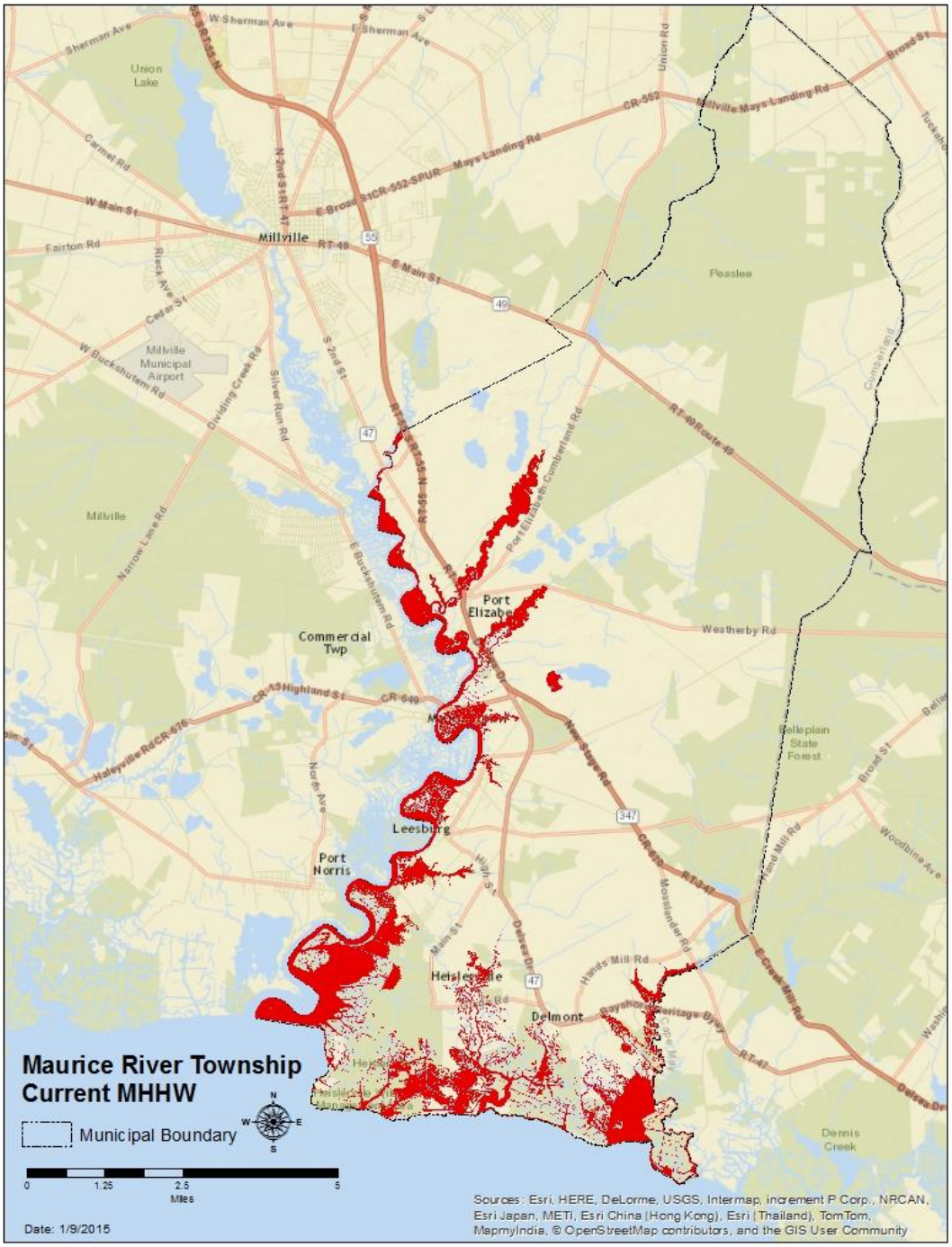
[20] The MHHW is the average of all high water heights observed over the National Tidal Datum Epoch - the specific 19-year period adopted by the National Ocean Service as the official time segment over which tide observations are taken and reduced to obtain mean values (e.g., mean lower low water, etc.) for tidal datums.

[21] See Footnote 6

[22] The 2050 scenario was determined to be a reasonable planning horizon for the purpose of the detailed assessment of exposure value. The Miller et. al. report projects low, central and high sea level rise values for 2030, 2050 and 2100. For 2050, the values range from a low of 1.08' to a high of 1.94'. ***For the purpose of this analysis the central value, 1.48', was added to the current day MHHW***.

[23] Developed by the U.S Army Corps of Engineers, http://planning.usace.army.mil/toolbox/library/EGMs/egm04-01.pdf

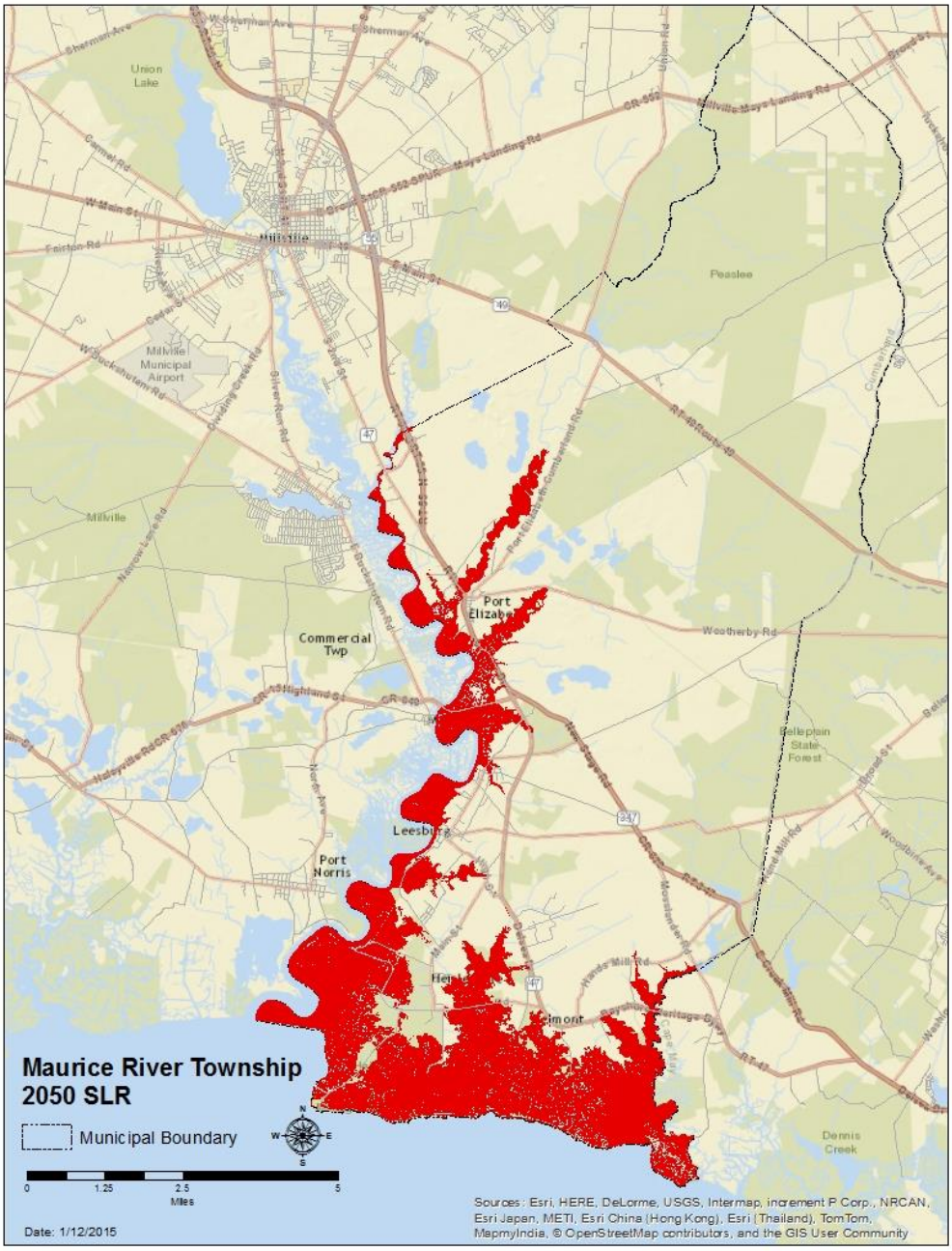
Figure 10: Current Conditions



A. Exposure Analysis: 2050 Sea Level Rise Scenario

Tables 5 and ***6*** were developed in accordance with the procedure outlined above and provides a breakdown of value of inundated parcels – "***exposure value***" - under the 2050 sea-level rise scenario.[24] ***Figure 11*** illustrates the 2050 Sea Level Rise exposure extent, demonstrating the projected impact within the boundaries of the Township. In addition to the improvement value (value of structures); the total land value associated with the inundated parcels is presented in ***Table 6***.

Figure 11: 2050 Sea-level Rise



[24] For the purpose of the analysis the depth damage function for residential, 2-story structures, with at-grade elevations was applied.

Table 5: Exposure: Inundated Parcels
2050 Sea Level Rise Scenario

Property Class (Class Code)	Total Township Lots	Vulnerable Lots	% Vulnerable Lots	Total Township Acres	Vulnerable Acres	% Vulnerable Acres
Vacant (1)	2,744	503	18%	8,977	2,026	23%
Residential (2)	1,587	139	9%	5,732	1,211	21%
Farm (3A)	20	6	30%	512	54	10%
Farm (3B)	68	7	10%	7,719	86	1%
Commercial (4A)	58	14	24%	312	107	34%
Industrial (4B)	40	7	18%	2,013	28	1%
Apartment (4C)	2	0	0%	7	0	0%
Class I Rail Road Property (5A)	5	0	0%	39	0	0%
Class II Rail Road Property (5B)	1	0	0%	14	0	0%
Public School Property (15A)	1	0	0%	14	0	0%
Other School Property (15B)	8	0	0%	53	0	0%
Public Property (15C)	2,986	320	11%	28,369	3,925	14%
Church/Charitable (15D)	19	2	11%	55	9	17%
Cemeteries and Graveyards (15E)	11	0	0%	17	0	0%
Other Exempt (15F)	119	59	50%	4,863	1,186	24%
Total	**7,669**	**1,057**	**14%**	**58,697**	**8,632**	**15%**

As ***Table 5*** reveals, under the 2050 sea-level rise scenario, 1,057 of the Township's 7,669 parcels (14%) and 15% (8,632 acres) of the total area of the community (58,697 acers) will be either partially or entirely inundated regularly during high tide conditions.[25] ***Table 6*** reveals that the value of these affected parcels represents 13% of the net taxable value of the entire municipality and 35% of the commercial areas of the Township.

Table 6: Exposure Value: Inundated Parcels
2050 Sea Level Rise Scenario

Property Class (Class Code)	Total Township Assessed Value	Vulnerable Land Value	Vulnerable Improvement Value	Vulnerable Parcels Value	% of Total Value
Vacant (1)	$17,406,549	$3,168,403	$0	$3,168,403	18%
Residential (2)	$238,423,343	$9,558,865	$14,925,393	$24,484,258	10%
Farm (3A)	$2,424,979	$209,330	$512,200	$721,530	30%
Farm (3B)	$2,346,998	$78,405	$0	$78,405	3%
Commercial (4A)	$20,357,164	$4,722,800	$2,317,979	$7,040,779	35%
Industrial (4B)	$15,040,269	$883,025	$710,000	$1,593,025	11%
Apartment (4C)	$619,700	$0	$0	$0	0%
Class I Rail Road Property (5A)	$0	$0	$0	$0	0%
Class II Rail Road Property (5B)	$0	$0	$0	$0	0%
Public School Property (15A)	$8,703,600	$0	$0	$0	0%
Other School Property (15B)	$176,324	$0	$0	$0	0%
Public Property (15C)	$142,568,313	$4,355,258	$2,759,100	$7,114,358	5%
Church/Charitable (15D)	$4,524,518	$108,918	$1,010,500	$1,119,418	25%
Cemeteries and Graveyards (15E)	$72,600	$0	$0	$0	0%
Other Exempt (15F)	$6,307,725	$1,295,909	$0	$1,295,909	21%
Total	**$458,972,082**	**$24,380,913**	**$22,235,172**	**$46,616,085**	**10%**
Net Taxable	**$296,619,002**	**$18,620,828**	**$18,465,572**	**$37,086,400**	**13%**

Parcel level property values presented in the exposure value tables in this report are obtained from the MOD-IV data set assembled and maintained by the New Jersey Division of Taxation and posted on the New Jersey Geographic Information Network web site[26]. The data presently available is an extract from the Division of Taxation's 2012 MOD IV data base.

[25] All parcels less than 10% flooded were not considered inundated and not included in the exposure value

[26] https://njgin.state.nj.us/NJ_NJGINExplorer/DataDownloads.jsp

The 2012 General Tax Rate tables for New Jersey Counties and Municipalities is posted on New Jersey's Department of Treasury, Division of Taxation's web site.[27] The applicable table for Cumberland County indicates that the 2012 General Tax Rate for Maurice River Township was $2.37 per $100 of assessed value. Based on this rate, under the 2050 Sea Level Rise scenario, the loss to the Township of $37 million of assessed value the community's taxable properties would result in a potential real estate tax revenue loss of $879,000, to the municipality. This loss would amount to 12% of the Township's total tax levy, which in 2012 was $7,118,595.[28]

B. Exposure Analysis: 2050 Sea Level Rise with 1% Annual Flood

The foregoing 2050 Sea Level Rise scenario assumes that areas of the municipality will be regularly inundated and, therefore, exposure values included total land and structural values for all parcels that are projected to be more than 10% inundated. However, for those additional parcels impacted under the 2050 Sea Level Rise plus 1% Storm scenario, land value may or may not be affected. Structures on properties that may be inundated by episodic flooding (e.g., a 1% storm) can and often are rebuilt. Since it's not possible to predict which parcels may or may not be suitable for redevelopment under this future scenario, three alternative exposure values have been calculated assuming: **1)** 100% of the land value is permanently extinguished; **2)** 50% of exposed land value is permanently lost, and **3)** no land value is permanently lost.

Table 7: Exposure - Inundated Parcels
2050 Sea-Level Rise with 1% Annual Flood

Property Class (Class Code)	Total Township Lots	Vulnerable Lots	% Vulnerable Lots	Total Township Acres	Vulnerable Acres	% Vulnerable Acres
Vacant (1)	2,744	688	25%	8,977	2,828	31%
Residential (2)	1,587	609	38%	5,732	2,811	49%
Farm (3A)	20	12	60%	512	147	29%
Farm (3B)	68	15	22%	7,719	152	2%
Commercial (4A)	58	26	45%	312	132	42%
Industrial (4B)	40	13	33%	2,013	43	2%
Apartment (4C)	2	0	0%	7	0	0%
Class I Rail Road Property (5A)	5	0	0%	39	0	0%
Class II Rail Road Property (5B)	1	0	0%	14	0	0%
Public School Property (15A)	1	1	100%	14	5	35%
Other School Property (15B)	8	1	13%	53	31	58%
Public Property (15C)	2,986	390	13%	28,369	4,889	17%
Church/Charitable (15D)	19	10	53%	55	16	30%
Cemetaries and Graveyards (15E)	11	0	0%	17	0	0%
Other Exempt (15F)	119	75	63%	4,863	1,265	26%
Total	**7,669**	**1,840**	**24%**	**58,697**	**12,319**	**21%**

Table 7 indicates that after accounting for rising sea levels by 2050, in the event of a 1% annual flood, 1,840 of the Township's 7,669 parcels (24%) would be entirely or significantly[29] inundated. The area of these parcels exceeds 12,300 acres, comprising almost 21% of the total area of the community. ***Table 8*** reveals that these parcels have a total net assessed value of $76.2 million represent approximately 26% of the entire total assessed value of the Township. **Figure 12: 2050 Sea-level Rise Scenario under a 1% Storm Event,** identifies areas that will be affected in locations throughout the Township.

[27] http://www.state.nj.us/treasury/taxation/lpt/taxrate.shtml
[28] Includes county, school and municipal taxes levied
[29] 10% or greater inundation

Figure 12: 2050 Sea-level Rise Scenario under a 1% Storm Event

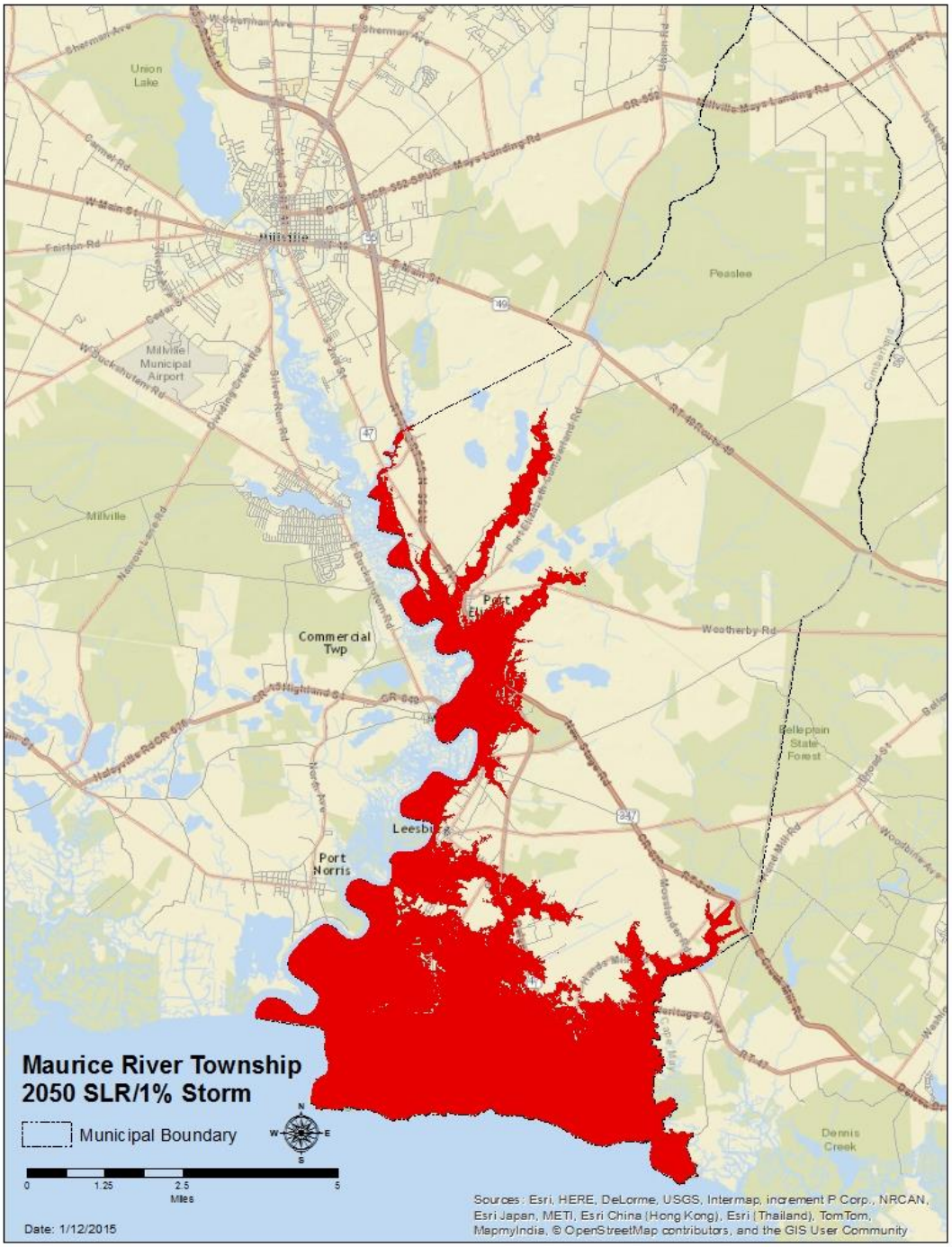


Table 8: Exposure Value - Inundated Parcels
2050 Sea-Level Rise with 1% Annual Flood (100% Extinguished Land Value)

Property Class (Class Code)	Total Township Assessed Value	Vulnerable Land Value	Vulnerable Improvement Value	Vulnerable Parcels Value	% of Total Value
Vacant (1)	$17,406,549	$7,232,944	$447,059	$7,680,003	44%
Residential (2)	$238,423,343	$30,345,853	$23,561,500	$53,907,353	23%
Farm (3A)	$2,424,979	$507,534	$555,484	$1,063,018	44%
Farm (3B)	$2,346,998	$174,841	$0	$174,841	7%
Commercial (4A)	$20,357,164	$8,995,285	$2,839,158	$11,834,443	58%
Industrial (4B)	$15,040,269	$750,075	$756,047	$1,506,122	10%
Apartment (4C)	$619,700	$0	$0	$0	0%
Class I Rail Road Property (5A)	$0	$0	$0	$0	0%
Class II Rail Road Property (5B)	$0	$0	$0	$0	0%
Public School Property (15A)	$8,703,600	$200,000	$790,835	$990,835	11%
Other School Property (15B)	$176,324	$36,900	$0	$36,900	21%
Public Property (15C)	$142,568,313	$15,469,869	$23,682,789	$39,152,658	27%
Church/Charitable (15D)	$4,524,518	$345,618	$1,182,299	$1,527,917	34%
Cemeteries and Graveyards (15E)	$72,600	$0	$0	$0	0%
Other Exempt (15F)	$6,307,725	$1,592,689	$73,832	$1,666,521	26%
Total	**$458,972,082**	**$65,651,608**	**$53,889,003**	**$119,540,611**	**26%**
Net Taxable	**$296,619,002**	**$48,006,532**	**$28,159,248**	**$76,165,780**	**26%**

Applying Maurice River Township's 2012 General Tax Rate - $2.37 per $100 of assessed value - to the total net value of all exposed, taxable properties under the 2050 Sea Level Rise with a 1% Annual Flood scenario, amounting to $76 million as shown in ***Table 8***, would result in a potential real estate tax revenue loss of $1.8 million.

Table 9: Exposure Value- Inundated Parcels
2050 Sea-Level Rise with 1% Annual Flood (50% Extinguished Land Value)

Property Class (Class Code)	Total Township Assessed Value	Vulnerable Land Value	Vulnerable Improvement Value	Vulnerable Parcels Value	% of Total Value
Vacant (1)	$17,406,549	$5,200,674	$447,059	$5,647,733	32%
Residential (2)	$238,423,343	$19,952,359	$23,561,500	$43,513,859	18%
Farm (3A)	$2,424,979	$358,432	$555,484	$913,916	38%
Farm (3B)	$2,346,998	$126,623	$0	$126,623	5%
Commercial (4A)	$20,357,164	$6,859,043	$2,839,158	$9,698,201	48%
Industrial (4B)	$15,040,269	$1,258,063	$756,047	$2,014,110	13%
Apartment (4C)	$619,700	$0	$0	$0	0%
Class I Rail Road Property (5A)	$0	$0	$0	$0	0%
Class II Rail Road Property (5B)	$0	$0	$0	$0	0%
Public School Property (15A)	$8,703,600	$100,000	$790,835	$890,835	10%
Other School Property (15B)	$176,324	$18,450	$0	$18,450	10%
Public Property (15C)	$142,568,313	$9,912,564	$23,682,789	$33,595,353	24%
Church/Charitable (15D)	$4,524,518	$227,268	$1,182,299	$1,409,567	31%
Cemeteries and Graveyards (15E)	$72,600	$0	$0	$0	0%
Other Exempt (15F)	$6,307,725	$1,444,299	$73,832	$1,518,131	24%
Total	**$458,972,082**	**$45,457,773**	**$53,889,003**	**$99,346,776**	**22%**
Net Taxable	**$296,619,002**	**$33,755,193**	**$28,159,248**	**$61,914,441**	**21%**

Table 9 assumes a **50% loss in land value** for parcels inundated in the event of a 1% flood, in addition to the parcels subject to 2050 Sea Level Rise inundation. Under this alternative, the total loss (value of exposed land and structures) would amount to $62 million or approximately 21% of the Township's net taxable assessed value.

Table 10: Exposure Value - Inundated Parcels
2050 Sea-Level Rise with 1% Annual Flood (0% Extinguished Land Value)

Property Class (Class Code)	Total Township Assessed Value	Vulnerable Land Value	Vulnerable Improvement Value	Vulnerable Parcels Value	% of Total Value
Vacant (1)	$17,406,549	$3,168,403	$447,059	$3,615,462	21%
Residential (2)	$238,423,343	$9,558,865	$23,561,500	$33,120,365	14%
Farm (3A)	$2,424,979	$209,330	$555,484	$764,814	32%
Farm (3B)	$2,346,998	$78,405	$0	$78,405	3%
Commercial (4A)	$20,357,164	$4,722,800	$2,839,158	$7,561,958	37%
Industrial (4B)	$15,040,269	$883,025	$756,047	$1,639,072	11%
Apartment (4C)	$619,700	$0	$0	$0	0%
Class I Rail Road Property (5A)	$0	$0	$0	$0	0%
Class II Rail Road Property (5B)	$0	$0	$0	$0	0%
Public School Property (15A)	$8,703,600	$0	$790,835	$790,835	9%
Other School Property (15B)	$176,324	$0	$0	$0	0%
Public Property (15C)	$142,568,313	$4,355,258	$23,682,789	$28,038,047	20%
Church/Charitable (15D)	$4,524,518	$108,918	$1,182,299	$1,291,217	29%
Cemeteries and Graveyards (15E)	$72,600	$0	$0	$0	0%
Other Exempt (15F)	$6,307,725	$1,295,909	$73,832	$1,369,741	22%
Total	**$458,972,082**	**$24,380,913**	**$53,889,003**	**$78,269,916**	**17%**
Net Taxable	**$296,619,002**	**$18,620,828**	**$28,159,248**	**$46,780,076**	**16%**

Table 10 assumes **no loss in land value** for parcels inundated in the event of a 1% flood, in addition to the parcels subject to 2050 Sea Level Rise inundation. Under this alternative, the total loss (value of exposed land and structures) would amount to $47 million or approximately 16% of the Township's net taxable assessed value.

Conclusion

The preceding analysis indicates that, ***if no actions are taken to minimize future risk***, under the 2050 Sea Level Rise projection of 1.48 feet, 15% of the area of Township, or over 8,600 acres – encompassing 1,057 parcels - would be exposed to flood inundation. The land value and the value of the structures currently constructed on the parcels subject to inundation would amount to over $37 million dollars, or 13% of the net taxable assessed value of the community, based on the Township's present day valuation. By 2050, a 1% storm, coupled with projected sea level rise would increase the number of parcels that would be at risk of inundation to over 1,840, exposing 21% of the area of the Township to flooding. The loss in the Township's assessed value from the impact of such inundation is estimated to range from $46.7 million to $76.2 million, or from 16% to 26% of the total assessed value of the community. In addition, the above analysis indicates that 7% of the area of the Township (1,967 acres) currently located within high-risk FEMA flood zones are zoned for residential and/or commercial development. Furthermore, over 63% (12,661 acres) of the Township's wetlands areas are located in high-flood risk A, AE or VE flood zones. These areas currently provide spawning, foraging, and nesting habitat and are the Township's first line of defense against flooding and storm surge providing critical protection to the adjacent residential and commercial areas. Fortunately, almost all of the areas designated for residential uses

This vulnerability and exposure analysis is intended to serve as the basis for an informed discussion among the elected and municipal officials of Maurice River Township and the between the municipal officials and the residents of the community about how best to prepare for and adapt to potential risks associated with projections of sea level rise and associated increasing flooding. The information

presented in this report should better equip the Township to make sound near and long-term land use planning and development decisions and formulate efficient and effective public investment strategies to guide recovery management, reconstruction, resiliency and adaptation measures. To that end, the data raises several questions, including but certainly not limited to:

- What types of infrastructure should the Township invest in that are most resistant to flooding, and can improve stormwater management capacity, particularly in those areas that are projected to be at risk?
- What strategies should the Township pursue to protect residential and commercial development in vulnerable areas along the coastline as well as the infrastructure that serves these areas?
- What measures can be taken to preserve, protect and extend the Township's coastal marshes and wetlands that currently serve as protective buffers? What is the likely impact to the economy and quality of life if these important natural resources revert to open water as a consequence of inundation?
- What emergency response measures can the Township put in place in the event that flooding makes critical evacuation routes impassable?
- What land use strategies can be employed to help gradually shift development to areas that would avoid or minimize risks of exposure to future flooding and inundation? How can those strategies be designed to best protect the safety of the residents at risk areas, retain community character and preserve the Township's economic stability?
- How can the Township most effectively engage residents in an ongoing discussion about vulnerability as well interim and long-term strategies that would be most suited to respond to potential risk?
- In view of the fact that effect strategies to address vulnerability may entail regional responses, what are the appropriate county, state and federal-level partnerships the Township needs to foster to help manage future challenges?
- What interim measures are needed, such as modifications/updates to floodplain management regulations, building codes and elevation standards to ensure public safety? Are current standards effective and what monitoring measures should be enacted to gauge the need for regulatory changes over time?

Chapter 4 Getting To Resilience Process and Report

As noted previously, the Township participated in a "Getting To Resilience" (GTR) process that used the on-line GTR questionnaire[30] and was facilitated by Jacques Cousteau National Estuarine Research Reserve (JCNERR) staff. The Getting to Resilience process started as a facilitated discussion regarding the Township's strengths, weaknesses, and hurdles concerning resiliency, the Township's codes, policies and procedures were then analyzed and the finally a series of recommendations for enhance resiliency were developed.

The GTR questionnaire is divided 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 Maurice River Township, this team included Gordon Gross (Construction & Zoning Official, OEM), Ben Stowman (Land Use Board Chair), Tiffany Cuviello (Professional Planner), and Andrew Sarclette (Mayor). The questions in the GTR questionnaire were answered by the municipality with JC NERR staff recording answers and taking notes on the discussions connected to each question.

The Getting to Resilience questionnaire was started with the town on April 30, 2014. JCNERR staff met with three representatives of Highlands and one representative of NJ Future. A discussion of the towns' resilience strengths and weaknesses began the meeting and sections one and three of the questionnaire were completed. On May 7, 2014, the questionnaire was completed with three (3) representatives of the Township meeting with JCNERR staff.

Upon completion of the GTR questionnaire, JCNERR staff analyzed the answers provided by the 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 and the NJ Floodmapper website[31]. After reviewing all of this information, this recommendations report was drafted to help assist Maurice River's decision makers as the Township works to recover from Hurricane Sandy and become more resilient.

The majority of the recommendations are related to communications and outreach activities, including ensuring that residents and businesses are aware of their vulnerability to storm events and flooding. However, there are also recommendations related to Township ordinances, maintaining records of various types in easily accessible locations, preparing a mitigation plan for properties that experience recurring flood damage, and capital improvements such as a continuous dune line.

These recommendations have been integrated into this report's recommendations chapter and implementation matrix. This Final Report is attached as ***Appendix 2 Getting To Resilience Report and Recommendations***.

[30] See http://www.prepareyourcommunitynj.org/
[31] See http://slrviewer.rutgers.edu

Chapter 5 Assessment of Existing Planning and Zoning Documents

Ten recent plans and studies were reviewed as a first step in identifying actions that are most urgently needed to improve public safety, increase resistance from damage from future storms and stimulate economic recovery. These included the Township's master plan, topic specific plans, the County's emergency management plan and studies that were performed as part of academic work. **Table 11** provides a list of the plans and studies reviewed for this SRPR. In addition, the Township Zoning Ordinance was analyzed as part of the GTR process.

Table 11: Planning Documents Reviewed

Name	Author	Date
Strategies for Flood Risk Reduction for Vulnerable Coastal Populations along the Delaware Bay	Rutgers School of Engineering	2014
Cumberland County Community Recovery Plan - FEMA	FEMA, community	2013-2014
Getting To Resilience Report	Jacques Cousteau National Estuarine Research Reserve	2014
Master Plan (2000) and Re-Examinations (2006 and 2012/2013)	Robert Brewer, PP (2000) Land Use Board (2006) Tiffany Cuviello, PP, (2012/2103)	2000, 2006, 2012, 2013
Draft Mitigation Plan for Four NJ Counties	Stuart Wallace, LLC	2014
Marsh Futures	Partnership for the Delaware Estuary (PDE)	2015

Existing Planning Document Analysis

These plans and studies recommend hundreds of separate actions. These recommendations were then vetted to eliminate those that had already been accomplished or were no longer valid and those that were not urgently needed to improve public safety, increase resistance to damage from future storms and stimulate economic recovery.

In addition to the review of existing plans and studies performed in conjunction with the SRPR, existing plans and regulations were examined in conjunction with the GTR process to determine how effective they were in helping the community to become resilient to flooding and storm events. Existing municipal procedures and processes, policies and notification actions were included in this review. More details are included in **Appendix 1**. This process yielded several additions to the list of recommended actions.

This assessment of the Township's existing planning documents, land-use regulations and other related regional plans is intended accomplish three objectives:

1. Determine whether such documents contribute to or create obstacles for implementing the municipality's recovery strategies;
2. Determine the extent to which such documents account for the likelihood of future storms and impacts of climate change, most particularly sea-level rise in the case of coastal communities, and;
3. Recommend opportunities to modify, update and/or strengthen current plans and regulations to better equip the Township to effectively accomplish recovery strategies and address climate changes.

While the Master Plan is the primary planning policy document for the Township, and will be assessed as noted above, several other plans and studies have recently been completed and are summarized below, since they may have relevance to this SRPR and to the Township's continuing recovery.

1. Strategies for Flood Risk Reduction for Vulnerable Coastal Populations along the Delaware Bay-Rutgers University Department of Engineering (August 2014)

This report indicates that the communities of Heislerville, Leesburg and Dorchester in Maurice Township are located within the 100-year flood zone and were flooded by the coastal storm surge produced by Superstorm Sandy in 2012.

The community is currently protected from flooding by a levee system on the Maurice River, called the Heislerville impoundment, that is not high enough or extensive enough to offer protection for coastal storms of an intensity greater than a 10-year event. Accordingly, it is recommended that consideration be given to elevating the existing Heislerville Impoundment and Thompson levees that protect the community to a height that will offer protection from a 100-year coastal storm and future sea level rise.

Consideration should also be given to extending the existing levees laterally to the north along the Maurice River and north then east of the Thompson levee. This extension would eliminate surge water pathways that allow flood waters to bypass the levees and flood the communities. If implemented, these flood mitigation measures will offer the community greater protection from the 100-year coastal storm event and future sea level rise than that which exists today.

2. Cumberland County Community Recovery Plan – FEMA

The State of New Jersey, Cumberland County's Bayshore community stakeholders and the Federal Emergency Management Agency's Community Recovery Assistance team determined that the Cumberland County Delaware Bayshore region would greatly benefit from a targeted technical assistance program. The New Jersey Delaware Bayshore Long-Term Recovery Committee was formed to identify recovery objectives and plan for future Bayshore issues. This committee formulated the Cumberland County Delaware Bayshore Recovery Plan,[32] which prioritizes recovery efforts that will help these communities achieve long-term recovery goals.

The Cumberland County Delaware Bayshore Recovery Plan identified **26** projects that would contribute to the recovery effort. The projects were assigned priority that ran from Vital, Important, Of Interest, and Community Interest. These projects will be implemented by subcommittees including Intergovernmental Relations, Tourism and Economic Development, Infrastructure, and Shoreline Protection/Coastal Management.

Intergovernmental Relations projects include:

1. Formation of a Bayshore Council/Conference (Vital)
2. Bayshore Resiliency & Sustainability Education & Outreach (Important)
3. Bayshsore Resiliency Roundtable (Important)

Tourism and Economic Development projects include:

4. Business Retention and Recruitment Plan (Vital)
5. Business Plan Initiatives Implementation (Vital)
6. Bayshore Eco-Tourism/Business Improvement Task Force (Vital)
7. Bayshore Marketing and Destination Plan (Vital)
8. Tourism Initiatives Implementation (Vital)
9. Historic Bayshore Oyster Industry Revitalization (Vital)
10. Maurice River Rails-to-Trails (Important)

[32] http://www.mauricerivertwp.org/pdfdocs2014/RecoveryPlanFEMAfinal.pdf

Infrastructure projects include:
11. Wastewater Management Feasibility Study (Vital)
12. Public Water Supply Feasibility Study (Vital)
13. Road Elevations & Improvements (Vital)
14. Emergency Generators (Important)
15. Transportation and Social Services Initiative (Important)
16. Telecommunications Infrastructure Needs Assessment (Important)

Shoreline Protection/Coastal Management projects include:
17. Beach and/or Dune Restoration (Vital)
18. Berms/Levees (Upland/Marshland) Restoration (Vital)
19. Bulkheads and Other Hard Structures Restoration and Construction (Vital)
20. Creek Maintenance Dredging (Vital)
21. Dikes/Levees (Waterfront) Restoration (Vital)
22. Maurice River at Peak of the Moon Bank Stabilization (Vital)
23. Maurice River at Bivalve Bank Stabilization (Vital)
24. Maurice River Northwest Reach Bank Stabilization and Marsh Re-Establishment (Vital)
25. Mouth of Cohansey River Restoration — Including Dredging (Vital)
26. Mouth of Maurice River Restoration — Including Dredging (Vital)

3. Getting to Resilience Report and Recommendations (2014)[33]

As discussed in the previous chapter, this is a web based questionnaire and process that was developed by NJ DEP and enhanced by the Jacques Cousteau National Estuarine Research Reserve. In Maurice River Township, the participants were: Gordon Gross (Construction & Zoning Official, OEM), Ben Stowman (Land Use Board Chair), Tiffany Cuviello (Professional Planner), and Andrew Sarclette (Mayor).

Goal: To foster municipal resiliency in the face of flooding, coastal storms, and sea level rise.

Recommendations: The GTR process resulted in identification of numerous recommendations that could increase the Township's Community Rating System ranking, improve communications and outreach and promote physical improvements, resiliency planning, municipal operations and zoning ordinance revisions. All of these actions are fully described in the report.

4. Township Master Plan & Re-examination

The Township Master Plan, adopted in 2000, articulates the following goals and objectives:

- To stimulate locally-oriented economic development opportunities
  - Use the Township's natural and cultural resources as a basis for sustainable economic development
  - Tap into the seasonal shore traffic on Routes 47 and 347
- Maintain and enhance the small town atmosphere of the existing communities within the Township
  - Encourage the rehabilitation and restoration of vacant and underused buildings and properties
  - Require new development to be architecturally compatible with the surrounding community
- Conserve Natural Resources
  - Use benefits of ecotourism to offset the impacts of environmental regulations on the community

[33] See Appendix 2 Getting To Resilience Report

  - Buffer environmentally sensitive areas from development
- Future land use and development compatible with the rural, small town atmosphere of the Township
  - Encourage new businesses and commercial development along Route 47 to attract and serve customers from the shore traffic using Route 347
  - Maintain the existing pattern of primarily forest land, open space and other low intensity uses east of Route 47
- Maintaining a navigable channel in the Maurice River to the Delaware Bay. This is a concern shared with the Port Norris area of Commercial Township.

The Township Master Plan Re-examination adopted in 2006 articulates the following goals and objectives:

- Maintain, enhance, preserve and protect the maritime commercial uses along the Maurice River.
- Protect the access to the Maurice River and its natural opportunities for river related activities for recreation and ecotourism like marinas, fishing industries and boat yards.
- Improve business opportunities along all of Route 47 and provide improved access to Route 347 for that portion located below the hamlet of Mauricetown Station which serves estuary and bay habitats and the economy that is derived from them.

The Township Master Plan Re-examination adopted in 2012 and 2013 articulates the following goals and objectives:

- Continue to work with the Pinelands Commission, NJDEP and other agencies to create opportunities for active recreation on former mining sites.
- Work with the Pinelands Commission to improve upon the existing commercial zoning districts located along Route 347
- The re-examination also specified specific areas for clustering development in accordance with Pinelands Commission regulations

5. Draft Mitigation Plan for Four NJ Counties (2014)

The mitigation plan[34] identified that the high priority hazards Maurice River Township faces include coastal erosion and sea level rise, flooding, high winds, levee failure, and wildfire. Moderate priority hazards include dam failure, earthquakes, and severe weather. Drought was classified as a low priority hazard. Critical facilities that may be affected by these hazards include Township Hall, Office of Emergency Management, communication towers, Public Works Facility, Fire/EMS stations, the Delmont Building (Post Office), and the elementary school.

Mitigation Measures Summary:
The Municipal Working Group established the following mitigation goals:

1. improved education and outreach efforts;
2. improved data collection;
3. improved capabilities and coordination; and
4. plan and project implementation.

The implementation of mitigation measures will be performed on a municipal-wide and a multi-jurisdictional basis.

[34] http://files.nj4hmp.com/DraftAppen/CuC_10_Maurice_River_TWP_DMA_2015_0109.pdf

Municipal mitigation measures include identification and pursuit of outreach and education opportunities, prioritization of critical facilities including identification of vulnerabilities, prioritization of recurrent drainage problem areas, and conducting regular Municipal Working Group meetings.

Mitigation Measures include:

1. Install backup power generator at Maurice River Township School, the township's largest shelter.
2. Install backup power generator at Maurice River Township Municipal Hall
3. Improvement of the dike network in Heislerville at Matt's Landing. This network is failing and protects the village of Heislerville from flooding.
4. Elevate the roadway; Main Street, Dorchester at Crowder Run. Roadway is prone to storm surge and tidal flooding.
5. Elevate the roadway; Mauricetown Causeway. Roadway is prone to storm surge and tidal flooding.
6. Elevate the roadway; Glade Road, Heislerville. Roadway is prone to storm surge and tidal flooding.
7. Create safety zones around critical facilities in wildfire risk areas.
8. Identify and map erosion hazard zones.
9. Acquisition/Elevation of 3 Repetitive Loss properties located on Blocks 32, 330, & 333.
10. Acquisition/Elevation of 5 Repetitive Loss properties located on Bay Ave.
11. Acquisition/Elevation of 1 Repetitive Loss property located on Moore's Beach Road.
12. Use USACE surge maps for community education and outreach.

Municipal Mitigation Measures include:

1. Identify and pursue outreach and education opportunities. (Estimated Cost: Staff Time Commitment)
2. Prioritize critical facilities and complete site and facility surveys to identify vulnerabilities and potential mitigation measures. (Estimated Cost: Staff Time Commitment)
3. Prioritize recurrent drainage problem areas and initiate data collection to track unreimbursed damages and related response and recovery expenses. (Estimated Cost: Staff Time Commitment)
4. Conduct regular Municipal Working Group meetings. (Estimated Cost: Staff Time Commitment)
5. Install an 85 kV backup power generator at Maurice River Township Hall. (Estimated Cost: $86K)
6. Install 125 kV backup power generator at Maurice River Township Elementary School (Estimated Cost: $136K)
7. Install backup power generator at Heislerville Fire Station. (Estimated Cost: less than $100K)
8. Install backup power generator at Cumberland Fire Station. (Estimated Cost: T.B.D.)
9. Install backup power generator at Port Elizabeth Fire Station. (Estimated Cost: less than $100K)
10. Require backup power generator at communication towers. (Estimated Cost: Staff Time Commitment through Regulations & Ordinances)
11. Address identified Repetitive Flood Loss Properties. (Estimated Cost: Staff Time Commitment)
12. Create safety zones around critical facilities in or near wildfire risk areas including Cumberland Fire Station. (Estimated Cost: Staff Time Commitment)

Multi-Jurisdictional mitigation measures mostly relate to areas that are prone to flooding from storm surge and tidal influence.

Multi-jurisdictional mitigation measures are as follows:

1. Alleviate flooding at Main Street, Dorchester at Crowder Run
2. Alleviate flooding at Glade Road, between Heislerville and Delmont
3. Alleviate flooding at NJ 47 in Bricksboro
4. Alleviate flooding at Mauricetown Causeway
5. Alleviate flooding at East Point Road
6. Alleviate flooding at River Road.
7. Alleviate flooding at Newell Road.
8. Alleviate flooding at NJ 47 & Whitney Point.
9. Alleviate flooding at Carlisle Place Road at Crowder Run Branch Crossing in Dorchester (CR 709).
10. Improvement of dike network in Heislerville at Matt's Landing. This network protects Delmont and Heislerville from flooding.
11. Impact of Sea Level Rise on septic systems and cesspools.

Mitigation measure implementation will be performed at the regional, county, and municipal levels. Mitigation efforts will require coordination between municipal governmental agencies and their communities along with county and state agencies. Plan integration of hazard mitigation goals, efforts, and recommendations will be made at the municipal level by sessions conducted by the Municipal Working Group.

6. Marsh Futures[35]

"*Marsh Futures is a survey tool to provide local site planning support and guidance for investments in salt marsh protection and enhancement. In the Delaware Estuary and vicinity, coastal wetlands are being lost and degraded at an alarming rate (more than an acre per day in the Delaware Estuary). More than 90% of our wetland tracts are eroding significantly, and coastal wetland loss is especially acute in areas dominated by micro-tidal salt marshes. The rate of wetland losses is expected to increase with the increasing rate of sea level rise. This presents enormous challenges to coastal communities and resource managers since coastal wetlands are a hallmark habitat type in the region, responsible for coastal flood protection, fish and wildlife production, and the maintenance of water quality…Interest in preserving natural coastal infrastructure is also very high because of the lessons learned from Hurricane Sandy, which revealed that coastal flood damages were not as severe in areas that still had protective coastal wetlands. As a result, many new protection and enhancement tactics that are emerging that promise to help offset wetland losses, such as living shorelines and sediment applications; e.g., the Delaware Estuary Living Shorelines Initiative.*"[36] The study recommended the following for the Maurice River shorelines.

The greatest vulnerability at the studied salt marsh along the Maurice River was deemed to be edge erosion, and hence it was considered to be more "horizontally challenged". The studied parcel of Maurice marsh had ample elevation and was likely benefiting from natural processes that create higher levee areas.

[35] Marsh Futures is a technical report submitted in support of the Bayshore Sustainable Infrastructure Planning Project (BaySIPP) and funded by the grant "Creating a Sustainable Infrastructure Plan for the South Jersey Bayshore" http://delawareestuary.org/science_reports_partnership.asp

[36] See Marsh Futures, Partnership for the Delaware Estuary, Wilmington, DE. PDE Report No. 15-03, Kreeger, D., J. Moody, M. Katkowski, M. Boatright and D. Rosencrance. 2015, page 1.

The Marsh Futures report points out that "large scale wave attenuation devices in both the sub-tidal and intertidal portions of the Bay-ward side are recommended, as soon as possible. In addition, bio-based living shorelines are recommended along the entire east-facing marsh edge, with intertidal groins placed near the creek mouth."[37]The report explicitly recommends the following strategies for Maurice River:

1. *Sub-tidal Sills and Breakwaters: As the primary driver of erosion at the Maurice River shoreline is the large scale incoming wave energy due to exposure to the entire fetch of the Bay, subtidal sills/breakwaters are recommended to dampen the energy moving up river and act as a first line of defense against high magnitude storm surges. The feasibility and exact placement of materials would be contingent on geotechnical, hydrologic and bathymetric surveys.*

2. *Intertidal/Subtidal Hybrid Living Shorelines: A secondary line of defense is recommended, consisting of hybrid living shorelines comprised of oyster castle breakwaters. These would provide additional energy attenuation of wind driven waves behind the subtidal, offshore sills/breakwaters. A final line of coir fiber logs along the intertidal vegetated marsh edge would help to trap sediment for grass production and mussel recruitment, leading to enhanced marsh strength and resistance to erosion along the Bay-ward edge.*

3. *Intertidal Bio-based Living Shorelines: Along the creek edge, bio-based living shorelines would help to stem creek widening and promote a healthy, vegetative edge. Cusps of interlocking logs would be installed in the intertidal zone to trap sediment that is being removed from the marsh by creek drainage, and promote grass growth and ribbed mussel habitat.*

4. *Intertidal Groins: Intertidal groins of oyster castles would be placed along these bio-based installations at the Bay-ward end. This would help to intercept and decrease incoming wave energy before making contact with the soft armor coir logs.*

[37] Ibid, page 45

Chapter 6 Recommendations for Action

Chapter 5 offered an overview of the plans and studies that were reviewed in preparing this Report. This review resulted in hundreds of separate recommended actions. These recommendations were then vetted to eliminate those actions that had been accomplished or were no longer valid or were redundant. The items in this remaining list are considered as "potential priority actions" and were further analyzed using the vulnerability assessment to determine which would require an alternatives evaluation. They are not listed in a value-numeric order.

While all of these projects are important to the Township, resources are limited, in terms of the municipality's budget as well as potential outside sources. However, in accordance with direction from the New Jersey Department of Community Affairs, this SRPR is explicitly intended to prioritize actions that are most urgently needed to improve public safety, increase resistance to damage from future storms, and stimulate economic recovery. The Highest Priority Actions are listed in the following table and described below.

Table 12: Highest Priority Actions

Shoreline stabilization and dredging of the Maurice River
Shoreline stabilization and protection of the East Point Lighthouse
Investigating wastewater solutions in the established villages and highway corridors
Redeveloping and repurposing underused structures and properties
Promote economic development within the Township
Develop signage and design regulations for the historic villages and highway corridors
Raise the levee network protecting Heislerville and Matts Landing
Alleviate flooding and raise roadways in identified locations
Install backup generators at key Township facilities

1. Shoreline stabilization and dredging of the Maurice River

Maurice River Township seeks to work in conjunction with Commercial Township, the United States Army Corps of Engineers (ACOE) and the New Jersey Department of Environmental Protection (NJDEP) on developing solutions to the erosion and siltation problems at the mouth of, and upstream, of the mouth of the Maurice River. The Township desires to aggressively pursue funding mechanisms to study the problems and to implement design solutions.

2. Shoreline stabilization and protection of the East Point Lighthouse

In November 2014, the New Jersey Department of Environmental Protection, in conjunction with the Township of Maurice River (with grant writing services provided by New Jersey Future), were awarded $500,000.00 from the New Jersey Historic Trust via the Sandy Disaster Relief Grant for Historic Properties. The grant, which will be used as matching funds for a larger United States Army Corps of Engineers project to protect the lighthouse, will be part of an approximately $1.7 million project to stabilize and protect the shoreline around the historic structure.

Post-Sandy Shoreline Erosion at the East Point Lighthouse (Nov. 2012)

The estimated timeframe to complete this shoreline stabilization is three (3) to five (5) years.

3. Investigate wastewater solutions in established villages and highway corridors
In August of 2014, the Township of Maurice River received two (2) SEARCH Grants (Special Evaluation Assistance for Rural Communities and Households) totaling $60,000.00 from the United States Department of Agriculture - Rural Development. The first $30,000.00 of the grant is being used in the Port Elizabeth/Route 47 area of the Township. The second $30,000.00 of the grant is being used in the Dorchester and Leesburg sections of the Township. The studies are being prepared by the Township Engineer, Dixon Associates, and are due to be completed in June 2015. The studies will identify potential wastewater solutions and recommendations with the projected expenditures of each project being identified.

Based on the findings of the studies, the Township will seek funding to implement the recommendations. Given the complexities and scope of any recommended project, this project is expected to take five (5) plus years to complete.

4. Redeveloping and repurposing underused structures and properties
The Township is continually reviewing selected properties and neighborhoods for redevelopment opportunities. The Maurice River Township Land Use Board recently adopted **Resolution 2014-08** which recommended to the Township Committee that Block 281, Lots 7, 8, and 18, and Block 296, Lots 33 and 34, in the Leesburg section of the municipality, be declared "In Need of Redevelopment"[38]. The Township Committee is in the process of acting on the recommendation. The site, located adjacent to the Maurice River, was home to numerous shipyards and has the potential to be developed in a fashion that could benefit the Township and its residents.

Existing Conditions: Block 281

Any subsequent Redevelopment Plan will be formulated through collaboration with the property owner, Land Use Board and Township Committee in the spring and summer of 2015.

5. Promote economic development within the Township
The Township's Deputy Mayor, Patti Gross, and the Township Committee are actively seeking to promote business and economic development within the Township. The Township's Economic Development Committee has been hosting events and seminars to assist existing and potential business owners.

The Township is working with the Cumberland County Department of Engineering and the New Jersey Department of Transportation on a signage program on Route 47, 49 and 347, to promote and identify businesses within the Township. The Bayshore Recovery group has also hosted business promotion and development programs.

[38] An area designated In Need of Rehabilitation is deemed to be a blighted area. This designation grants several powers to the municipality including the power to: acquire properties, undertake clearance, construct or reconstruct infrastructure and site improvements, replanning, development and redevelopment planning initiatives. See New Jersey Local Redevelopment and Housing Law (http://www.state.nj.us/dca/divisions/dlgs/programs/au_docs/40a_12a_1.pdf)

7. Develop signage and design regulations for the existing villages and highway corridors
Maurice River Township recognizes that its natural resources and scenic historic villages are crucial parts of the Township's past, present, and future. The Township's 2000 Master Plan sought to maintain and enhance the small town atmosphere of the existing communities within the municipality and to require new development to be compatible with the architecture of the existing buildings throughout the surrounding community. In 2015The Township seeks to review its existing zoning ordinances and develop design regulations to insure that that future development is befitting of the Township's natural and built resources.

8. Raise the levee network protecting Heislerville and Matts Landing
Sandy's considerable impact on the levees that protect Matts Landing and Matts Landing Road, helped highlight that the current levee heights are not sufficient to protect the four (4) marinas within the Heislerville Wildlife Management Area, and on Matts Landing Road.

The Township has conducted preliminary and basic investigations that examine the existing Heislerville Impoundment and Thompson levees that protect the community. More detailed studies must be conducted to determine what actions are needed to increase the height of the levees so that they offer protection from the 100-year coastal storm and future sea level rise. The Township will continue to search for resources to fund an engineering study to examine options and costs.

9. Alleviate Flooding in Select Locations
The Township seeks to alleviate flooding at the following locations: Glade Road, between Heislerville and Delmont; New Jersey Route 47 in Bricksboro; the Mauricetown Causeway (CR 709); East Point Road; River Road; Newell Road; Route 47 & Whitney Road; and Carlisle Place Road at Crowder Run Branch Crossing in Dorchester. The Township will try to secure local, county, state and federal funding to investigate flooding issues at these key locations.

9. Install backup generators at key Township facilities
Through work sessions conducted during the Cumberland County Hazard Mitigation Plan process, the Township described the need for backup power generators at the following locations: the Maurice River Township municipal building (estimated cost: $86K); the Maurice River Township Elementary School (estimated cost: $136K); the Heislerville Fire Station. (estimated cost: <$100K); the Cumberland Fire Station. (estimated cost: T.B.D.); Port Elizabeth Fire Station (estimated cost: <$100K). The Township is currently trying to identify funding sources to install generators at these locations.

Appendix 1: FEMA Flood Zones Definitions

Flood zones are geographic areas that FEMA has defined according to varying levels of flood risk and type of flooding. These zones are depicted on the published Flood Insurance Rate Map (FIRM) or Flood Hazard Boundary Map (FHBM).

Special Flood Hazard Areas – High Risk

Special Flood Hazard Areas represent the area subject to inundation by 1-percent-annual chance flood. Structures located within the SFHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory flood insurance purchase requirements apply in these zones.

Zone	Description
A	**Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown.**
AE, A1-A30	**Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. BFEs are shown within these zones. (Zone AE is used on new and revised maps in place of Zones A1–A30.)**
AH	**Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are 1–3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone.**
AO	**Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are 1–3 feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone.**
AR	**Areas that result from the decertification of a previously accredited flood protection system that is determined to be in the process of being restored to provide base flood protection.**
A99	**Areas subject to inundation by the 1-percent-annual-chance flood event, but which will ultimately be protected upon completion of an under-construction Federal flood protection system. These are areas of special flood hazard where enough progress has been made on the construction of a protection system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. Zone A99 may be used only when the flood protection system has reached specified statutory progress toward completion. No BFEs or flood depths are shown.**

Coastal High Hazard Areas – High Risk

Coastal High Hazard Areas (CHHA) represent the area subject to inundation by 1-percent-annual chance flood, extending from offshore to the inland limit of a primary front al dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. Structures located within the CHHA have a 26-percent chance of flooding during the life of a standard 30-year mortgage. Federal floodplain management regulations and mandatory purchase requirements apply in these zones.

Zone	Description
V	**Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves. Because detailed coastal analyses have not been performed, no BFEs or flood depths are shown.**
VE, V1-V30	**Areas along coasts subject to inundation by the 1-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. BFEs derived from detailed hydraulic coastal analyses are shown within these zones. (Zone VE is used on new and revised maps in place of Zones V1–V30.)**

Moderate and Minimal Risk Areas

Areas of moderate or minimal hazard are studied based upon the principal source of flood in the area. However, buildings in these zones could be flooded by severe, concentrated rainfall coupled with inadequate local drainage systems. Local stormwater drainage systems are not normally considered in a community's flood insurance study. The failure of a local drainage system can create areas of high flood risk within these zones. Flood insurance is available in participating communities, but is not required by regulation in these zones. Nearly 25-percent of all flood claims filed are for structures located within these zones.

Zone	Description
B, X (shaded)	**Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (Zone X (shaded) is used on new and revised maps in place of Zone B.)**
C, X (unshaded)	**Minimal risk areas outside the 1-percent and .2-percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (Zone X (unshaded) is used on new and revised maps in place of Zone C.)**

Undetermined Risk Areas

Zone	Description
D	**Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.**

Appendix 2: Getting to Resilience Report and Recommendations

Maurice River Township
"Getting to Resilience"
Recommendations Report

Prepared by the Jacques Cousteau National Estuarine Research Reserve in partnership with New Jersey Future

March 2015

Recommendations based on the "Getting to Resilience" community evaluation process.

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Introduction

The Getting to Resilience 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 assist in reducing 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 Coastal Community Resilience Specialists can enhance the outcomes of the evaluation by providing community-specific recommendations, guided discussions with municipal representatives, a vulnerability analysis, and municipal plan reviews.

When Superstorm Sandy came to shore in October of 2012 it was the sixth extreme high tide over the course of two years for Maurice River Township. The flooding from Sandy was widespread, causing damage to homes, marinas, shipping channels, and fishing and oyster beds. In some areas Sandy was the catalyst that weakened susceptible infrastructure, such as roads and dikes, leading to increased vulnerability to future storm and tidal surge. One dike in particular that protects Matts Landing Road was breached during Sandy, but was fixed temporarily. The same dike was breached again In late December of 2012 and with every tide the road behind it, Matt's Landing Road, flooded causing more and more damage until the road became impassable. Access to Matts Landing was limited during this time as the only way for property owners to reach their property was via a bike path. The repairs to the dike and road were not complete until April of 2013. This is one of the areas that Maurice RIver Township has identified and is investigating for future mitigation and increased resilience.

As part of a combined letter of agreement between Maurice River Township and New Jersey Future, New Jersey Future outlined a scope of services that would be provided to the town through their Local Recovery Planning Manager Program. These services included providing guidance, technical assistance, project management, and staff support to develop and implement effective long term recovery and resilience strategies; assist Maurice River Township to rebuild in a manner that anticipates and responds to future severe storms and sea level rise; and to promote planning principles that were endorsed in town resolution requesting that NJ Future provide a Local Recovery Planning Manager.

The JC NERR's participation with Maurice River is highlighted under *Task 5.1 Existing Conditions Analysis and Vulnerability Assessment* of the "Letter of Agreement between Maurice River Township and New Jersey Future". The recommendations given by JC NERR at the end of the Getting to Resilience process are part of this task that add to the deeper evaluation that NJ Future will be doing as the Vulnerability Assessment of Maurice River Township. The assessment will be based on detailed mapping of the characteristics described in part 1 of the "Elements of a Vulnerability Assessment" summary attached to the Letter of Agreement. The assessment shall evaluate potential impacts of a range of hazards (coastal storm events/flood patterns, category 1-4 hurricanes, erosion, flooding, sea level rise, storm surge) for past events, existing conditions, and year 2030, 2050, 2100 planning horizons.

The Getting to Resilience process started as a facilitated discussion regarding the Township's strengths, weaknesses, and hurdles concerning resiliency. Maurice River identified the townships older

infrastructure, small tax base (and therefore limited funding), and lack of maintenance of infrastructure such as roads, dikes, and levees by entities other than the township as weaknesses and hurdles. One of the largest strengths identified was the township's ability to solve issues together as a community. The municipal leaders also expressed an interest in joining FEMA's Community Rating System, which offers flood insurance discounts to the municipality.

A large portion of Maurice River Township's economic stimulator, including fishing and shellfish industries, are along the Maurice River. Like much of Cumberland County's bayshore these areas are vulnerable to sea level rise, storm surge, and flooding. Much has been protected over time with the use of dikes, berms, and levees. While these systems protect the assets behind them their potential failure puts the properties that they were built to protect at risk. Additionally, the properties and marinas that are along the coast rely on these protective systems to keep roadways passable. These built up areas can experience a slow and steady settling of their sediments due to compaction. This can lead to subsidence of streets and lots. To protect these areas Maurice River Township, in conjunction with other local municipalities, have investigated expanding their dike and berm system to create a line of protection from flooding.

Maurice River Township identified their greatest challenges to resiliency as the financing and permitting of projects. As Maurice River Township is small and has a limited tax base, funding of projects is very difficult. The municipal budget and staff have already been stressed by the recovery effort after Sandy and there are very few resources left to either enact resiliency projects or find funding for resiliency projects. When or if a resiliency project is decided on, the time and resources needed to obtain all the appropriate permits needs to be considered as a factor in the project implementation.Working with neighboring communities, Maurice River Township has contributed to the Cumberland County Delaware Bayshore Recovery Plan. Within this plan are strategies for implementing projects and identifying potential funding sources. The plan is the result of goals that the recovery committee, a group of elected officials and residents, identified before determining the specific projects that would support and accomplish them. Within this plan there are four categories; Intergovernmental Relations, Tourism and Economic Development, Infrastructure, and Shoreline Protection and Coastal Management. Understanding the challenges that Maurice River identified, as well as the work that went into the creation of the Cumberland County Delaware Bayshore Recovery Plan, was important to take into consideration when planning this recommendations report. Where applicable, the recommendations of this report reference and complement the Cumberland County Delaware Bayshore Recovery Plan.

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 Maurice River this team included Gordon Gross (Construction & Zoning Official, OEM), Ben Stowman (Land Use Board Chair), Tiffany Cuviello (Professional Planner), and Andrew Sarclette (Mayor). The questions in the GTR questionnaire were answered by the municipality with JC NERR staff recording answers and taking notes on the discussions connected to each question.

The first meeting with Maurice River Township took place on April 30th. JC NERR met with two representatives of Maurice River Township and started going through the Getting to Resilience

questionnaire. At this initial meeting all sections of the questionnaire were covered, with a few questions left unanswered for a later meeting. On May 7th, the questionnaire was completed with three representatives of Maurice River Township and a discussion of the township's resilience strengths and weaknesses took place.

Upon completion of the GTR questionnaire, JC NERR staff analyzed the answers provided by Maurice River Township, linkages provided by the GTR website, notes taken during the discussion of questions, the Cumberland County Delaware Bayshore Recovery Plan, and mapping of risks, hazards, and vulnerabilities provided by Rutgers University and the NJFloodmapper website. After reviewing all of this information, this recommendations report was drafted to help assist Maurice River Township decision makers as the Township works to recover from Superstorm Sandy and become more resilient.

Recommendations

1. Investigate the potential for creating a multi-jurisdictional Program for Public Information that can work with the Bayshore Resiliency and Sustainability Education and Outreach Intergovernmental Relations subcommittee.

Maurice River Township expressed an interest in joining FEMA's Community Rating System (CRS). The National Flood Insurance Program's (NFIP) Community Rating System (CRS) is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. One of the biggest sections to receive points in is Public Outreach, and it is under this section that the points for creating a Program for Public Information (PPI) exists. A PPI is a researched, organized, and implemented program for public outreach that is seen as having a seven step process. These steps are Establish a PPI Committee, Assess the Community's Public Information Needs, Formulate Messages, Identify Outreach Projects to Convey the Messages, Examine Other Public Information Initiatives, Prepare a PPI Document, and Implement, Monitor and Evaluate the Program.

Some of these steps may already be taking place within the Bayshore Resiliency and Sustainability Education and Outreach Intergovernmental Relations Subcommittee. The description of this project states,

> "The purpose of the project is to provide increased awareness and education about the issues of rising sea levels, coastal resiliency and mitigation options and strategies along Cumberland County's Delaware Bayshore in New Jersey. Public engagement with the issues and hazards presented by rising sea levels and erosion is instrumental in creating sustainable, resilient communities along the Bayshore."
>
> "The project will use for community education and outreach the information developed by the Office of Emergency Management (state/county/local) on Erosion Hazard zones and the U.S. Army Corps of Engineers' surge maps, which capture all risk areas."

These goals align with the purpose of a PPI. If done correctly, a PPI will make outreach initiatives more effective and can gain CRS credits in numerous categories besides outreach. For guidance on establishing a PPI, visit http://crs2012.org/uploads/docs/300/developing_a_ppi_2-24-12.pdf.

2. Make sure all outreach programs are quantified and catalogued according to CRS standards.

Maurice River should examine the current number of outreach programs it runs and what it would take to gain additional points by adding more or expanding on those that currently take place. Outreach

should include information about the natural and beneficial functions of floodplains. Particularly after Sandy, residents throughout the impacted area have been looking for as much information as possible. 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 and one Maurice River should focus on heavily. Establishment of a PPI would again help this process to maintain efficiency. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

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

Maurice River Township should consider developing a collection of outreach projects in anticipation of future 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 for additional CRS credits, helping the 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://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf)

4. Make sure all flood maps are available on the town website, at Municipal Hall, and the closest public library.

Having the most up to date FEMA issued floodplain maps available at numerous locations in different forms of dispersal is critical to ensuring your citizens are informed and has the added benefit of allowing for CRS credits in the Outreach section specifically for the town website and public library. Maintaining a link to FEMA's website on the Township website is highly recommended and should highlight a section that deals specifically with flooding and other coastal hazards. For more information on Outreach Projects credit requirements, visit page 330-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

5. Transfer personal knowledge of coastal storm and flooding event damages to digital format 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 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. Meetings to allow for public input on historic storm damage extents may also earn CRS credits in the Outreach section. Hard copies of documents and other records should also be digitized for preservation and access. For more information on Outreach Projects credit

requirements, visit page 330-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

6. Maurice River 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. These areas could include any waterfront that is not bulkheaded and has experienced erosion. Factors that could amplify erosion (sea level rise, surge) should be defined. Throughout the Mid-Atlantic, the erosion of wetlands has been heavily documented. Maurice River Township has topographic and maritime maps that go back many years at it's disposal, as well as google historical data. These maps show where areas of the coastline has been eroding. Much of the Township is bordered by or protected by wetlands, the Township should make an effort to locate areas of erosion in their wetlands to identify possible problem areas. 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. A related challenge is unwanted deposition from shoaling and runoff can also be problematic for storm water management, navigation in waterways, and access to docks. Large-scale replenishment projects often change the erosional patterns of beaches as well so a change should be expected after each Beach and/or Dune Restoration project in Maurice River Township identified in the Cumberland County Delaware Bayshore Recovery Plan is completed. Having information on the patterns prior to these project can be used to gauge the project's success and help to improve the design for future replenishment projects. The American Littoral Society through grants coming from DOI/NFWF have sand replenishment projects at both Moores Beach and Thompsons Beach. They have as part of both major projects the element of monitoring which way the sand migrates after placement. From some already completed work at Moores Beach they have advance indications of the sand erosion and deposition patterns in the area. Keeping information on coastal erosion can result in CRS credit in the Erosion Data Maintenance (EDM) section. 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

While answering the Getting to Resilience questionnaire it was identified that there are maps and or studies of the bay possessed by the Army Corps of Engineers and NJDEP. These maps should be collected, put into electronic format, and made available to the municipality for future planning purposes.

In the Cumberland County Delaware Bayshore Recovery Plan there is the Creek Maintenance Dredging project which identifies the efficiency of a comprehensive study of the dredging needs of all creeks by the U.S. Army Corps of Engineers. This study is an example of the type of data that should be kept on record by the community for future planning purposes.

7. Adopt the latest version of FEMA's flood maps and rewrite elevation and freeboard requirements in a Flood Damage Prevention Ordinance as based upon the Best Available Flood Hazard Data or the most stringent version of FEMA's flood maps.

Best Available Flood Hazard Data is defined by NJ DEP as the most recent available flood risk guidance FEMA has provided. The Best Available Flood Hazard Data may be depicted on but not limited to Advisory Flood Hazard Area Maps, Work Maps or Preliminary FIS and FIRM. For more information on NJ DEP recommended Flood Damage Prevention Ordinances, visit http://www.nj.gov/dep/floodcontrol/modelords/modelde-bestavail.doc.

By adding "or the most stringent version of FEMA's flood maps" to this ordinance, higher standards may be instituted that may result in the town becoming more resilient. For example, the Advisory Base Flood Elevation maps may have a more expansive V-zone than the Flood Insurance Rate Maps. By requiring building to adhere to the stricter requirements of the Advisory Base Flood Elevation maps, more homes will be built to higher standards. An amended ordinance may 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 Maurice River 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. While municipal staff are informally urging homeowners to build to the 1 foot freeboard requirement, an official requirement would allow for credit in the Freeboard section of Higher Regulatory Standards. For more information on the Higher Regulatory credit requirements, visit 430-2 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

8. 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 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. For example, Preliminary FIRMs for Cumberland County were just released on April 29th, 2014. Notifying the public of this 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 a township Flood Information webpage may help to alleviate questions the public may have as each map is updated, thereby reducing the workload on municipal staff.

The new RISK map products from FEMA include a GIS layer depicting the "changes since last FIRM" which will help the township in describing the changes in flood zones on individual properties and for the township 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 these data sets 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 website soon. The draft data for Comberland County can be downloaded from http://content.femadata.com/Public/Draft_Non_Regulatory_Flood_Risk_Products/Cumberland/. The more familiar the citizens are with the maps, the more likely they will take appropriate actions.

9. Continue to maintain StormReady Community status as designated by 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. For more

information, visit http://www.stormready.noaa.gov/howto.htm. Maurice River Township has been listed as a StormReady Community in the past but must update their standing. Being listed as 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://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

10. Maurice Township should identify sea level rise as a hazard in town plans and consider disclosing hazard risks to potential buyers and real estate agents.

Even with the lowest level of predicted sea level rise, Maurice River will experience significant impacts in the near future. 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 1.3 feet along the Jersey Shore. By 2100 sea level rise the "best" estimate is 3.1 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. 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://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

11. Maurice River Township should ensure future infrastructure and protection projects take sea level rise projections into consideration.

While roads, berms, and levees have been identified for improvements and restoration in the Cumberland County Delaware Bayshore Recovery Plan the best way to ensure longevity in the lifespan of these projects is to consider future conditions caused by sea level rise. As these projects protect people, property, and vital evacuation routes and have already been identified through the in-depth process of writing the Cumberland County Delaware Bayshore Recovery Plan it is critical that future conditions are considered before the project is funded and implemented. Considering these conditions can not only improve the length of time these projects are able to function, but can potentially save the township money in the future as the lifespan of the infrastructure is increased.

12. 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 large CRS credits in the Repetitive Loss Area Analysis section (and more if mitigation actions are initiated). Many of Maurice River's homes were built prior to the release of the current building code and therefore, are more prone to damage in flooding and storm events. Creating a plan for these buildings as well can help to transition these properties towards better resiliency. For more information on Repetitive Loss Area Analysis credit

requirements, visit page 510-29 of the CRS Coordinator's Manual. http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

13. 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 good that the members of 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 area 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. 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. While the Cumberland County Annual_Loss_Hazus tool is not yet available, it will be included on the site in the near future at http://content.femadata.com/Public/Draft_Non_Regulatory_Flood_Risk_Products/Cumberland/. For more information about this and other non-regulatory tools please visit http://www.region2coastal.com/flood-risk-tools/tool-descriptions.

14. 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 independant 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://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf

15. 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 move to create them. Further content regarding this recommendation can be found below in the section titled, "Coastal Hazard Incorporation in Planning".

16. Begin the long term planning process to prepare for sea level rise.

Maurice River Township, like most other coastal municipalities, will experience future impacts from sea level rise in the form of regular tidal flooding and heightened storm impacts. Maurice River 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, Maurice River Township will need to preemptively decide on actions and begin to carry them out. The range of options are bountiful, ranging 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 still feels that buyouts are not a good option, mitigation strategies will need to be looked into. However, not only will the individual mitigation options need to be examined, but the time frame of their effectiveness will need to be determined as well. 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 buyout programs. Again, these decisions will not be easy ones to make but it is critical that the decisions do take place.

JC NERR recommends Maurice River Township consider learning from the resiliency planning process undertaken by Gilford, 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 to 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 Maurice River 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 Maurice River 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, dikes, levees, berms, marinas, municipal facilities, seawalls, and tide gates.
- 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:

- **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.
- **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.

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). Maurice River 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 – Create scientific fact sheets about climate change addressing 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

- 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.
- 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.

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.

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.

Maurice River 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, Maurice River 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.

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 rediscussed 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. Many of the recommendations in this municipal master plan example are closely tied to goals already addressed in the current Municipal Master Plan. Refer to the link below 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 county'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. Areas of the township's 100-year floodplain are highly 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 Maurice River, 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.

Maurice River Township, with its low relief, 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 Maurice River Township. Narrow bay beaches and wetlands at low elevations, both important habitats, would be lost to even a modest rise in sea level. 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 developing a hazard mitigation plan. This first step will 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 federal 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. Limit new development and construction in the floodplain.
3. For new development, encourage the dedication of 100-year floodplains (not including wetlands) to open space.
4. Promote uses, such as golf courses, open space easements, natural areas, and recreational open space to reduce impervious surfaces in floodplains.
5. Work to acquire properties in the 100-year floodplain, and return them to a natural state.
6. Reevaluate the effectiveness of the current floodplain protection regulations.
7. Discourage the location of new homes and roadways in the "V" or wave velocity zone and the 100-year floodplain.
8. Work with the county to complete a hazard mitigation plan for flooding, wildfire, and other natural hazards.
9. Develop and implement a post-disaster recovery and reconstruction plan to facilitate recovery and to reduce exposure to future disasters.
10. Participate in the Community Rating System to receive flood insurance premium credits.
11. Consider code changes that will limit impervious surfaces.
12. Develop a sea level rise response strategy (include a two foot freeboard requirement for properties exposed to flooding and discourage 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. In the near future, the Getting to Resilience website, www.prepareyourcommunitynj.org, will host community profiles that include municipal mapping 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.

Maps Recommended During GTR Meetings:

Sea Level Rise 1-3 feet with Critical Facilities (provided in Appendix)

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 much of Maurice River Township is near current sea level, Sea Level Rise maps should be utilized heavily for municipal planning documents.

Storm Surge (SLOSH Category 1, SLOSH Category 2, & SLOSH Category 3) (provided in Appendix)

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 Maurice River 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.

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.

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 Maurice River 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 the 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

As much of Maurice River Township is at or near current sea level, fluctuations in sea level through surge events and trends towards higher sea level are of great significance. 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. SLOSH models for Category 2 and 3 storms show flooding covering roughly 25% of the town for a Category 2 storm and 30% of the town in a Category 3 storm. Both scenarios flood the critical evacuation route of Route 47 and the capillary roads into Heislerville. 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 of portions of the route between Port Elizabeth and Leesburg, as this area will see fairly regular tidal inundation. Scientists anticipate the arrival of 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 the amount of additional sea level rise.

Total sea level rise projections for New Jersey.

	Total cm	Total inches	Total feet
2050 best	**40**	**16**	**1.3**
2050 low	23	9	0.7
2050 high	60	24	2.0
2100 best	**96**	**38**	**3.1**
2100 low	50	20	1.6
2100 high	147	58	4.8

All values with respect to a year 2000 baseline.

NJ sea level rise projection ranges and best estimates. Miller AK, Kopp RE, Horton BP, Browning JV and Kemp AC. 2013. A geological perspective on sea-level rise and its impacts along the U.S. mid-Atlantic coast. Earth's Future 1(1):3-18.

Three feet of sea level rise will result in amplified tidal inundation of the route between Port Elizabeth and Leesburg, as well as regular tidal flooding of Heislerville and Delmont. Any level of inundation due to regular tidal flooding will have large-scale impacts on emergency response. 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 heightening of other hazards such as surge must be taken into account when planning for the future. The information provided in this recommendations document is the JC NERR part of the in depth Vulnerability Assessment that NJ Future is doing for Maurice River Township. While going through the tasks in the "Letter of Agreement..." New Jersey Future will be digging deeper into these vulnerabilities, sea level rise and storm surge, as well as the other hazards described in the introduction of this recommendation document..

CRS Sections That Likely Have Current Available Points

The following sections of the Community Rating System will likely contain credit points that are available for Maurice River based off of the answers given in our Getting to Resilience questionnaire, discussions with JCNERR staff, and reviews of other documents. These sections represent the current state of the Township but also include planned projects or uncompleted projects we are aware of. However, these projects may need to be complete in order to be granted credit. These sections do not represent guaranteed points for the CRS but are likely achievable to a certain degree and should be investigated 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 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). (GTR 2.4, 2.5.1, 2.8, 2.11, 2.14, 4.9)
- **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. (GTR 2.4, 2.8, 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. (GTR 2.4)
- **Stakeholder delivery (STK):** Up to 50 points added to OP credits for having information disseminated by people or groups from outside the local government. (GTR 2.4)

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, 2.15)
- **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.
- **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)

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 410: Floodplain Mapping: To improve the quality of the mapping that is used to identify and regulate floodplain development.

- **Floodplain mapping of special flood-related hazards (MAPSH): Up to 50 points if the community maps and regulates areas of special flood related hazards. (GTR 1.1)**

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, 5.12)
- **Natural shoreline protection (NSP):** Up to 120 points for programs that protect natural channels and shorelines. (GTR 3.3, 5.9)
- **Deed restrictions (DR):** Up to 50 points extra credit for legal restrictions that ensure that parcels credited for OPS will never be developed.
- **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 3.3, 5.9, 5.12)
- **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 1.3, 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).

- **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.

- **Additonal 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. (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): Up to 382 points for a community wide FMP that follows a 10 step planning process. Step 2 is to involve the public. (GTR 2.3, 3.3, 3.3.2)**

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, 2.12, 4.3, 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 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 2.11, 2.12, 4.7, 4.9)
- **StormReady community (SRC):** 25 points for designation by the National Weather Service as a StormReady community. (GTR 4.1, 4.6)

Section 620: Levees: To encourage communities to properly inspect and maintain levees and to identify impending levee failures in a timely manner, disseminate warnings to appropriate floodplain occupants, and coordinate emergency response activities to reduce the threat to life and property.

- **Levee failure warning (LFW):** Up to 50 points for disseminating the warning to the public. (GTR 2.11, 4.9)
  - **LFW 7:** 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, provided that the community has coordinated with NOAA and there are arrangements for issuing warnings about levee failures. (GTR 4.11)
- **Levee failure response operations (LFO):** Up to 30 points with 5 points awarded for maintaining a database of people with special needs who require evacuation assistance when a levee failure warning is issued and for having a plan to provide transportation to secure locations. (GTR 2.12, 4.7, 4.8, 4.9, 4.9.6)
- **Levee failure threat recognition system (LFR):** Up to 30 points for having a system to advise the emergency manager when there is a threat of a levee's failure or overtopping. (GTR 4.6, 4.7)

FEMA's definition of a Levee - A levee is a structure, usually an earthen embankment, designed and constructed using sound engineering practices, to contain, control, or divert flood waters in accordance with a designated risk reduction level. (Page 620-2 of the 2013 CRS Coordinator's Manual)

Additional CRS Resources and Information

The CRS Resources webpage (http://crsresources.org/) has information, worksheets, forms, tables, handouts, checklists, training information, etc. There is a resource for almost every activity/element that CRS gives credit for. Click through the links at the top of the page (http://crsresources.org/) to see what will benefit your community. The following links are also available on the CRS Resources webpage.

- Information on Training & Video's (including Webinars) can be found at: http://crsresources.org/training/
- The "Application Letter of Interest and CRS Quick Check" can be found at: http://crsresources.org/quick-check/
- The 2013 NFIP CRS Coordinator's Manual can be found at: http://crsresources.org/files/2013-manual/crs_manual_508_ok_5_10_13_bookmarked.pdf
- The CRS Community Self Assessment can be found at: http://www.crs2012.org/self-assessment/
- The following information was taken from the May 18th, 2014 "FEMA (Federal Emergency Management Agency) Weekly Digest Bulletin" which can be found at: http://crsresources.org/files/100/newsletters/2014-April_MayNFIP_CRS%20Update.pdf

Another Look at Elevation Certificates

As CRS communities know, participation in the CRS requires that a community "maintain completed FEMA Elevation Certificates showing the 'finished construction' elevations for all buildings constructed or substantially improved in the Special Flood Hazard Area (SFHA)" after the date of its application to the CRS.

Further, the community must review all the certificates that it collects to be sure that they are filled out completely and correctly. Pages 310-7 and 310-8 of the *CRS Coordinator's Manual* include checklists to help communities review the 2006, 2009, and 2012 Elevation Certificates.

Because correct and complete Elevation Certificates are so valuable to effective floodplain management, and are also a good indicator of a community's implementation of its program, the CRS works continually to improve its process for assessing the Elevation Certificates and for helping communities better use this tool. To this end, a new step is introduced in the 2013 *Coordinator's Manual*. Under Activity 310 (Elevation Certificates), communities now must submit a list of all permits issued for new buildings and substantial improvements in the SFHA since the last visit, along with copies of all Elevation Certificates.

These modifications were described in previous issues of this newsletter *[see March 2013, page 3; and May 2013, page 3]*, but here is a recap of what to expect and suggestions for making your first cycle verification visit under the 2013 *Coordinator's Manual* go smoothly.

--Have ready a list (digital or paper) of all permits issued for new construction and substantial improvements in the SFHA (or your regulatory floodplain) since your last cycle verification visit. In most cases you should not include permits for areas outside the SFHA, or permits for less-than-substantial improvements.

Talk to your ISO/CRS Specialist about permit list specifics before your visit, to ensure that you are prepared, especially if your community is regulating floodplain development outside the SFHA.

--Have ready copies (paper or digital) of the Elevation Certificates for all of the properties on the list. Be sure the copies of the Elevation Certificates can be correlated to the permit list.

--Your ISO/CRS Specialist will collect all the Elevation Certificates. He or she will then select a random sample of 30 of them, and review them. Your EC credit is based on this initial sample. If you have issued fewer than 30 permits, then all your Elevation Certificates will be reviewed.

--EC credit will be based on the first review of the sample of Elevation Certificates. Regardless of the EC credit determination, minimal CRS participation requires that at least 90% of a community's Elevation Certificates be complete and correct. If the review of the sample indicates a less-than-90% correct rate, your community will be given a chance to correct all the ECs.

--All Elevation Certificates that were not reviewed during the sampling process will be retained by the CRS. At a later date, when the centralized Elevation Certificate review project has been completed *[see "Tidbits from the Task Force," on page 5]* all the collected Elevation Certificates will be scanned andreviewed, and your community will receive comments on them.

--Remember that, for some properties on your permit list, you may need to provide a V-Zone design certification or a Floodproofing Certificate *[see the article on page 3 of the May 2013 issue]*.

After your first visit under the 2013 *Coordinator's Manual*, each annual recertification will need to be accompanied by a fresh permit list and copies of all the Elevation Certificates (and other certifications) for properties on the list. But even though your visit may be a year or two away, you may want to begin a list now and organize your Elevation Certificates accordingly. Many communities say that organizing and submitting Elevation Certificates each year works better than having to get everything organized just before the cycle visit.

If you have any questions about Elevation Certificates, contact your ISO/CRS Specialist.

Appendix

Maurice River Township
1 Feet of Sea Level Rise

Legend

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

Year 2010 Population: 7976

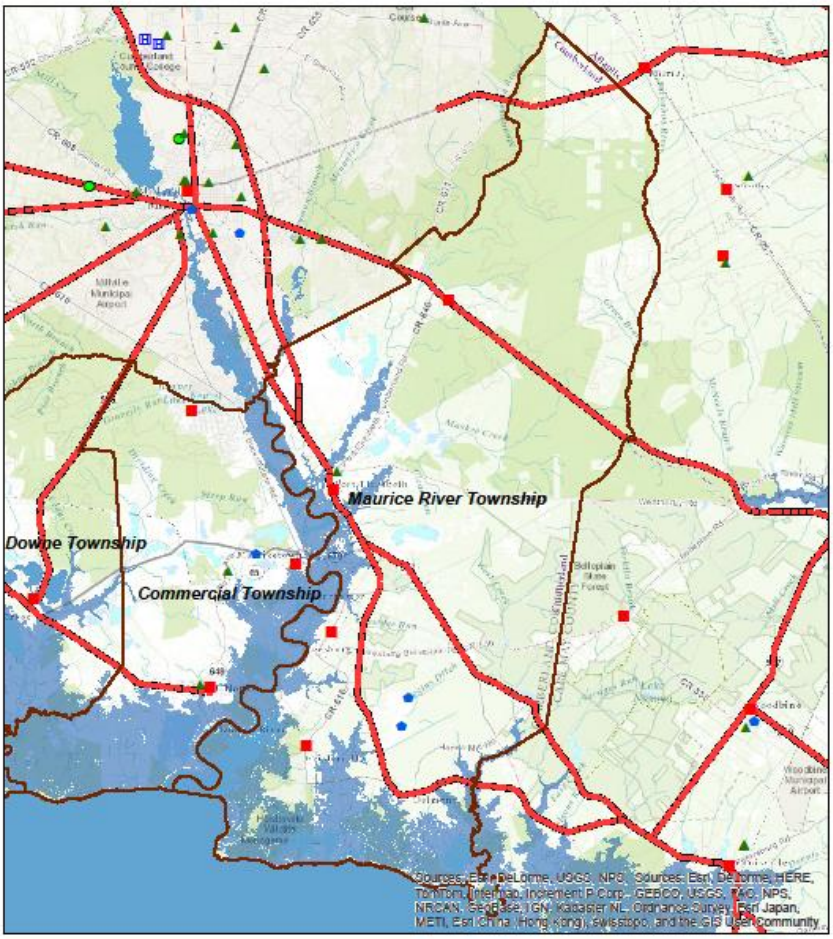
According to Kenneth G. Miller et al. in the 2013 study "A Geological Perspective on Sea-Level Rise and its Impacts Along the U.S. Mid-Atlantic Coast" a probable threat is the 1ft sea level rise condition that could be expected by 2050. This map depicts that sea level rise and is centered on target municipalities.

0 1.25 2.5 5 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

N

CRSSA



Maurice River Township
2 Feet of Sea Level Rise

Legend

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

Year 2010 Population: 7976

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 and is centered on target municipalities.

0 1.25 2.5 5 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

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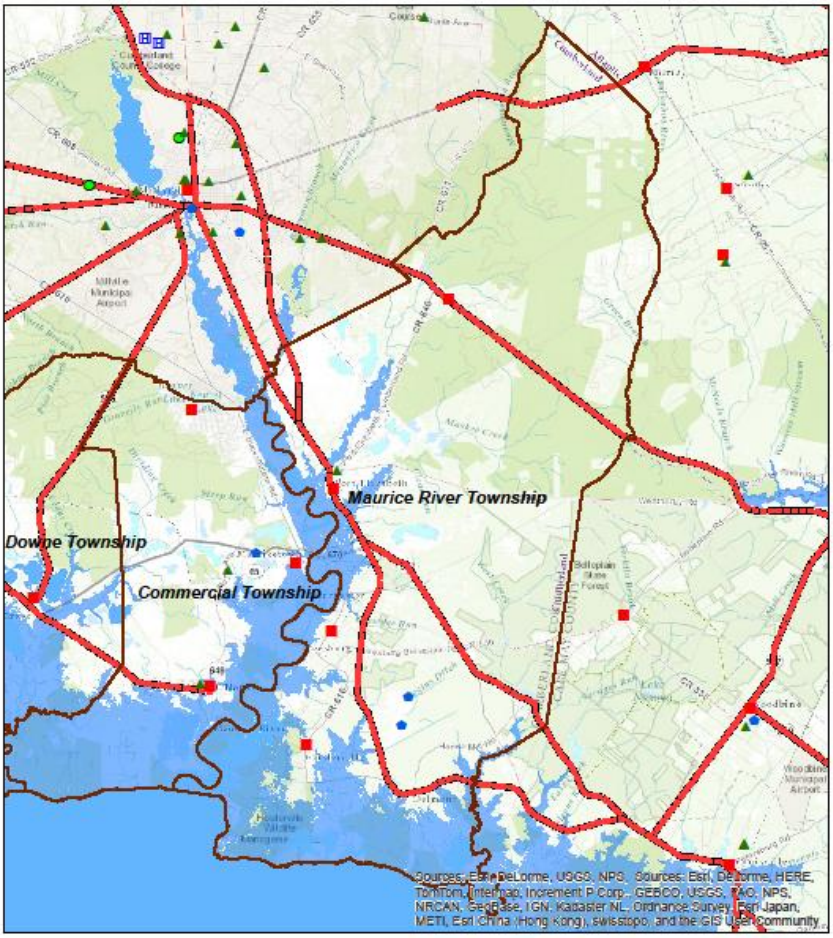
CRSSA



Maurice River Township
3 Feet of Sea Level Rise

Legend

- Municipality
- Schools
- Fire Stations
- Law Enforcement
- Assisted Living
- Hospitals
- Evacuation Routes
- 3ft SLR

Year 2010 Population: 7976

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 and is centered on target municipalities.

0 1.25 2.5 5 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

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Maurice River Township
Category 1 SLOSH Model

Legend

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

Category 1 SLOSH

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

Year 2010 Population: 7976

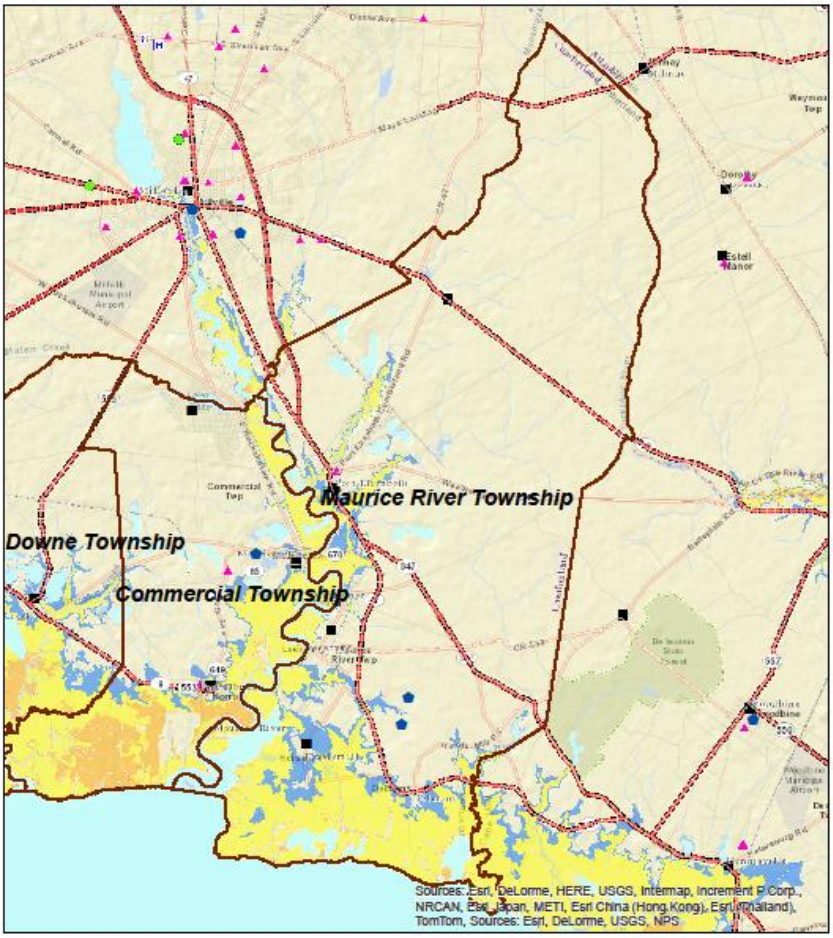
This map depicts the SLOSH model extents provided by NOAA. The depths are ranged from 0-9 or greater feet of inundation above ground level and are categorized in the legend above.

0 1.25 2.5 5 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

N

CRSSA



Maurice River Township
Category 2 SLOSH Model

Legend

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

Category 2 SLOSH

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

Year 2010 Population: 7976

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.

0 1.25 2.5 5 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

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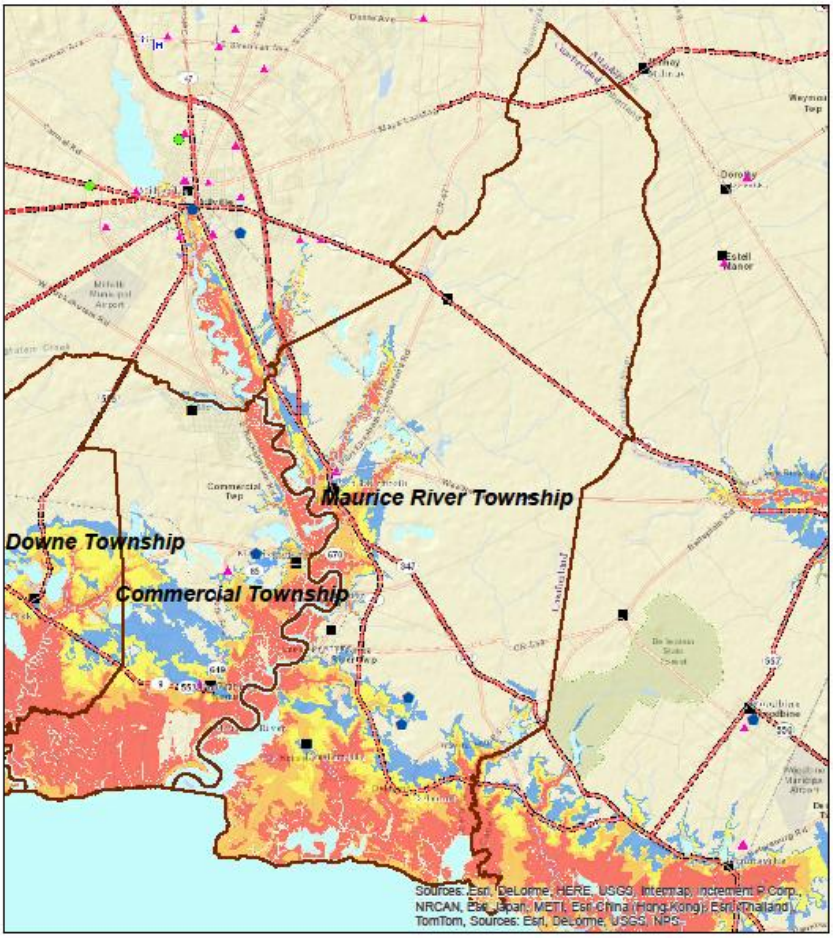
CRSSA



Maurice River Township
Category 3 SLOSH Model

Legend

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

Category 3 SLOSH

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

Year 2010 Population: 7976

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.

0 1.25 2.5 5 Miles

Map Author: Bryan Serino
Rutgers, New Brunswick
Center for Remote Sensing
and Spatial Analysis

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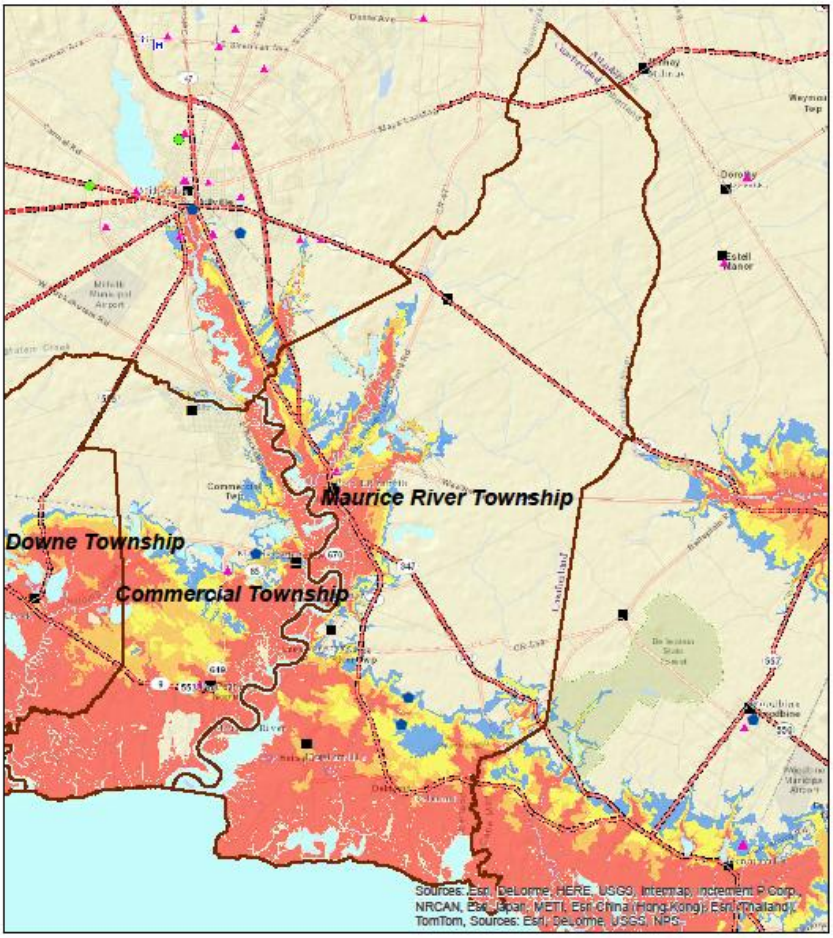
CRSSA



Marsh Retreat at 1 feet of Sea Level Rise Maurice River Township

Legend

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

Marsh Retreat at 1ft SLR

- Unimpeaded Marsh Retreat Zone
- Impeded Marsh Retreat Zone
- Marsh Conversion: Unconsolidated Shore
- Marsh Conversion: Open Water
- Unchanged Tidal Marsh

0 1.25 2.5 5 Miles

Year 2010 Population: 7976

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

N

CRSSA

Marsh Retreat at 2 feet of Sea Level Rise Maurice River Township

Legend

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

Marsh Retreat at 2ft SLR

- Unimpeaded Marsh Retreat Zone
- Impeded Marsh Retreat Zone
- Marsh Conversion: Unconsolidated Shore
- Marsh Conversion: Open Water
- Unchanged Tidal Marsh

0 1.25 2.5 5 Miles

Year 2010 Population: 7976

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

N

CRSSA

Marsh Retreat at 3 feet of Sea Level Rise Maurice River 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 1.25 2.5 5 Miles

Year 2010 Population: 7976

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

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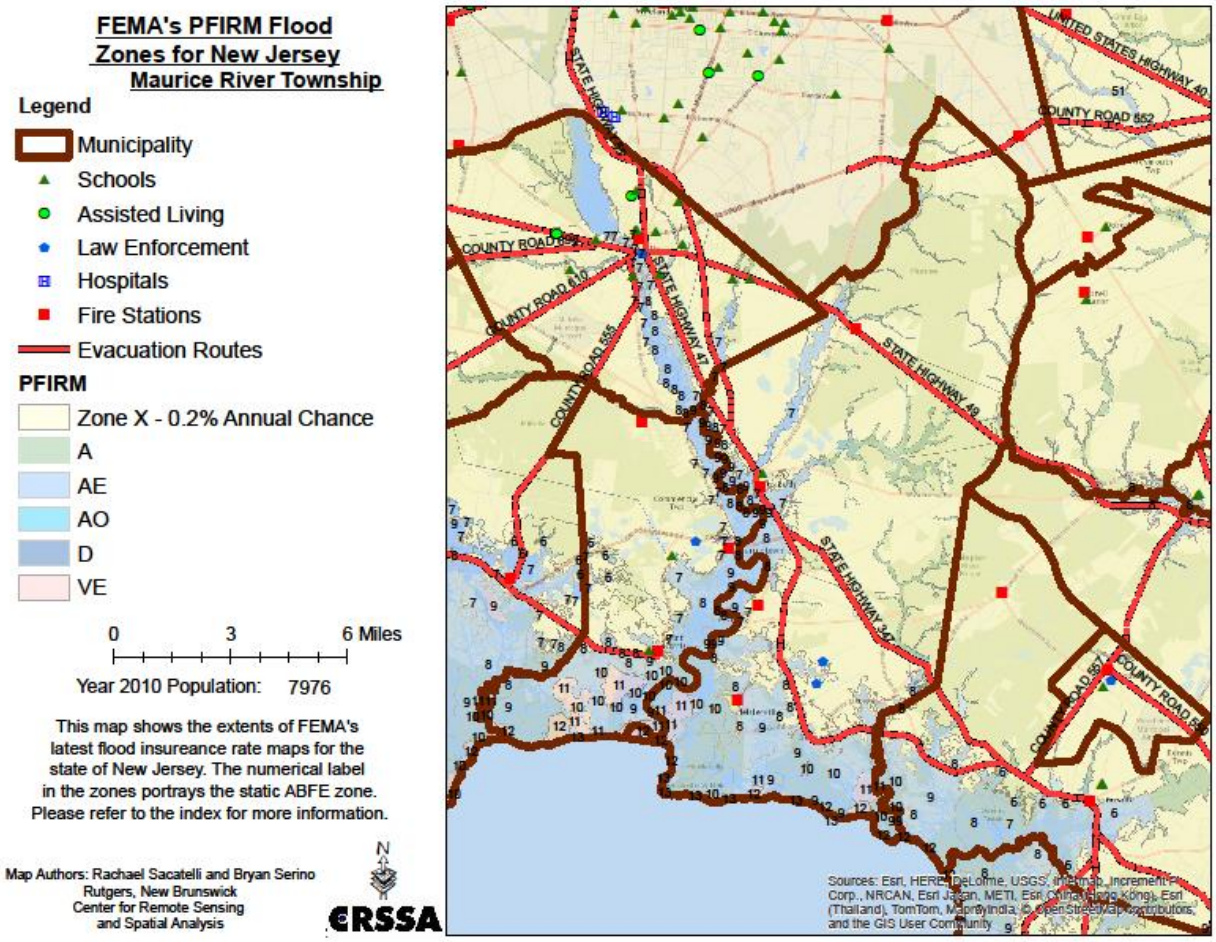
CRSSA


FEMA's PFIRM Flood Zones for New Jersey
Maurice River 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
0
3
6 Miles
Year 2010 Population: 7976
This map shows the extents of FEMA's latest flood insureance 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
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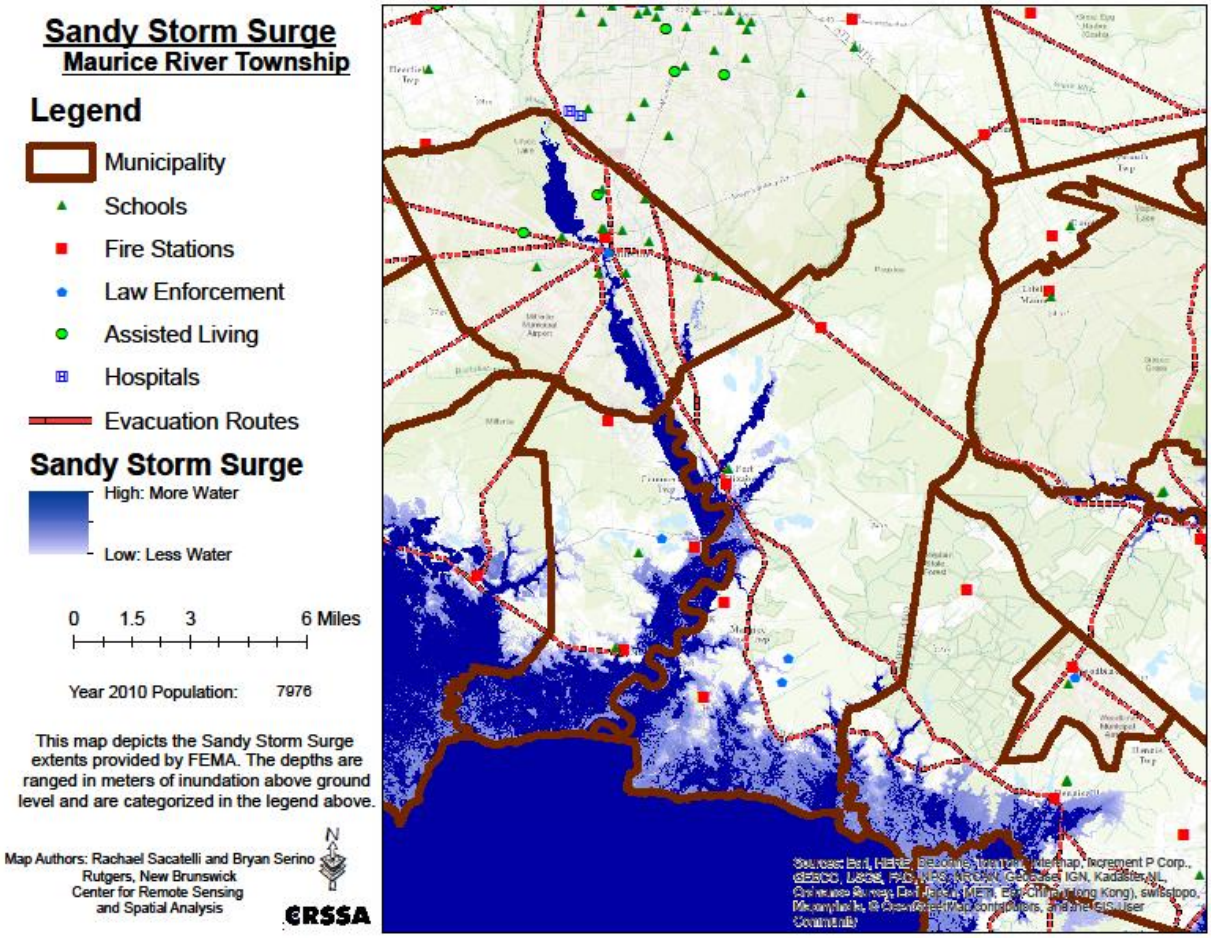
CRSSA
UNITED STATES HIGHWAY 40
COUNTY ROAD 652
COUNTY ROAD 692
COUNTY ROAD 610
COUNTY ROAD 555
STATE HIGHWAY 47
STATE HIGHWAY 49
STATE HIGHWAY 347
COUNTY ROAD 557
COUNTY ROAD 550
Sources: Esri, HERE, DeLorme, USGS, Intermap, Increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Sandy Storm Surge
Maurice River Township
Legend
Municipality
Schools
Fire Stations
Law Enforcement
Assisted Living
Hospitals
Evacuation Routes
Sandy Storm Surge
High: More Water
Low: Less Water
0 1.5 3 6 Miles
Year 2010 Population: 7976
This map depicts the Sandy Storm Surge extents provided by FEMA. The depths are ranged in meters 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
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CRSSA