SUSTAINABLE & RESILIENT COASTAL COMMUNITIES

A Comprehensive Coastal Hazard Mitigation Strategy

FINAL REPORT

NEW JERSEY FUTURE

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Members of the Steering Committees

This report would not have been possible without the guidance, insights, and active participation of the members of the ***Little Egg Harbor Township/Tuckerton Borough Joint Steering Committee*** and the ***Toms River Township Steering Committee***.

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1. Executive Summary

a. Context

New Jersey has been developing densely and extensively along its 1,800 miles of tidal coastline and fragile barrier islands for more than three centuries. Over this period, New Jersey's coastal areas have become the state's most prominent tourist destination and the life-blood of the economy of more than 20 percent of the state's 565 municipalities. According to a 2015 tourism research study, New Jersey's shore-based tourism industry accounts for one out of every ten (10) New Jersey jobs and contributes $10.2 billion in government revenues annually. Over several generations, living and recreating at the shore has become deeply embedded in the social and cultural psyche of New Jersey residents.

However, the patterns of development that characterize the New Jersey coast have left many people and structures dangerously vulnerable to subsiding and eroding coastlines, increasingly frequent and severe storms, and growing flood risks associated with sea-level rise. This became evident on Oct. 29, 2012 when Hurricane Sandy made landfall in New Jersey - destroying or damaging 346,000 homes and resulting in 37 deaths - and was reinforced with Hurricanes Joaquin in 2015 and Jonas in 2016.

Scientific analysis reveals that flooding and storm damage will occur at an increasing pace into the foreseeable future[1]. These conditions have the potential to cause considerable property damage, loss of property value and declining municipal tax revenues. There is also growing recognition and concern that in some places along the coast, rising sea levels will regularly result in increasingly intense flooding. Eventually, when nuisance flooding becomes a regular occurrence, and tolerance to accommodate inundation is exhausted, it will become necessary to shift growth away from high-risk areas.

b. Project Objective

The New Jersey Department of Environmental Protection (NJDEP) Office of Coastal and Land Use Planning (OCLUP) reviews and administers New Jersey's Coastal Management Program[2]. In response to recurring storm events and projections of future rising sea levels, OCLUP is working on initiatives to improve the sustainability and resiliency of the state's 239 coastal towns. One of these initiatives, the Sustainable, and Resilient Coastal Communities (S&RCC) project - the focus of this report - is intended to assess OCLUP's requirements for designating Centers under the Coastal Areas Facility Review Act[3] and to align the designation process with updated priorities of the Coastal Zone Management Program. Preliminary guidance, published in 2004, was intended to address

The S&RCC project is intended to answer the following questions:

- How can New Jersey's coastal municipalities prepare most effectively for changes such as sea-level rise and land subsidence?
- When and where should land use and development changes occur in response to these hazards?
- How can the state regulatory framework encourage long-term land use planning that accounts for communities' vulnerability to sea-level rise?

[1] Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel, NJ Climate Adaptation Alliance, October 2016

[2] New Jersey's Coastal Management Program is part of the National Coastal Zone Management Program, which addresses coastal issues, including sustainable and resilient coastal community planning, climate change, ocean planning, and planning for energy facilities and development. It is a voluntary partnership between the federal government and U.S. coastal and Great Lakes states and territories authorized by the Coastal Zone Management Act (CZMA) of 1972 and administered by the National Atmospheric and Oceanic Administration (NOAA).

[3] **Note**: see Section 2 of this report for terms and definitions used throughout

issues facing developing coastal communities; however, coastal hazards were not recognized as an imminent concern at that time. As new studies and data have been released, it has become evident that sea-level rise and land subsidence pose increasing risk to the New Jersey coast. Through the S&RCC project, NJDEP sought to fund a pilot comprehensive planning approach that would identify actions municipalities could take to respond to coastal hazards while protecting New Jersey's coastal resources. The intent was to apply project outcomes to inform potential changes in the Coastal Zone Management Rules (N.J.A.C. 7:7), which regulate the use and development of the state's coastal resources, and ensure that coastal hazard risks are addressed.

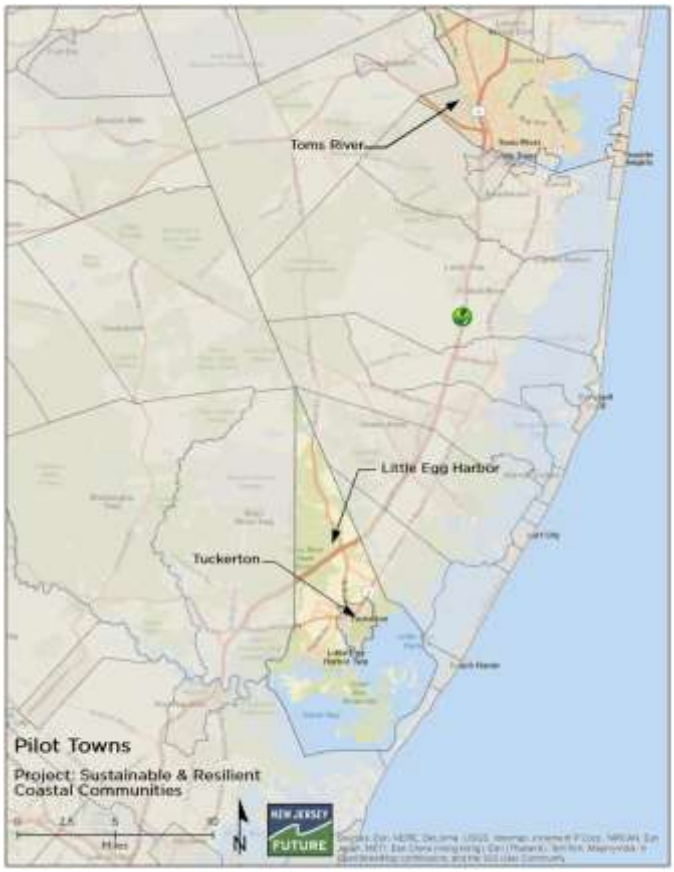
c. Process

To accomplish the S&RCC project objective, NJDEP contracted New Jersey Future to evaluate coastal development patterns and areas of projected flood inundation in three pilot communities - Little Egg Harbor Township, Tuckerton Borough, and Toms River Township.

Little Egg Harbor Township, Tuckerton Borough, and Toms River Township were selected to participate in the S&RCC project through a competitive process initiated by NJDEP in January 2015. These municipalities are representative of many of New Jersey's coastal community types and therefore provide NJDEP with a reliable model for how towns coast-wide may respond to modifications to the plan endorsement process and changes to state planning and regulatory approaches.

All three pilot municipalities are in Ocean County. All three towns experienced extensive damage during Hurricane Sandy, and all three have been active in post-Sandy recovery projects and efforts to enhance local resilience to coastal hazards.

Figure 1: Pilot Towns



Using the process of CAFRA Center designation and plan endorsement as a template, the New Jersey Future project team worked with each town to assess existing studies and risk assessments, evaluate the vulnerability and the different types of shoreline within the study areas, and develop recommendations for how the state could implement a risk-based, CAFRA Center designation process.

d. Report Elements

This report offers a detailed description of work performed and products developed by the New Jersey Future project team as it undertook the S&RCC Project. As mentioned above, the report is intended to inform the NJDEP's CZM Rules so that future revisions account for risks associated with rising sea levels

and a changing climate. To accomplish these objectives, the report provides a description of:

- The characteristics of the pilot communities that participated in the S&RCC project, their essential differences, and similarities, and the extent of damage they sustained during Hurricane Sandy;
- The critical elements of the analysis, planning process, and methods the project team used to evaluate flood hazard issues the pilot communities are presently facing;
- The community participation and outreach process followed, including the level of involvement on the part of the project steering committees, the input the project team received, and the interest and engagement participants displayed during public meetings held during the project;
- Observations about the differences among the participating communities in terms of their receptivity to addressing coastal risks, and possible explanations for that variance;
- The current federal, state, and municipal regulatory environment to illustrate the complicated maze of rules and tools on which communities rely on to shape coastal development patterns;
- Planning scenarios the project team devised to examine how projections of future risk can be used to guide and reshape coastal land use and development patterns;
- Implementation options that New Jersey's coastal communities can consider to achieve the planning scenarios. These implementation options are currently being used throughout the country to address risks associated with flood inundation exposure and sea-level rise;
- Recommendations for new and amended state-wide policies; proposed changes to the CZM Rules; and modifications to New Jersey's plan endorsement process, with the intent of threading risk avoidance, adaptation and mitigation awareness into all state and municipal land use planning regulations, policies, procedures and investments that shape coastal development patterns;
- Barriers the state will confront if it chooses to incorporate the changes proposed in this report to address risks associated with sea-level rise and flood inundation in the densely-developed communities that lie along New Jersey's coastline;
- An examination of the likely consequences if no action is taken to address the threat of future sea-level rise, a strategy that is emphatically discouraged; and
- Additional research that is needed to answer challenging questions raised during the planning process about managing land use changes, municipal obligations for providing services, costs, and benefits of various proposed implementation strategies and legal implications of strategic disinvestment in at-risk areas.

The project team believes NJDEP's overall objectives for the S&RCC project were sound and effective but that the process, strategies, and scenarios proposed in this report require additional "on-the-ground" tests. The team encourages NJDEP to replicate the project with additional pilot communities.

e. Planning Scenarios

New Jersey's coastal communities face risks from rising sea levels, erosion, and coastal storms that are likely to affect future development patterns. For this reason, it is important that towns consider altering their current development form if favor of future growth and conservation land-use patterns that will minimize their extent of exposure to coastal risk and increase resilience to flood events. To achieve this objective, it may be necessary to shift existing and proposed growth from areas that are, or will be inundated due to sea-level rise.

To facilitate the community re-envisioning that coastal communities will need to undertake, the project team developed three risk-based planning scenarios, the foundation, and focus of this report's recommended risk response strategy. Four flood zones, a nested series of bounded areas of diminishing development limitations and varying conservation objectives as they proceed landward from the shoreline, are proposed in each scenario to guide choices of implementation options. The scenarios range from a low-risk tolerance/high-risk management approach to a high-risk tolerance/low-risk management approach.

The scenario descriptions are associated with a menu of seventeen implementation options, introduced in **Section 7,** which communities can adopt to achieve varying development/conservation objectives. The seventeen options, many of which are presently employed in municipalities and states outside of New Jersey, fall into six specific categories: hazard disclosure; allowance for marsh mitigation; more resilient/stringent codes; restricting rebuilding; redistributing development; and realigning capital investment priorities. The options – their purpose, advantages, and limitations, where they're presently being used, how they can be applied in New Jersey and some web links for additional information about each – are presented in **Appendix 1**.

This range of implementation options will allow communities to select a preferred planning scenario based on the municipality's risk-tolerance threshold and its development objectives. Although the pilot towns served as models for their development, the scenarios and implementation options were designed for use coast-wide and they are based on data that can be collected readily and an analysis process that can be applied anywhere within the CAFRA zone.

f. Recommendations/Conclusions

The combination of a subsiding coastline, increasing rate of sea-level rise, and accelerating frequency and severity of storms points to a growing threat to the viability of every New Jersey community that borders a tidally-influenced waterway. These are extremely difficult topics of conversation in shore communities, which have a well-established cultural, as well as financial connection to their patterns of development. Without support and guidance, municipal officials are often ill-equipped to address the risk of climate change to their communities or to discuss these risks with their constituents. These discussions can be particularly difficult when they involve the potential for altering long-standing patterns of land use and development.

However, if these topics are unaddressed, municipal officials who seek to respond to coastal hazards are likely to perpetuate the ongoing cycle of merely putting people and property back in harm's way after a storm event rather than charting a course for resilient coastal development.

To this end, this S&RCC project report includes several recommendations designed to offer specific steps state and local elected officials can consider to respond to growing risks associated with sea-level rise and climate change:

- **State Leadershi**p: Local officials need the state to assume a leadership role in assisting coastal municipalities with evaluating adaptation and mitigation options and set uniform guidelines and standards for implementation. A state endorsement of scientifically informed and supported climate change metrics, such as uniform sea-level rise standards, will foster equivalent practices at all levels of government and encourage consistent application in public and private sectors.
- **Immediate Action**: The most recent scientific analyses underscore the urgency to initiate coordinated, focused planning in response to rising sea levels. This is because the land use changes that are needed to ensure that people and property are not in harm's way will require a long period of adjustment before they deliver successful outcomes. Sea levels are rising at an accelerating rate

and immediate action will allow time for rational deliberation among alternatives while it is still feasible.

- **Coordinated, Comprehensive Response**: The need for a long-term, coast-wide climate adaptation plan, which would set a framework and provide direction for county and local hazard mitigation and adaptation planning is increasingly evident. To meet this need, the state should consider formal appointment of a commission charged with advising the Governor and Legislature on strategies to mitigate the causes of, prepare for, and adapt to the consequences of climate change.
- **Revisions to the Municipal Land Use Law:** The MLUL, New Jersey's the enabling legislation guiding municipal land use and development planning and zoning must be amended to ensure that risk and vulnerability analysis and appropriate mitigation and response strategies are incorporated into and throughout local master plan elements. This is particularly important in the land use, circulation, parks and open space, community facilities, and housing elements, as well as land use regulations; design guidelines; capital improvement plans (as they relate to siting and design of critical facilities, services and infrastructure); and administrative procedures, policies and decision-making. The municipal master plan should be coordinated with the community's Hazard Mitigation Plan and Shoreline Protection Plan.
- **Alignment of State Programs and Incentives:** Sea-level rise, storm surge, and flooding should be factored into facility siting, permits, and any state infrastructure assistance programs. Any state programs that encourage or discourage development should account for flood and inundation risk factors.
- **Develop self-renewing funding sources to promote adaptation and finance land use change:** When and where risks associated with sea-level rise can no longer be tolerated it will be necessary to develop innovative approaches to finance property acquisition and equitably distribute economic burdens. The S&RCC report suggests creation of regional revenue-sharing strategies, regional transfer-of-development rights and life-rights programs to create incentives and offset ratables losses that vulnerable coastal areas are likely to experience. Concepts such as risk-insurance policy surcharges, social impact bonds, resilience/catastrophe bonds, and environmental impact bonds, (see descriptions on p 47 and 48) with considerable research and testing, hold the promise to serve as renewable funding options.
- **Promoting nature-based and gray-infrastructure solutions:** risks posed by sea-level rise will require aggressive application of combinations of "green" and "gray" infrastructure technique. Federal and state permitting processes must become more flexible and react more quickly than they do currently to ensure that projects can be designed and constructed in a timely, cost effective, and environmentally protective manner.

The report presents an extensive variety of specific state-wide policy recommendations for the Coastal Zone Management Rules and the CAFRA Center designation and plan endorsement processes. The report emphasizes that these recommended policies, guidelines, and standards will be most effective if they originate in and are directed by the governor's office. It also stresses that the state needs to create a mechanism to compel every coastal municipality to assess ***immediately*** its risk and vulnerability to sea-level rise. The most recent scientific analyses underscore the urgency of initiating as soon as possible coordinated, focused actions in response to rising sea levels. This is because the land use changes that are needed to ensure that people and property are not in harm's way will require a long period of adjustment before they achieve successful outcomes.

The report acknowledges that there are several barriers to widespread acceptance of the need to alter the course of development patterns along the coast in response to risk. These hurdles influence the

level of difficulty and resistance that will be encountered in trying to make the needed changes in the CZM Rules and Municipal Land Use Law to achieve the recommended scenarios. However, the report stresses that the proposed land use policy and regulatory changes are not impossible to enact and the obstacles New Jersey is likely to encounter if it elects to pursue them are not insurmountable. If it elects to adopt these recommendations, the state will have ample company since states throughout the country have initiated programs, policies, and regulations described in the report.

Additional research is needed. In the course of working with the three pilot towns, it became clear that additional research is needed relating to managing land-use changes, municipal obligations for providing services, costs and benefits of strategies, and how to allow legally for strategic disinvestment. The report concludes by recommending specific research subjects in the following topic areas:

- Municipal Responsibilities and legal and financial liabilities;
- Financial considerations of managed retreat including new approaches to financing acquisition of property in areas at risk of inundation;
- Timing and managing existing adaptation approaches;
- How the proposed implementation strategies will affect and be affected by the state's Local Redevelopment and Housing Law;
- How the recommendations could be administered most effectively; and
- How the proposed overlay zone strategies and implementation options can be applied in urban coastal areas (i.e. Jersey City, Hoboken, Perth Amboy) as compared to the typical shoreline municipalities.

g. Project Team

New Jersey Future - a nonprofit, nonpartisan organization - assembled an experienced and knowledgeable team to undertake the scope of work for the S&RCC Project. **David Kutner**, PP/AICP, New Jersey Future's Planning Manager, is the project manager. Mr. Kutner has considerable background in land use, community, and environmental planning. For the past four years, he has overseen New Jersey Future's Local Recovery Planning Manager program. **Leah Yasenchak**, PhD, AICP/PP, CEcD/EDP and **Katie-Rose Imbriano,** AICP/PP are with **BRS, Inc.**, a consulting firm that assists local government entities plan and implement redevelopment and resiliency projects and specializes in environmental management and policy. For the past four years, Ms. Yasenchak, the co-owner of BRS, also served as a local recovery planning manager under New Jersey Future's Local Recovery Planning Manager program, providing on-going, direct assistance to Little Egg Harbor Township and Tuckerton Borough. Ms. Imbriano provides municipal planning services through BRS. **Jessica Jahre**, PP/AICP/CFM; **Christiana Pollack**, GISP/CFM; and **Mary Paist-Goldman**, PE, are with **Princeton Hydro**, an environmental resources management/restoration consulting firm. Ms. Jahre is a planner with experience in project management, communications, urban design, geospatial analysis, and research. Ms. Pollack is an ecologist and GIS specialist who helped develop the mapping and risk analysis protocols used in the Strategic Recovery Planning Reports prepared for all communities participating in New Jersey Future's Local Recovery Planning Manager program. Ms. Paist-Goldman is an experienced water resource engineer.

2. Terms and Definitions

1% Flood: The flood event having a 1-percent chance of being equaled or exceeded in any given year. The 1-percent annual chance flood is also referred to as the *base flood* or 100-year flood. Owners of properties situated at elevations below the 1% flood event are required to purchase flood insurance on a federally backed mortgage.

10% Flood: The flood event having a 10-percent annual chance of being equaled or exceeded in any given year, often referred to as the 10-year flood. This zone is not shown on FEMA mapping. However, FEMA has published the 10% flood profile in the Flood Insurance Studies, which accompany FEMA mapping.

0.2% Flood: The flood event having a 0.2-percent chance of being equaled or exceeded in any given year, often referred to as the 500-year flood. This zone is mapped by FEMA, but not regulated by the NFIP; properties within this area are not required to have flood insurance on a federally-backed mortgage.

Base Flood: The flood having a 1 percent chance of being equaled or exceeded in any given year.

Base Flood Elevation (BFE): The computed elevation to which floodwater is anticipated to rise during the base flood.

Coastal Areas Facilities Review Act (CAFRA): A New Jersey act that authorizes the Department to regulate a wide variety of residential, commercial, public or industrial development such as construction, relocation, and enlargement of buildings and structures; and associated work such as excavation, grading, site preparation and the installation of shore protection structures within the CAFRA area. The CAFRA area begins where the Cheesequake Creek enters Raritan Bay in Old Bridge, Middlesex County. It extends south along the coast around Cape May, and then north along the Delaware Bay ending at Kilcohook National Wildlife Refuge in Salem County. The inland limit of the CAFRA area is an irregular line that follows public roads, railroad tracks, and other features. The width of the CAFRA area varies from a few thousand feet to 24 miles. The CAFRA area is divided into zones with different regulatory thresholds for each zone.

CAFRA Center: A center located within the CAFRA zone that is both endorsed by the State Planning Commission and accepted by NJDEP under the Coastal Zone Management Rules (see N.J.A.C. 7:7-13.16). There are two categories of centers, CAFRA and coastal. Each of these center types is further categorized as a regional center, town, village, or hamlet.

Category 1 Storm: A tropical strorm with maximum sustained winds of at least 74 mph according to the Saffir-Simpson hurricane wind scale.

Center: An area identified in the New Jersey State Development and Redevelopment Plan as a location for accommodating growth.

Coastal Planning Areas: Areas designated in the State Map that share a common set of conditions such as population density, infrastructure systems, level of development, or environmental sensitivity. Coastal Planning Areas are one component of regulations adopted by the NJDEP pursuant to CAFRA. The impervious cover limits and vegetative cover percentages for proposed developments requiring a CAFRA permit are determined by the location of proposed development within a Coastal Planning Area, CAFRA center, CAFRA core, CAFRA node or non-mainland coastal center, and for the Coastal Suburban Planning Area, whether the site is located in a sewer service area.

V Zone: Portions of the Special Flood Hazard Area (SFHA) where wave heights are at least three feet.

Coastal A Zone: Portions of the Special Flood Hazard Area (SFHA) landward of the V zone, where wave heights are between 1.5 and3.0 feet.

Coastal Zone Management Act: A voluntary federal state partnership designed to encourage states to develop coastal management plans, passed in 1972 and administered by NOAA.

Core: A pedestrian-oriented area of commercial and civic uses serving the surrounding municipality or center, generally including some housing and access to public transportation (N.J.A.C. 7:7-13.2).

Design Flood Elevation (DFE): The elevation of the design flood, taken as the greater of the base flood elevation shown on the FIRM or the flood shown on a community's flood hazard map. It can also refer to the base flood elevation plus a freeboard amount.

Digital Flood Insurance Rate Map (DFIRM) Database: An electronic flood insurance mapping database developed by the Federal Emergency Management Agency (FEMA) for use with geographic information systems (GIS) technology; a computer-based analytical tool that can be used for automated analysis and map updates.

Flood Insurance Rate Maps (FIRMs): The official maps of a community on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to that community.

Freeboard: A safety factor, typically measured in feet above a flood elevation.

Maximum of maximums (MOMS): The maximum storm surge heights for all hurricanes of a given category, regardless of forward speed, storm trajectory, landfall location, etc.

Mean Higher High Water (MHHW): 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 datum. The higher high tide extent is interpolated from regional tidal stations and is dynamic along the shoreline.

Mean High Water: The average of all the high-water heights observed over the National Tidal Datum Epoch. For stations with shorter series, simultaneous observational comparisons are made with a control tide station in order to derive the equivalent datum of the National Tidal Datum Epoch.

MOD IV: The property tax record data set assembled and maintained by the New Jersey Division of Taxation and posted on the New Jersey Geographic Information Network website.

National Flood Insurance Program (NFIP): A program created by Congress in 1968 to provide flood insurance protection to property owners in return for local government commitment to sound floodplain management and related flood disaster mitigation efforts.

Plan Endorsement: A process to ensure consistency among municipal, county, regional, and state agency plans and the State Plan and facilitate their implementation.

Planning and Implementation Agreement (PIA): An agreement among a petitioner for plan endorsement and all relevant state agencies outlining the planning implementation mechanisms to be undertaken during the endorsement period to ensure the goals and vision of the endorsed plan are achieved.

Preliminary Flood Insurance Rate Map (PFIRMs): A series of maps showing the best information available at the time and including new or revised Flood Insurance Rate Maps (FIRMs), Flood Insurance Study (FIS) reports and FIRM databases. While they can be used for regulatory purposes in New Jersey, especially by DEP, preliminary flood maps are those that have not yet been made effective by FEMA.

Repetitive Loss (RL): Any insurable building for which two or more claims of more than $1,000 were paid by the NFIP within any rolling ten-year period, since 1978. A RL property may or may not be currently insured by the NFIP.

Sea, Lake and Overland Surges from Hurricanes (SLOSH): A computerized numerical model developed by the National Weather Service (NWS) to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes by taking into account the atmospheric pressure, size, forward speed, and track data**.**

Sea-level rise (SLR): An increase in global mean sea level resulting from an increase in the volume of water in the world's oceans. Sea-level rise is usually attributed to global climate change by thermal expansion of the water in the oceans and by melting of ice sheets and glaciers on land.

Sea Level: The horizontal plane or level corresponding to the surface of the sea at mean level between high and low tide.

Severe Repetitive Loss (SRL): Any NFIP-insured residential property that has met at least one of the following paid flood loss criteria since 1978, regardless of ownership: 1) Four or more separate claim payments of more than $5,000 each (including building and contents payments); or 2) two or more separate claim payments (building payments only) for which the total of the payments exceeds the current value of the property.

Special Flood Hazard Area (SFHA): The land area covered by the floodwaters of the base flood. The SFHA is the area where the NFIP's floodplain management regulations must be enforced and the area where the mandatory purchase of flood insurance applies.

Substantial Damage: A damaged structure in a SFHA for which the total cost of repairs is 50 percent or more of the structure's market value before the disaster occurred, regardless of the cause of damage.

3. Existing Regulatory Framework

While the focus of this project is the New Jersey CAFRA Center designation and plan endorsement process, it is important to understand the interrelation between various coastal land use regulations and planning policies. Some of these are state and national policies designed to address the risk associated with rising sea levels and coastal storms; meanwhile, others may need to be modified to address risk so communities can minimize their vulnerabilities to coastal hazards.

a. Coastal Zone Management Act (CZMA)

The Coastal Zone Management Act (CZMA), passed in 1972 and administered by NOAA, is a voluntary federal/state partnership designed to encourage states to develop coastal management plans. The goal is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." New Jersey has been a participant in this program since 1978 when the state developed a federally approved Coastal Management Program (CMP).

As an amendment to the CZMA, the 309 Coastal Zone Enhancement Grant Program was developed to encourage states to enhance their CMP in one of nine "enhancement areas", wetlands, coastal hazards, public access, marine debris, cumulative and secondary impacts, special area management plans, ocean and Great Lakes resources, energy and government facility siting; and aquaculture. To receive Section 309 grant funding, the state must evaluate its CMP in these enhancement areas every five years through a process known as the Section 309 Assessment and Strategy. The NJDEP's Office of Coastal and Land Use Planning (OCLUP) initiated the 2016-2020 Section 309 Assessment and Strategy on October 1, 2014, following the format specified by NOAA's Office of Coastal Management, and received a letter of approval on Sept. 28, 2015.

Figure 2: New Jersey CAFRA Planning Areas

b. Coastal Area Facility Review Act (CAFRA)

The Coastal Area Facility Review Act (CAFRA), N.J.S.A. 13:19-1, *et seq.* was originally passed in 1973. This act regulates the use and development of coastal resources, and establishes the CAFRA zone as the boundaries of CAFRA regulation, consistent with the goals and policies of the CZMA and New Jersey's CMP. The act also specifies which types of developments require CAFRA permits, outlines the permit application and review process, and identifies enforcement mechanisms and penalties. The CAFRA legislation is administered by NJDEP, in conjunction with the Waterfront

Development Law (N.J.S.A. 12:5-3, *et seq.*) and the Wetlands Act of 1970 (N.J.S.A. 13:9A-1, *et seq.*)

In 1993, the Legislature amended the original CAFRA legislation to, among other things; tighten the regulatory thresholds for CAFRA permits. In 1999, NJDEP proposed a rule change to incorporate the State Development and Redevelopment Plan (discussed below) into the CZM Rules (see 31 N.J.R. 2042(a)). After taking public comment, these amendments were adopted on Feb. 7, 2000 (see 32 N.J.R. 503). The coordination of the State Plan into the CZM Rules established a new approach for determining impervious cover limits and vegetative cover percentages for sites in the CAFRA area that applied only to new development (including redevelopment) that is subject to regulation under the state's coastal permitting program.

c. State Planning Act

The New Jersey State Planning Act, N.J.S.A. 52:18A-196 *et seq.* was originally enacted in 1985. In the act, the Legislature declared that New Jersey needed sound and integrated state-wide planning to conserve its farmland and natural resources, revitalize its urban centers, protect its environment, and provide housing and adequate public services at reasonable cost while promoting beneficial economic growth.

To that end, the Legislature required the development of the State Development and Redevelopment Plan (the State Plan), which was adopted in 1992, after lengthy negotiations and public participation. According to the New Jersey Department of State, the State Plan provides a vision for the future that will preserve and enhance the quality of life for all residents of New Jersey. The purpose of the State Plan is to: "coordinate planning activities and establish statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic preservation, public facilities and services, and intergovernmental coordination (N.J.S.A. 52:18A-200(f))." Reflecting the state Legislature's concern for the quality of life and the detrimental effects of continued unmanaged growth, the State Planning Act requires that the State Plan provide a balance of development and conservation objectives best suited to meet the needs of the state.

State Plan Organization

A key organizing principle for development and redevelopment in the State Plan is "Centers" which the plan defines as areas of compact development designed to consume less land, deplete fewer natural resources and be more efficient in the delivery of public services. The areas outside of Centers are called the Environs; and the regions in which they are found are called Planning Areas.

Centers are designated and delineated as part of the plan endorsement process. There are five (5) types of Centers:

- Urban Centers
- Regional Centers
- Towns
- Villages
- Hamlets

Centers have a "Core" of public and private services and a development area surrounding the Core defined by a "Center Boundary." The "Center Boundary" defines the geographic limit of the Center.

The State Plan also divides New Jersey into Planning Areas (more than one square mile in extent) that

share a common set of conditions, such as population density, infrastructure systems, level of development or natural systems. They serve an important role in the State Plan by setting forth Policy Objectives that guide the application of the State Plan's statewide policies within each area, guide local planning and decisions on the location and size of Centers and Cores within Planning Areas, and protect or enhance the Environs of these Centers, primarily in Planning Areas 3 through 5.

The Planning Areas are:

- Metropolitan Planning Area (PA 1)
- Suburban Planning Area (PA 2)
- Fringe Planning Area (PA 3)
- Rural Planning Area (PA 4)
- Rural/Environmentally Sensitive Planning Area (PA 4B)
- Environmentally Sensitive Planning Area (PA 5)
- Environmentally Sensitive/Barrier Islands Planning Area (PA 5B)

d. Relationship between CAFRA and the State Plan

In 1993, the New Jersey Legislature amended the original CAFRA legislation to require that coastal rules adopted to implement the legislation be "closely coordinated with the State Plan" (N.J.S.A. 13:19-17). In addition to amending the CAFRA statute, the 1993 legislation also amended the State Planning Act to allow the State Planning Commission to adopt the coastal planning policies from the NJDEP coastal rules as the State Plan in the coastal (CAFRA) area. The overall goals of the State Plan as well as the statewide policies of the State Plan that apply in the CAFRA area - are all consistent and/or compatible with the eight coastal goals (formerly referred to as the eight basic policies) implemented by the Coastal Zone Management (CZM) rules. Both the State Plan and the CZM rules stem from similar policies, and many of the same factors were considered in developing both.

As in other parts of the state, Centers are also designated in the CAFRA zone and represent a compact form of development which may have one or more Cores and residential neighborhoods. There are two categories of coastal centers, mainland coastal centers and non-mainland coastal centers, each of which may be further categorized as a coastal regional center, coastal town, coastal village, or coastal hamlet. All mainland Coastal Centers expired in March 2017, whereas the non-mainland Coastal Center remain in place until their expiration date or until that designation is superseded by a CAFRA Center designation.

Further, the CZM Rules provide that, whenever the State Planning Commission formally approves a new or changed CAFRA Center or Coastal Planning Area boundary, DEP must evaluate the new boundary to determine whether it is consistent with CAFRA and the CZM Rules.[4] According to a report by the Monmouth University Urban Coast Institute, Centers are the designation through which both the State Plan and CAFRA can meet their respective mandates of accommodating necessary growth while preserving natural resources. This is accomplished by permitting higher levels of density in the Centers.[5] In the CAFRA zone, density is measured as the percentage of coverage permitted.

[4] N.J.A.C. 7:7E-5B.3(b)

[5] Kennedy, Susan. "Coastal Resource Protection: A Review of Select New Jersey Regulatory and Planning Tools." Monmouth University Urban Coast Institute.

Within the CAFRA area today, the impervious cover limits of development subject to the requirements of the Coastal Zone Management rules are established by the Coastal Planning Areas. These limits are listed in the following table:

Table 1: CAFRA Planning Area Coverage

Planning Area	Maximum Impervious Cover %
CAFRA Urban Center	90%
CAFRA Metropolitan Planning Area – PA1	80%
CAFRA Town	70%
Coastal Town	70%
CAFRA Village	60%
Coastal Village	60%
CAFRA Hamlet	50%
Coastal Suburban Planning Area – PA2 (in a sewer service area)	30%
Coastal Suburban Planning Area – PA2 (outside sewer service area)	5%
Coastal Fringe Planning Area – PA3	5%
Coastal Rural Planning Area – PA4	3%
Coastal Environmentally Sensitive Planning Area – PA5	3%

f. Plan Endorsement Process

Plan Endorsement is an official recognition by the New Jersey State Planning Commission that a local, county, or regional plan is consistent with the State Plan. The process is voluntary and Plan Endorsement lasts for 10 years. To petition for Initial Plan Endorsement, a municipality must submit to the State Planning Commission its master plan and elements, any amendments to the master plan, and a Reexamination Report, if the municipality adopted one during or after master plan adoption. It must also submit Board of Education five-year facilities plans and the municipal capital improvement program.

There are additional documents that must accompany the petition, including the Planning and Implementation Agreement (PIA). The PIA outlines the planning implementation actions and strategies that a municipality will undertake within the 10-year endorsement period to achieve the goals and objectives described in its endorsed plan. The PIA also describes state agency benefits that would be needed to implement the municipality's plan successfully. The PIA could be a very useful mechanism for integrating risk management into the local planning process, a point that will be explored in detail in subsequent sections of this report.

g. Comprehensive Planning

In New Jersey, comprehensive planning is subject to the regulations of the Municipal Land Use Law (MLUL) (N.J.S.A. 40:55D *et seq.*), the enabling legislation for municipal land use and development planning and zoning. The MLUL is the legislative foundation of planning boards and zoning boards of adjustment. It defines the powers and responsibilities of boards and is essential to their functions and decisions. Its relationship to municipal master plans and zoning codes is explored briefly below.

Master Plans

The MLUL defines a master plan as a composite of one or more written or graphic proposals for the development of the municipality. According to the MLUL, a master plan should define the objectives, principles, assumptions, policies and standards a municipality will apply to guide the use of lands throughout the community in a manner that protects public health and safety and promotes the general

welfare. Required master plan elements include:

(1) A statement of the objectives, principles, assumptions, policies and standards upon which the constituent proposals for the physical, economic and social development of the municipality are based; and

(2) A land use plan element that:

(a) takes into account and states its relationship to the statement of objectives and to natural conditions, including, but not limited to, topography, soil conditions, water supply, drainage, flood plain areas, marshes, and woodlands;

(b) shows the existing and proposed location, extent and intensity of development of land to be used in the future for varying types of residential, commercial, industrial, agricultural, recreational, educational and other public uses.

Optional master plan elements include housing, circulation, utility service, community facilities, recreation, conservation, economic, historic preservation, recycling, farmland preservation, development transfer, educational facilities, and green buildings and environmental sustainability.

The master plan must also contain a specific policy statement describing the relationship of the proposed development of the municipality, as outlined in the master plan, to 1) the master plans of contiguous municipalities, 2) the master plan of the county in which the municipality is located, and 3) the State Development and Redevelopment Plan adopted pursuant to the State Planning Act. Each municipality is required to reexamine its master plan at least every ten (10) years.

Zoning

The zoning ordinance is one of the most powerful tools a municipality has to shape its land use and development patterns. The MLUL delegates to a governing body the authority to adopt or amend a zoning ordinance that regulates the uses of land and of buildings and structures thereon (N.J.A.C. 40:55D-62). A zoning ordinance can only be adopted after the planning board has adopted the land use plan element and the housing plan element of a master plan, and all the provisions of the zoning ordinance must be substantially consistent with the land use plan element and the housing plan element of the master plan.

A zoning ordinance can be used to discourage development in flood-prone areas. A 2013 report by the New Jersey Climate Adaptation Alliance[6] recommends that local planners use up-to-date flood mapping, in conjunction with climate change projections, to develop maps of areas with high flood risk, including coastal areas at risk from sea-level rise, and riparian and low-lying inland areas likely to flood during heavy precipitation events. Planners should then use this information to consider imposing stricter regulations for new development in these areas by zoning for very low density uses, transferring development rights, establishing minimum requirements for building construction, limiting a property owner's ability to rebuild structures subject to repetitive flood losses, requiring large setbacks from shorelines and water bodies, and requiring owners to maintain riparian vegetation along waterways. These and other risk management tools are examined in further detail later in the report.

h. Hazard Mitigation Planning

The Federal Disaster Mitigation Act of 2000, also known as DMA 2000, requires local and state

[6] New Jersey Climate Adaptation Alliance. "Climate Change Preparedness in New Jersey: Best Practices for Local Planners." December 2013. Rutgers University.

governments develop and adopt hazard mitigation plans to qualify for federal disaster assistance grants. The purpose of a hazard mitigation plan is to understand and address risk within the community from natural hazards to reduce loss and minimize the need for recovery. New Jersey has a state Hazard Mitigation Plan, which identifies the relevant hazards and risks across the state, and outlines goals and mitigation priorities to address those risks. Within the state, counties have been encouraged to take a regional approach to hazard mitigation planning, since disasters do not respect political boundaries, and to work with local municipalities in plan development.

The Ocean County Multi-Jurisdictional All Hazard Mitigation Plan (2014) identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in municipalities throughout the County, including Little Egg Harbor, Tuckerton, and Toms River. The risks identified by the All-Hazard Mitigation Plan in the S&RCC project pilot communities includes coastal erosion, floods, flash floods, ice jams, hurricanes, tropical storms, Nor'easters, climate change, wildfires, and nuclear incidents. Toms River Township also recently completed a local update of its municipal hazard mitigation plan with a strong focus on coastal hazards.

i. Other Applicable Regulations

In addition to the major regulatory controls described above, there are other applicable state and federal regulations that address coastal flooding, climate change and other potential hazards to residents of the state's impacted coastal areas. These include the following:

New Jersey Flood Hazard Control Act

The New Jersey Flood Hazard Area Control Act Rules (N.J.A.C. 7:13) regulate construction in tidally controlled flood hazard areas, fluvially controlled flood hazard areas, and riparian zones under the authority of the Flood Hazard Area Control Act (N.J.S.A. 58:16A-50 et seq.) and other enabling statutes, including N.J.S.A. 12:5-3, 13:1D, 13:19, 13:20, 58:10A, and 58:11A. These flood hazard areas are defined by the flood hazard area design flood, and the definition of this flood and its corresponding elevation is different than that used by FEMA. In some cases, the flood hazard area design flood elevation is equivalent to FEMA's 100-year flood elevation. But in other cases, the flood hazard area design flood elevation is greater than FEMA's 100-year flood elevation. Among other things, the Flood Hazard Area Control Act Rules apply to the construction of new buildings, the substantial improvement of existing buildings, and the construction of additions to existing buildings, as well as the construction and reconstruction of roads, parking areas, and access drives associated with these buildings. According to these rules, low floors and travel surfaces of roads must be elevated to at least one foot above the flood hazard area design flood elevation. In some cases, higher elevations are required.

New Jersey Uniform Construction Code

The New Jersey State Uniform Construction Code Act , which was signed into law in 1975, authorizes the commissioner of the State's Department of Community Affairs to adopt and enforce rules pertaining to construction codes and provides for the administration and enforcement of those rules throughout the State. The design and construction of buildings in New Jersey is subject to the New Jersey Uniform Construction Code). Though municipalities have home-rule authority over land use decisions, local governments cannot regulate building codes and cannot be more restrictive than the state's building codes.

The NJUCC applies to all building types and covers repairs, renovations, and new construction. It incorporates various supra state codes, such as The International Construction Code, with specific New

Jersey modifications as sub-codes and also has specific New Jersey sub-codes such as The Rehabilitation Code.

According to the UCC, new buildings, additions to existing buildings, and existing buildings that are substantially improved or repaired, must comply with the applicable flood-resistant construction requirements (N.J.A.C. 5:23-6.3A). The UCC requires a minimum floor elevation of 1 foot above the base flood elevation. In certain cases, depending upon the use of the building and whether or not the building is located in the V zone or Coastal A zone, the lowest floor must be placed at an even higher elevation.

National Flood Insurance Program

The National Flood Insurance Program (NFIP) was created by Congress in 1968 and is administered by the Federal Emergency Management Agency. To be eligible, a property must be in a community that participated in the NFIP through the adoption and enforcement of municipal ordinances that meet or exceed minimum FEMA standards for flood risk reduction, including minimum elevation standards for new construction or substantial improvement of structures in flood hazard areas.[7] Further, private property owners who obtain or re-finance mortgage loans through an FDIC-supervised institution for properties located in flood hazard areas are required to purchase flood insurance.[8]

In general, different building standards apply depending upon what flood zone (AE, Coastal A, or V zone) a property is located in. For example, on the issue of foundations, NFIP rules in Coastal V flood hazard zones require the foundation to be open (minus breakaway walls). The NFIP rules, however, do not require a foundation in the Coastal A flood hazard zone to be open. Property owners in this zone could construct a shallow masonry foundation in lieu of a pile foundation (Section 4.5.1.2 of the ASCE 24-2014); however, if this type of foundation is chosen, it must have sufficient strength to resist the anticipated combination of flood loads.

[7] 44 CFR 60.1
[8] 12 CFR 339.3

4. Pilot Communities

Little Egg Harbor

The Township of Little Egg Harbor is the southernmost mainland municipality in Ocean County, New Jersey. The township is bordered by the Barnegat Bay on the east, Eagleswood and Stafford townships to the northeast, and Burlington County to the west. Little Egg Harbor also surrounds the Borough of Tuckerton, another pilot community.

Little Egg Harbor has a total land area of 49.5 square miles, much of which consists of state- and federally-protected lands, such as the Bass River State Forest and the Edwin B. Forsythe National Wildlife Refuge. A portion of the township is in the Pinelands Comprehensive Management Plan Area, and the rest is located within the boundaries of the Coastal Area Facilities Review Act, or CAFRA, zone. Two CAFRA mainland centers are located within the township: Mystic Island, a Town Center; and Parkertown, a Village Center. In accordance with the Permit Extension Act of 2008, which, in part, extended CAFRA center designations to 2016, these centers are valid until Dec. 31, 2018.

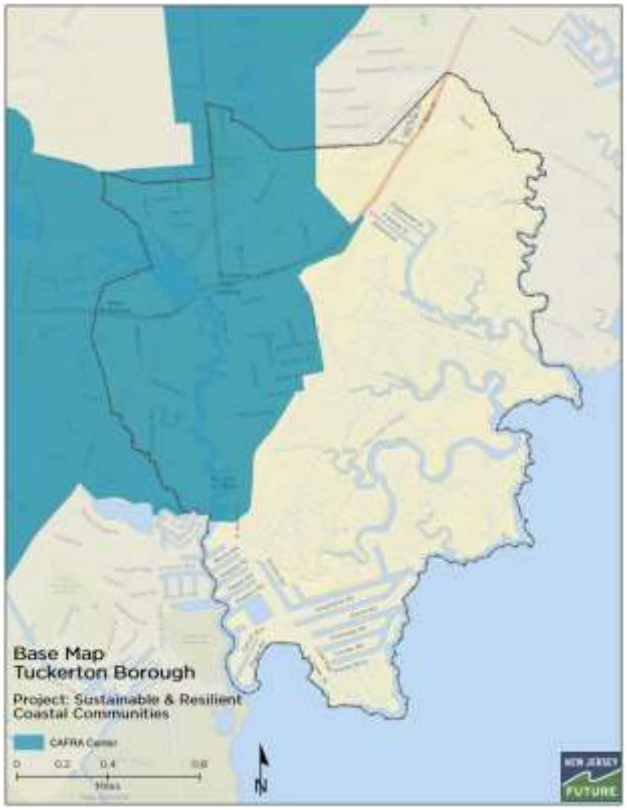
Figure 3: Little Egg Harbor Township CAFRA Centers

In 2010, the U.S. Census recorded Little Egg Harbor's population as 20,065. The township experienced explosive growth over the last 40 years, with an increase in population from 2,972 residents in 1970 to more than 20,000 residents in 2010. The 2010 Census also counted a total of 10,324 housing units, of which 2,264 (or 22 percent) were vacant, of which approximately 1,701, or more than 75 percent, were seasonal vacancies, a similar figure to Tuckerton Borough.

According to the Little Egg Harbor Township Strategic Recovery Report, prepared by the township engineer in April 2014, approximately 4,000 homes - 40 percent of the township's housing stock - sustained damage during Hurricane Sandy. Of those, 800 homes were deemed substantially damaged. Many of the homeowners adversely affected by the storm were senior citizens. A total of 921 households received funding through the Homeowner Resettlement Program (HRP) and 376 households in the township were awarded funding through the state's Reconstruction, Rehabilitation, Elevation, and Mitigation (RREM) program. Several of these homeowners are still awaiting completion of repairs. The township received $3,344,363 for debris removal.

Tuckerton

Figure 4: Tuckerton Borough CAFRA Center



The Borough of Tuckerton is located in southern Ocean County and covers approximately 2,360 acres or 3.78 square miles. According to the 2010 U.S. Census, Tuckerton had a population of 3,347 residents. This number increased slightly to 3,370 according to 2014 American Community Survey estimates. In addition, the 2010 U.S. Census identified a total of 1,902 housing units in the borough, of which 506 (or 27 percent) were vacant. Of these vacant units, 382 (or 75 percent) were seasonal vacancies.

Tuckerton is unique in that it is surrounded by Little Egg Harbor Township, and nearly half of the area of the borough is within the Edwin B. Forsythe National Wildlife Refuge. The entire land area of the borough is located within the boundaries of the Coastal Area Facilities Review Act or CAFRA zone. The borough is designated as two separate CAFRA planning areas: CAFRA Coastal Environmentally Sensitive Area (PA 5) and CAFRA Coastal Suburban Area (PA 2). The Mystic Island CAFRA mainland center encompasses the north-westerly quadrant of the borough. A portion of the borough is a designated Town Center in accordance with the New Jersey State Development and Redevelopment Plan. Straddling the borders of Tuckerton and Little Egg Harbor is the Greater Tuckerton Town Center – a designation that recognizes the common, interrelated issues facing both municipalities.

The three Little Egg Harbor and Tuckerton centers are wholly located within Planning Area 2 (PA-2) -- Suburban Planning Area. The State Plan defines PA-2 as follows:

> "*The Suburban Planning Area is generally located adjacent to the more densely developed Metropolitan Planning Area, but can be distinguished from it by a lack of high intensity Centers, by the availability of developable land, and by a more dispersed and fragmented pattern of predominantly low-density development. Suburban Planning Areas are or will be served by regional infrastructure, except that, outside of Centers and major transportation corridors, there is limited, if any, availability of alternative modes of transportation to the automobile.*"

Most of the remaining area outside of the designated Centers and within the boundaries of the pilot communities is designated PA-5, "Environmentally Sensitive Planning Area," or "Parks & Natural Areas."

Flood water from Hurricane Sandy inundated an estimated 2.43 square miles, or 69 percent of Tuckerton, with an estimated 1,277 parcels experiencing some flooding. In total, National Flood Insurance, Individual Assistance and Public Assistance claims exceeded $39 million. Borough residents filed 470 NFIP claims after Sandy, exceeding the cumulative number of claims the community had filed since 1977. The borough spent more than $955,000 to remove debris in the 30-day period after Sandy.

Toms River

Figure 5: Toms River CAFRA Centers

Toms River Township (known as Dover Township until November 2006) is a 52.7-square-mile coastal municipality located in northern Ocean County, New Jersey. The boundaries of the township encompass eight neighborhoods: Toms River; East Dover; West Dover; North Dover; Pleasant Plains; Silverton; Ortley Beach; and Dover Beaches North (which includes Chadwick Beach, Ocean Beach, and Normandy Beach). Ortley Beach and Dover Beaches North are barrier island communities with approximately three miles of frontage on the Atlantic Ocean. The inland areas of the township have approximately 31 miles of shoreline frontage on Barnegat Bay. Much of the township is suburban in character with more densely populated areas located along the northern border and the beach areas of the barrier islands. Commercial development is concentrated along Route 37, Route 70, Route 9, Fischer Boulevard, Hooper Avenue, and in downtown Toms River.

Toms River Township's population has increased steadily since 1930 when it was 3,940. The township's most significant growth spurt occurred between 1950 and 1970 when its population increased by almost 470 percent, from 7,707 to 43,751. Although the municipality's rate of population growth had slowed considerably by 2010, the current number of people reported to be living in the township, 91,239, is more than 23 times greater than in 1930.

The 2010 census data indicates that Toms River Township had 43,334 housing units, 2,218 more than the 41,116 reported in 2000. The number of vacant units increased from 7,606 (18.5 percent of total) in 2000, to 8,574 (19.8 percent of total) in 2010. In 2000, more than 57 percent of the vacant units (4,351) were seasonal, recreational, or occasional use homes. By 2010, 81 percent of the vacant units (6,974) were seasonal, recreational or for occasional use.

Two CAFRA planning areas encompass almost the entire area of Toms River, the Suburban Planning Area (PA 2), which restricts impervious surface coverage to 30 percent; and the Environmentally Sensitive Planning Area (PA 5), with an impervious coverage limitation of 3 percent. A large portion of the township had been designated as a Coastal Regional Center, which allowed for an impervious surface maximum of 80 percent but that designation expired on March 15, 2016. During the course of the S&RCC project, the township was engaged in a plan endorsement process to re-establish its center designation; with redrawn boundaries to cover a more tightly defined area (**Figure 5** depicts the new and prior CAFRA Center boundaries). Because of the extent of existing development, the barrier islands are designated non-mainland centers – a classification currently without a sunset date.

Damage from Hurricane Sandy resulted in the demolition of 1,292 housing units, more than half of the

increase in homes in the township between 2000 and 2010. Of those, 1,232 were single-family dwellings and 54 were multi-family dwellings. According to the township's Strategic Recovery Planning Report (SRPR), 762 of the permitted demolitions had been completed (building leveled; debris removed; site cleared) as of July 2014. The report also notes that the municipality issued 653 rebuild permits and 265 building elevation permits as of July 2014.

Toms River Township's Sustainability and Resiliency Master Plan update describes additional impacts from Hurricane Sandy including:

- Damage to more than 6,500 homes on the barrier island communities (Ortley Beach and Dover Beaches North) and 4,000 homes on mainland Toms River;
- "Substantially damaged" designation for 3,795 properties were designated[9];
- Loss of more than $2 billion in assessed value from 9,972 affected properties (24.1 percent of all parcels);
- Receipt of more than $16.8 million in FEMA Public Assistance[10] (the second highest of all New Jersey municipalities).

CAFRA Centers in the Pilot Communities

The State Plan map delineates the CAFRA boundaries and centers statewide. Figure 6 illustrates the three (3) CAFRA centers in Little Egg Harbor Township and Tuckerton Borough - Mystic Island, Little Egg Harbor (Town Center); Tuckerton, Tuckerton and Little Egg Harbor (Town Center), and Parkertown, Little Egg Harbor (Village Center) – and the Center areas of Toms River Township.

Toms River previously had a center designation for a portion of the mainland, but it expired on Dec. 31, 2016. During the course of the S&RCC project the township was engaged in the plan endorsement process to reauthorize its center designation. The mainland center consists of all areas south of Route 37 (including the downtown), the Ciba Geigy site and all commercial strips located on the north side of Route 37, every area located between Fischer Boulevard and Hooper Avenue located north of Route 37, areas located on each side of Route 9, commercial areas on both sides of Hooper

Figure 6: CAFRA Centers in Pilot Towns

[9] The cost of repairs exceeds 50% of the market value of the structure

[10] For debris removal, life-saving emergency protective measures, and the repair, replacement, or restoration of disaster-damaged publicly owned facilities, and the facilities of certain private non-profit organizations

Avenue located north of Fischer Boulevard, both sides of Route 70, and the triangle area located between Route 70 and Route 9.

However, despite the expiration of the original center designation, the township has been coordinating with the state since March 2016 to adopt a new center designation. Comments the township received regarding the original map proposal recommended moving boundaries to comply with sewer service areas and removing some areas from the proposed center due to wetlands. The township has complied with the comments provided by NJDEP and modified the sites to comply with sewer service area boundaries.

The boundaries of Toms River Township also encompass two non-mainland Coastal Centers - the Normandy Beach coastal center and Ortley Beach coastal center. Non-mainland Coastal Centers overlay the Planning Area 5B designation, and unlike the mainland centers created by NJDEP, they did not expire in 2005. The CAFRA Barrier Island Coastal Center designation enables these areas to be treated as centers with a correspondingly higher impervious coverage requirement (70 percent), as shown in **Table 1: CAFRA Planning Area Coverage**, above. According to the township's 2016 smart growth plan, the non-mainland Coastal Centers "are an artifact of the original effort by NJDEP to use the State Plan Policy Map as the Coastal Planning Map."

5. Planning Methods

a. Vulnerability Analysis and Plan Evaluation

As an initial step to understanding the development patterns, objectives, vulnerabilities to coastal hazards, and the character of the pilot communities, the project team examined all of their existing studies and plans. The project team worked with the municipalities to collect three reports and data, which included vulnerability and risk assessments; natural resource inventories; local land use regulations; building permit data; water quality reports; all-hazards mitigation plans; and recovery plans. Once a complete collection of plans, data, and resource documents was assembled, the project team performed a comprehensive review to ensure they had a thorough understanding of the issues, concerns, and priorities for each town. The list of documents and summary descriptions of the review findings are provided in **Appendix 2**.

b. Shoreline Assessment

In addition to reviewing the existing vulnerability analyses for each town, the project team prepared a shoreline assessment to gain a better understanding of the potential risks faced by each town.[11] The assessment report for Little Egg Harbor/Tuckerton Borough and the report for Toms River are provided in **Appendix 3**.

Each assessment included the development of a digitized inventory of shoreline features, a comparison of the current and historic shorelines to evaluate shoreline change, and an assessment of existing and historic wetland extent. Once the shoreline assessment was completed for Tuckerton and Little Egg Harbor the project team conducted three field visits to confirm mapped information. As noted above, the Toms River assessment was limited to a desktop GIS analysis, and did not include field visits. The objectives of the assessment were to evaluate shoreline changes between 1930 and 2015; estimate the change in wetlands during that time; identify the location and integrity of shoreline features along the coastline; and evaluate the vulnerability of these features to future flood hazards associated with sea-level rise. In addition to the other analysis tasks performed in Little Egg Harbor and Tuckerton, the project team evaluated the current elevation and health of tidal wetlands, given the size of the marsh area and its role in protecting the communities from coastal hazards.

The first step in developing the assessment was to review shoreline conditions over time. To accomplish this task, the project team digitized the shoreline using aerial imagery from 1930, 1956, 1972, and 2012. Once the shorelines were digitized, the team analyzed shoreline change over time using the United States Geologic Survey's (USGS) Digital Shoreline Analysis System (DSAS). The DSAS computed the distance and rate of shoreline change. In addition to shoreline change, this assessment examined tidal wetland loss. Wetland loss was characterized by change in wetland extent between 1930 and 2015, using the NJDEP's Land Use/Land Cover dataset and 2015 aerial imagery. To create the inventory of features, the 2012 shoreline was used in conjunction with the NOAA Environmental Sensitivity Index

[11] The scope also called for development of a shoreline protection strategy. Given the constraints on budget and time, the original scope limited the project team to conducting the shoreline assessment for Little Egg Harbor Township and Tuckerton Borough as a basis to generate the protection strategy. After the project began, it became clear that having a baseline characterization of shoreline features and shoreline change in all three participating communities was necessary to identify critical issues. Consequently, the original scope was modified to include a baseline desktop shoreline assessment for Toms River Township. However, budget constraints for this task precluded the project team from developing a shoreline strategic plan for Toms River, though the team did summarize the assessment methodology and results, as well as some recommendations to the Township based on the results.

(ESI) dataset. The NOAA data was refined manually by looking at aerial imagery from 2015 to determine the presence of shoreline features such as beaches, wetlands, unarmored lawn, or bulkheads.

The shoreline inventory informed the field visits in Tuckerton Borough and Little Egg Harbor Township, enabling the project team to target engineered features along the shore. During the field visit, GPS survey data was collected to evaluate the potential for inundation and overtopping based on sea-level rise predictions. The life cycle age, current condition, and potential need for replacement or retrofitting of shoreline protection structures was accounted for throughout the study area. Two additional visits were conducted to evaluate current elevations and health of the salt marsh adjacent to Little Egg Harbor and Tuckerton. The results of the shoreline assessments, found in **Appendix 3**, were used to identify critical community issues described below and the recommendations outlined in **Section 8**.

c. Community Engagement

As part of the scope of the S&RCC project, NJDEP stressed a clear preference for an interactive planning process with opportunities for public participation and input. To meet this expectation, the project team proposed establishing a municipal steering committee in each municipality to provide feedback and review the products that would be generated as key project tasks were being performed (e.g., shoreline assessment findings, identification of critical issues, selection of development scenarios, and evaluation of implementation strategies). The members of the steering committee, in conjunction with municipal staff, served as the project team's principal municipal points of contact.

Little Egg Harbor and Tuckerton

The effort in Tuckerton and Little Egg Harbor built upon the relationship members of the project team had established over the past four years of work in these communities, partially funded by the OCLUP through a competitive award from NOAA. That work included the preparation of a Strategic Recovery Planning Report (SRPR) completed for Tuckerton and Vulnerability Assessment completed for each town, and participation in the Getting to Resilience (GTR) process facilitated by Jacques Cousteau National Estuarine Research Reserve. Tuckerton's SRPR was developed in conjunction with the Post Sandy Planning Assistance program administered through New Jersey's Department of Community Affairs to support long-range community planning after the hurricane. The GTR process links municipal planning, mitigation and adaptation by engaging community representatives in a guided self-assessment of local plans and regulations to ensure that they protect the community from future coastal hazard risk and vulnerability. The work also built upon the Health Impact Assessment conducted for the Mystic Island area of Little Egg Harbor regarding potential property buyouts, and the Comprehensive Master Land Use plans and Re-Examination Reports completed for both communities by outside consultants.

Little Egg Harbor Township and Tuckerton Borough formed a joint steering committee to guide the S&RCC project. The committee was composed of the mayors of both towns, one councilperson from Little Egg Harbor and two from Tuckerton, a neighborhood representative, Township Administrator, and member of the Environmental Commission in Little Egg and the Borough Clerk in Tuckerton Borough.

The joint Little Egg Harbor/Tuckerton Steering Committee met three times: May 23, 2016, July 20, 2016, and September 15, 2016. The purpose of the first meeting was to introduce the project and define the role of the steering committee, lay out the schedule moving forward, and describe in detail the Shoreline Assessment. The second meeting focused on the three proposed development scenarios. Also discussed were the timing of when to implement a scenario, and the implementation options that could be associated with each zone within the scenarios. The steering committee provided important

feedback on these issues, but declined to make any decisions pending a public meeting that would provide more residents a chance to weigh in on the topics. The third and final steering committee meeting reviewed the feedback from the public meeting, whereby the moderate risk reduction scenario was determined to be the most palatable. The final public meeting was then scheduled

Figure 7: 8.25.16 Public Meeting Breakout Discussion

The project team held two well-attended and productive public meetings with residents from Little Egg Harbor and Tuckerton. The first public meeting was held on Aug. 25, 2016, at the Jacques Cousteau Coastal Center in Tuckerton Borough. The objective of this meeting was to review the outcomes and implications of the risk assessment previously conducted for both towns. Following this overview, the participants were divided into breakout groups with the intent of discussing whether and when residents of coastal communities would be prepared to discuss changes in development patterns in order to minimize exposure to future risks and how such changes might be achieved. Participants were asked to respond to four questions:

1. Should local officials from coastal communities consider future risk of flooding when they plan development? If yes, should the community plan for minimizing risk to the greatest extent or take a more moderate approach?

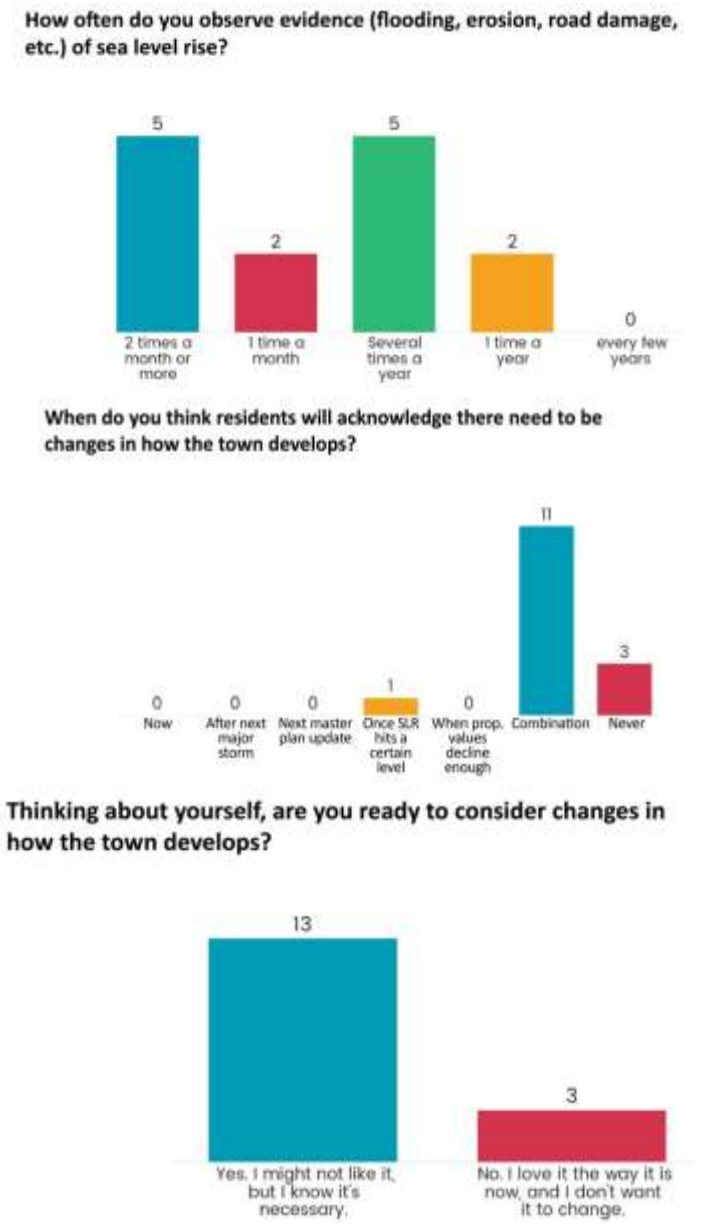
Figure 8: 10.4.16 Public Meeting

2. Where do you think the towns should permit residential development in the future; and where should future businesses and municipal functions such as schools, libraries, fire stations, and police headquarters be located?
3. When do you think the tipping point might be reached when residents who live along the coast can no longer tolerate flooding and storm damage and are ready to act to shift development patterns to address risks?
4. Which, among 11 different possible zoning and land use regulations explicitly intended to alter current development patterns and shift growth away from areas at risk, might be supported by the residents of the town?

No clear consensus to these questions emerged, but residents engaged in productive dialogue as they considered the implications of various answers. Participants acknowledged that they observed evidence of sea-level rise (flooding, erosion, road damage, etc.). Participants also indicated that it was likely that residents of the town would be ready to acknowledge that changes may be warranted in how the towns develop. And most of the participants also acknowledged that, although they may not like it, they need to begin thinking about development changes now.

The second public meeting was held on Oct. 4, 2016, at the Little Egg Harbor Township Community Center. Meeting participants acknowledged that nuisance flooding is occurring on a regular basis and agreed that development changes will eventually be necessary. Discussion focused on the planning scenarios (see **Section 6**), what point in time the community's tolerance for flooding would be exhausted, and what implementation options to respond to flooding might be preferable. From many comments made during the meeting, it was clear that participants felt strongly that the municipality should decide on which set of implementation options are most suitable/palatable. However, participants also expressed concerns about who would bear the costs of implementation. Some participants supported the installation of more bulkheads, while others felt that the only viable option was retreat.

Figure 9: 10.4.16 Little Egg/Tuckerton Public Meeting Survey Questions



NOTE: For greater legibility, a full-page version of Figure 9 is provided in **Appendix 6**

Toms River

Toms River appointed a nine-member body composed of its township planner and assistant planner; OEM coordinator and deputy coordinator; director of public works (who also serves as the Township's assistant business administrator); township engineer; the executive director of the chamber of commerce; and a member of the public from one of the township's barrier island communities.

As the project in Toms River was getting started, the township was engaged in the development of a Community Vulnerability Assessment, Hazard Mitigation Plan, and Post Disaster Recovery Capital Improvement Plan. The township was also overseeing preparation of a Resilient and Sustainable

Development Plan (R&SDP) to augment its master plan. The R&SDP is intended to promote land use practices that would protect the community's natural and built resources more effectively against natural hazards. Prior to the Community Vulnerability Assessment and the R&SDP, Toms River had engaged in the Getting to Resilience (GTR) process. Through these efforts, the municipality has initiated considerable concurrent efforts to evaluate its risk profile.

The project team conducted three meetings with the Toms River Steering Committee. During the first, a project kickoff meeting on May 20, 2016, the team reviewed the committee's role, the project objectives, scope tasks, schedule, and anticipated outputs. At the second meeting, on July 20, 2016, the team presented proposed risk-based development scenarios and discussed implementation strategies to accomplish the proposed scenarios. At this meeting, the team requested authorization to schedule a public meeting to seek input from community residents. However, members of the steering committee expressed considerable reservations about the viability of the proposed scenarios and the costs the municipality might incur to enact many of the implementation strategies. Members of the committee were also concerned about the negative reaction they expected residents to have after four difficult years of rebuilding and recovery from the damage the township experienced from Hurricane Sandy. After the meeting, the team decided to conduct additional research on the implementation strategies and reconvene the steering committee.

A third meeting with the Toms River Steering Committee was held on Oct. 18, 2016. During this meeting, the committee reconsidered the implementation options and discussed when various strategies might be enacted. The team stressed that the entire list of options may not be specifically suited to Toms River but that the full range would be included in the report to NJDEP. This is because different option combinations would be needed in order to fit different community needs.

No public meetings have been scheduled in Toms River due to reservations expressed by the township about the development scenarios and implementation recommendations generated in conjunction with this project. A public meeting may be scheduled and facilitated by the township as part of the S&RCC project in fall 2017.

d. Observations from the Planning Process

Little Egg Harbor/Tuckerton

Members of the project team had a longstanding, well-established working relationship with various representatives from Little Egg Harbor Township and Tuckerton Borough. At the time the S&RCC project was initiated, members of the team had been working with both communities for more than three years. This relationship was a considerable advantage because extensive discussions about risks associated with sea-level rise and flood inundation had already been conducted with municipal officials and the public. The towns were well acquainted with the implications of future sea-level rise projections and likely impacts on their communities. The project team had built a level of trust that gave the steering committee a level of confidence that the team was focused on the communities' interests.

Nevertheless, the members of the joint Little Egg Harbor Township/Tuckerton Borough Steering Committee were initially reluctant to take any position with respect to the development scenarios and implementation options. Before they would select a preferred development scenario, set of implementation options, or implementation trigger points, the committee members requested that the project team present the various alternatives to the public for feedback. Allowing a public discussion of these topics was indicative of the progress that had been made over three years of collaboration. Early

in the relationship, town officials had been reluctant to share information with the public about coastal hazards risks that might discourage investment.

By the time the S&RCC project team engaged the steering committee in discussing the various scenarios, the committee wanted some assurance that the public was open to entertaining at least a subset of the proposed adaptation and mitigation strategies to address future risks, and some understanding of which strategies the community would find palatable. Ultimately, the committee agreed that some response was needed in advance of the next storm or significant increase in sea-level rise.

Meanwhile, residents who attended the public meetings observed that rising sea levels were threatening their properties and agreed that response strategies are warranted, although there was no consensus about which options would be both acceptable and effective.

Toms River

The project team had no prior affiliation with Toms River Township, which has a staff of two full-time, experienced, professional planners and an engineer. Unlike many communities along the coast, Toms River township staff has considerable knowledge about the full range of programs available from the state to address the impacts of Sandy. The municipality assembled a steering committee composed of a representative of the local chamber of commerce and barrier island neighborhood as well as several members of the township staff, including the municipal planner and assistant planner, engineer, public works administrator, and OEM coordinator.

At the time the S&RCC project started, Toms River's mainland CAFRA center designation was on the verge of expiration and the township was engaged in a plan endorsement process to designate new centers, in accordance with the State Planning Act. Expiration of the township's center designations would mean that the township's coastal centers, which encompassed the municipality's primary mainland commercial corridors and residential areas, would revert from 80 percent coverage allowance to 30 percent, severely restricting the development and redevelopment opportunities the township planned for and was relying on.

With the exception of its downtown area (and areas located on Route 166 and the triangle between routes 70 and 9), the township is largely characterized by single-family residential development. Toms River was in the process of developing a smart growth plan to promote a vibrant, bicycle- and pedestrian-oriented downtown area characterized by compact, mixed-use growth, infill development, and reuse of existing under-used buildings. The intent was to develop a plan that would be consistent with smart-growth principles of the State Plan and promote downtown development that would directly support and counter-balance its extensive residential neighborhoods. These plans would be at considerable risk if the center designations expired.

As recounted in **Section 4**, above, Toms River sustained extensive damage from Hurricane Sandy and more than four years after the storm the municipality continues to be engaged in rebuilding and recovery as it strives to protect the high and increasingly high value of its waterfront property. Its initiative to develop a smart growth plan clearly emphasizes that the township is also focused on promoting redevelopment of its downtown centers. Because of the considerable effort the township has made to promote and enhance its economic opportunities, it was extremely wary of any proposed strategies that would encumber its prospects for development. Reservations about shifting development patterns and limiting growth in high-risk areas, predictable in most coastal communities, were amplified in Toms River. A more gradual vetting process that allows for relationship-building might

help to overcome this hurdle, but that was not possible under the scope and schedule of the S&RCC project.

e. Summary of Critical Issues

The three pilot municipalities that participated in the S&RCC project are coastal communities that have several characteristics found in many communities along New Jersey's coast. Each has a designated CAFRA mainland center surrounded by extensive patches of environmentally sensitive areas. Each has a coastline that is intensively developed with high-value residential and limited commercial and water-dependent uses. Each experienced considerable damage during Hurricane Sandy which, although the most devastating, was only one such event in a long string of coastal storms and hurricanes. Each is experiencing ever-more extensive, localized, recurring flooding, particularly during high tide periods, because of rising sea levels, gradual subsidence, and increasing coastal erosion. Each is inhabited by residents who have a strong attachment to the shore, have passed their houses down from generation to generation, and are likely to recoil at the thought of retreating from those homes, regardless of whether they are year-round or seasonal dwellings.

Each pilot community also experiences specific issues – flooding, shoreline protection, infrastructure vulnerability, and planning/zoning/ land use controls – that are becoming increasingly problematic as the impacts of sea-level rise continue to grow. And although all three communities experience these issues, the impact the issues have in each town and the priority each assigns to addressing them vary based on the community's character, composition, and resources.

To understand the differing municipal contexts, the S&RCC project team reviewed the Getting to Resilience and Strategic Recovery Planning reports that had already been prepared for each town. The project team also reviewed existing municipal master plans, land use regulations, hazard mitigation plans, natural resource inventories, and various data provided by the NJDEP (land use/land cover, flood plain boundaries, CAFRA center boundaries, etc.) The team also relied on the strategic shoreline assessment and cumulative and secondary impacts analysis the team generated. This information was used to identify critical issues the towns must address to respond to the risk of future coastal hazards and sea-level rise.

The project team then reviewed the list of critical issues and a description of possible response strategies were then reviewed with the members of the Tuckerton/Little Egg Harbor Joint Steering Committee and the Toms River Steering Committee. The list of critical issues was also presented at public meetings with the residents of Tuckerton Borough and Little Egg Harbor Township for discussion and comment. Some of these issues, listed below, are associated with the physical characteristics of the communities and others are regulatory.

Flooding

- **Localized Flooding**: The pilot communities have among the highest number of repetitive loss events and payouts through the NFIP nationally of any communities in the program. In addition, the shoreline assessment indicates current bay, stream, and creek channels are expanding, which is likely to increase risk of flood exposure.

  Several studies and news reports have documented frequent occurrences of stormwater backing up into town streets during rainfall events. It is unclear from the studies the project team reviewed if this issue is a result of lack of maintenance, the elevations of the infrastructure, or backflow from the adjacent waterbodies. It is also unclear whether parts of the towns experience periodic nuisance

back-flooding on the streets from high tides.

- **Coastal Storm Risk/Tidal Surge:** Tidal surges endanger approximately 1,500 homes along the bay in Little Egg Harbor Township. Further, since much of Tuckerton is at or near current sea level, future tidal surge equivalent to a Category 1 hurricane will produce flooding on a similar scale to Sandy, with surge impacts increasing with more severe storms.

  The three pilot towns experienced devastating flooding from surge during Hurricane Sandy and many of the storm events that followed Sandy. Several low-lying areas in each town, including the barrier island of Toms River and lagoon communities in the three towns, continue to be vulnerable to flooding associated with storm surge. This risk is expected to increase as sea levels rise.

- **Sea-level Rise:** If no action is taken to minimize future risk, by 2050, 55 percent of the area of Little Egg Harbor Township, or over 9,000 acres, would be exposed to inundation from sea-level rise. Further, one foot of sea-level rise will result in regular tidal inundation of every street in Tuckerton Beach. Three feet of sea-level rise will result in regular tidal inundation of all of Tuckerton Beach and areas bordering Tuckerton Creek.

  According to Toms River's Community Vulnerability Assessment, rising sea levels will increase flooding from daily tides as well as from coastal storms. The extent of this increase has yet to be determined. Sea-level rise is also expected to exacerbate overtopping of bulkheads, declining marsh vitality, and reduced vehicular accessibility.

Shoreline Protection

- **Bulkhead Integrity and Consistency:** Approximately 67 percent of Toms River's shoreline is protected by a bulkhead, and these structures protect many of the properties in the lagoon areas of Little Egg Harbor and Tuckerton. Most of these structures are privately owned and maintained, though regulated. Bulkheads and revetments help reduce the risk of erosion and nuisance flooding, but need to have sufficient freeboard above existing mean high-water levels to protect the shoreline under future conditions. Without added height, these structures may experience frequent overtopping. Repetitive or forceful overtopping can undermine the structure and compromise its effectiveness and integrity. Additionally, the elevation of shoreline armoring is inconsistent, and can result in variations of, and potential increases in, flooding or erosion. Furthermore, scouring associated with storm surge frequently undermines bulkheads.

- **Marsh Vitality:** The marshes that border all or portions of the coasts of the three pilot municipalities provide flood and wave attenuation for landward communities. All of these marshlands are vulnerable to erosion and sea-level rise. As the marshes erode and shrink over time, the level of protection they provide will diminish and community vulnerability to future storm surges and wind, wake, and wave action may increase.

  Hardscape development restricts the natural ability of the marsh to migrate inland. It is uncertain that mitigation strategies, such as living shorelines and the thin-layer deposition currently planned for Little Egg Harbor and Tuckerton, will ensure that the marshes keep pace with sea-level rise over the long term. The local governments are frustrated by the lack of direction and unclear lines of responsibility at the regional and state levels, which results in communities competing with their neighbors for scarce resources, and work being conducted in a piecemeal fashion. The communities have also become frustrated by the pace and difficulty of obtaining permits for marsh restoration projects. In addition, the extensive amount of area owned by the State and Federal government that surrounds the towns make marsh resiliency projects more challenging for direct municipal action.

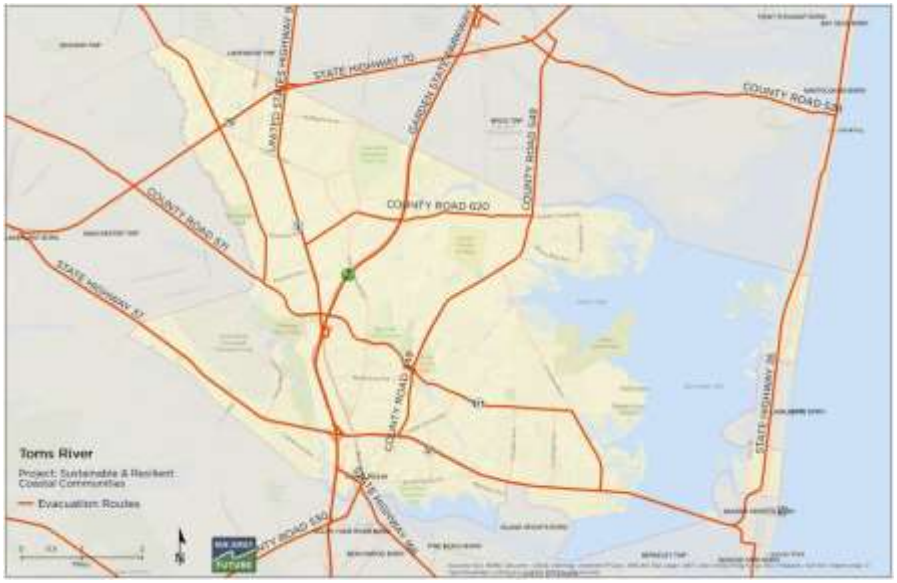
- **Soil Limitations/Erodibility**: The coastline of all three communities is characterized by shoreline types that are potentially vulnerable to erosion, including sandy beaches, marsh, and unarmored lawn area. Much of these areas are too sandy or flood-prone to support future land development. Estimates of historic erosion and shoreline change are included in the shoreline assessment prepared as part of the scope of the S&RCC project.
- **Groundwater Vulnerability**: The aquifer supplying water to Little Egg Harbor and Tuckerton, and other adjacent municipalities, is prone to future saltwater invasion.
- **Other Natural Hazards:** The Ocean County All-Hazard Master Plan determined that the pilot communities are at risk for coastal erosion, ice jams, hurricanes, tropical storms, Nor'easters, climate change, wildfires, and nuclear incidents.
- **Water Quality:** Development has resulted in a degradation of water quality and a loss of natural lands and vegetation that might otherwise absorb stormwater. Parts of Tuckerton are also experiencing noticeable effects from excessive aquifer withdrawals, threatening plant and animal habitats, potable water supplies and saltwater intrusion.

Infrastructure Vulnerability

- **Infrastructure and Critical Facilities:** There is no uniform direction to guide utilities in fortifying facilities to ensure resilience. Capital improvement plans should be required universally and are particularly critical in coastal areas of risk, but Tuckerton has not prepared one. At a minimum, capital improvement plans should evaluate age of infrastructure, elevation (i.e. bulkhead/dunes) as it relates to current and projected sea levels, current condition, and useful life, in the context of future expected conditions and vulnerability to risk.

  Critical **i**nfrastructure, such as storm drains and pumps stations, which serve low-lying communities, experience frequent inundation. This inundation can occur during normal tide cycles as well as coastal storm events. Minimal information is available about the vulnerability of the critical infrastructure serving each of the three pilot towns. An action in the County Hazard Mitigation Plan indicates that the Toms River Municipal Utilities Authority plans to flood-proof four facilities, but the plan does not indicate which facilities or the level of their vulnerability.
- **Utility Vulnerability:** Little Egg Harbor and Tuckerton are susceptible to bayfront flooding from coastal storms, which can lead to power outages and damage to utility infrastructure.
- **Water Supply**: Toms River is largely dependent on groundwater for its drinking water supply. Coastal aquifers can be vulnerable to saltwater intrusion due to over-withdrawal. There was limited information on this issue in the plans the project team reviewed.
- **Sewer System**: Lack of power during major storm events creates backups and renders the sewer systems that serve large areas of the three pilot communities inoperable.
- **Road Access:** There are only two major roads in Tuckerton, and neither was designed to handle current or projected traffic volumes. These issues are exacerbated in an emergency or evacuation scenario, when the roads are likely to become impassable. Evacuation concerns are considerable, given that many roadways are at capacity during peak travel periods, a condition that becomes more pronounced in coastal areas during the summer season, and given that evacuation roads are located in flood areas.

Figure 10: Toms River Evacuation Routes



In Toms River, segments of 10 evacuation routes are located on the mainland. Route 9, the Garden State Parkway, Route 37, Route 70, County Road 571, County Road 549, and County Road 527 are designated Hurricane Evacuation Routes. On the mainland, except for Route 37, these roads appear to be at higher elevations, though several neighborhoods along low-lying areas of the waterfront may experience flooding on local access roads. It is unclear if the township experiences periodic roadway flooding during high tides.

Only limited evacuation access is available from the barrier island. Route 35 provides egress for residents and visitors. Route 37 is the single point of access from the township to the barrier island communities. The piers under Route 37 experienced severe scouring from Hurricane Sandy, which was fixed shortly after the storm.

Toms River filed requests for $8 million in public assistance funding for roads and bridges, which suggests that the municipality's transportation network has considerable vulnerability to coastal storm events. However, this vulnerability has not been considered in the documents reviewed in conjunction with the S&RCC project.

Presently, each pilot community experiences recurring flooding that hinders roadway accessibility in many low-lying neighborhoods. In an effort to provide relief to area residents, Little Egg Harbor and Tuckerton have applied additional paving to elevate some roadway surfaces. Toms River's township engineer evaluated costs to elevate roadways that were likely to experience inundation. At the time of the engineer's assessment, the township was piloting a program to elevate four roadways in the municipality that experience the most frequent flooding. The engineer estimated that the cost to elevate affected streets throughout the township to 3.0 NAVD88[12] would be $4.5 million to $5 million per mile, or $72 million to $80 million for the 16 miles of roads under consideration. The engineer suggested that these costs should be compared to the value the municipality gains by retaining access to the approximately 3,000 parcels that the roads serve.

- **Adaptation Strategies**: The principal adaptation strategy presently being followed in residential areas of the pilot communities is to raise homes above the base flood elevation. This strategy is being deployed in a random fashion, largely without local, state, or federal coordination. This is having a significant adverse effect on community character, particularly where elevated structures are interspersed among at-grade dwellings. In addition, elevated structures are often enlarged considerably, thus altering the character of the neighborhood and driving up property values, making ownership unaffordable for families that have lived in these areas for generations.

[12] NAVD – North American Vertical Datum – the national standard base measurement from which elevations are determined

Planning/Zoning/Land Use Controls

- **Land Use Planning**: Current local master plans, zoning ordinances, capital investment plans (where they exist), water management plans, stormwater management plans, and hazard mitigation plans do not reflect flood inundation risks associated with sea-level rise. Toms River is currently in the process of updating several plans, including its master plan, which may inform short- and long-term land use planning.

  To inform the analysis of critical issues and provide recommendations for actions the pilot communities could take to address them, the NJDEP prepared a build-out analysis in conjunction with the S&RCC project. The principal purpose of the analysis was to establish a baseline assessment of existing conditions and an evaluation of future development potential. The procedures for the analysis are outlined in a June 17, 2016, memo from NJDEP (see **Appendix 5**). Using the output from the analysis, the project team mapped all parcels in Little Egg Harbor Township and Tuckerton Borough identified as developable, and confirmed with the municipalities' building official that the parcels were, in fact, vacant. However, analyses of population growth projections and distribution across the community were outside the project scope. These areas were viewed as development alternatives the municipalities could consider where adherence to the various planning scenarios, described in **Section 6**, would result in limiting or prohibiting new coastal area development. But the impacts such development might have on natural resources were not evaluated.

- **Zoning Regulations:** A limited amount of developable property is available in certain zoning districts and in the pilot communities in general. Further, the towns' master plans, currently permitted uses, land use intensity and density, zoning controls, natural resource constraints, and service area restrictions do not account for known coastal hazards risks. In Toms River, some of the zoning and standards may be inappropriate for the parcel sizes and character of the existing neighborhoods. However, the township is currently updating its master plan and reviewing zoning in certain areas, so updated regulations may address future conditions.

- **Environmental Regulations**: Development is limited or prohibited in certain environmentally sensitive areas of the pilot communities, including wetlands, flood plains and critical wildlife habitats.

- **Community Character:** The public expressed concerns about the changing residential character as an increasing number of homes are elevated. Often structures that are raised are enlarged considerably. As a result, these homes are no longer compatible with the character of the surrounding neighborhood. These homes can also be far more expensive than pre-existing structures, forcing surrounding property values and taxes to rise to the point where families that had resided in these areas for generations are no longer able to afford to reside there.

6. Scenario Planning

a. Purpose

The evaluation of critical issues revealed that the pilot communities face risks from sea-level rise, erosion, and coastal storms that are likely to affect future development patterns. Though all three towns are exposed to these risks, the anticipated impacts to land use patterns, infrastructure and public services, and tax base are unique to each community. For this reason, it is important that each town envision future growth and conservation land-use patterns that are most suited to minimizing the extent of its exposure to coastal risk and increasing resilience to flood events. This long-range planning effort could be undertaken when the municipality engages in the plan endorsement process to achieve center designation.

One objective for this project was to assist the pilot communities in this visioning process in advance of pursuing plan endorsement. In Toms River, the plan endorsement process occurred concurrently with the S&RCC project.

To facilitate the community visioning effort, the New Jersey Future project team developed three risk-based planning scenarios. The three scenarios range from a low-risk tolerance/high-risk management approach to a high-risk tolerance/low-risk management approach. Each of the scenarios propose a hierarchy of four overlay coastal flood zones, a nested series of bounded areas of diminishing development limitations and varying conservation objectives as they proceed landward from the shoreline.

To aid public understanding of how development may be affected, **Section 7** introduces a list of seventeen implementation options that could be applied to achieve the development/conservation objectives in each of the four overlay zones. The seventeen options, many of which are presently employed in municipalities and states outside of New Jersey, fall into six specific categories: hazard disclosure; allowance for marsh mitigation; more resilient/stringent codes; restricting rebuilding; redistributing development; and realigning capital investment priorities. The options – their purpose, advantages, and limitations, where they're presently being used, how they can be applied in New Jersey and some web links for additional information about each – are presented in **Appendix 1**.

This range of implementation options was structured to allow each pilot community to select its preferred planning scenario based on its threshold for risk and its development objectives. Although the pilot towns served as models, the scenarios were designed for use coast-wide, are based on data that can be collected readily, and used an analysis process that can be applied anywhere within the CAFRA zone.

b. Scenario Development Process

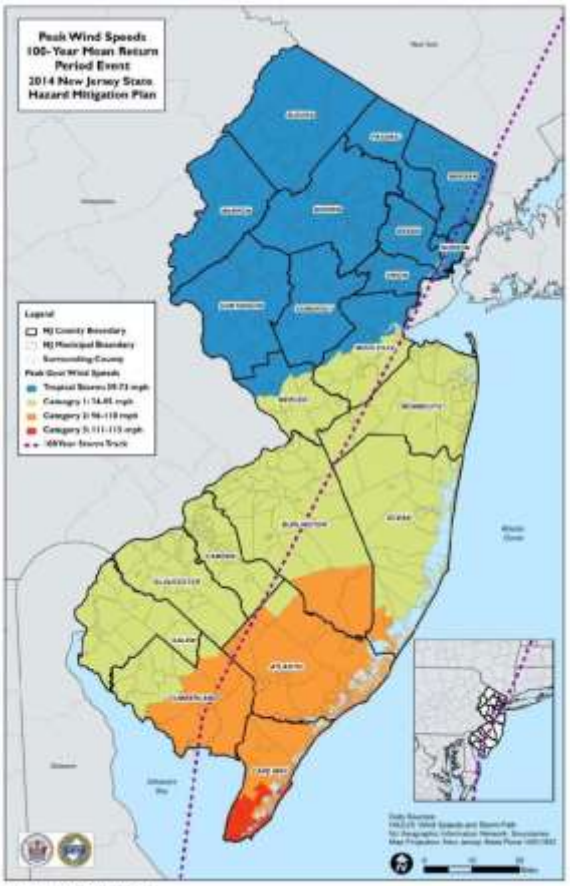
To develop the planning scenarios, the project team gathered the best available data for sea-level rise projections, flood risk, and storm surge. The sea-level rise projections were obtained from a 2016 report prepared for the New Jersey Climate Adaptation Alliance by its Science and Technical Advisory Panel (STAP). The STAP report indicates that there is a 50 percent probability that sea levels along the coast of New Jersey will increase by 1.4 feet or more by 2050. The year 2050 was selected as an initial planning target for this exercise because a 34-year period is within the lifespan of many residents in the project area; it parallels the typical duration of a conventional mortgage; and it is a reasonable lifespan of most municipal infrastructure. However, other planning horizons, such as to 2100, may be more appropriate

when planning major critical infrastructure such as power generation facilities. Additionally, communities that are likely to experience a sharp increase in risk as sea levels continue to rise may want to undertake a planning process with a longer-term horizon to consider significant shifts in land use patterns.

Based on the availability of data for all the pilot towns, the project team decided that the four coastal flood zones used as the basis for the three proposed planning scenarios should be based on the estimated extents, assuming 1.4 feet of sea-level rise, of 1) the MHHW line, and the storm surge water surface elevations for 2) the 10 percent FEMA flood zone, 3) the 1 percent FEMA flood zone, and 4) the .2 percent FEMA flood zone. These four risk zones represent different probabilities and types of risk within coastal communities. Using these zones as the basis for the scenarios in each town ensures consistency in approach and scientific support for the analysis. An added benefit to using the FEMA flood zone boundaries as the basis for the scenarios is that this approach will be consistent with FEMA's Community Rating System eligibility criteria and, depending on the policy options selected, could contribute to a municipality's Community Rating System[13] ranking.

In addition to the flood models produced by FEMA and NJDEP, the project team considered storm surge inundation water surface elevations produced by NOAA, referred to as SLOSH (Sea, Lake, and Overland Surges from Hurricanes). SLOSH inundation extents are mapped for hurricane categories I through IV in New Jersey. To help determine which hurricane category is appropriate for this study, the project team considered the statistical probability of each category storm affecting the coast. The 2014 State Hazard Mitigation Plan includes a map (see **Figure 11**) that correlates the 100-year return period and anticipated hurricane category. The statistical probability of each hurricane category storm varies across the New Jersey coast; however, as **Figure 11** reveals, Category I hurricanes have a 1 percent probability of occurring during any given year for the majority of Ocean County. Therefore, Category I is the most reasonable hurricane storm to use for Tuckerton, Little Egg Harbor, and Toms River. When comparing storm inundation extents in Tuckerton, Little Egg Harbor, and Toms River for a 1 percent annual chance, between FEMA and NOAA SLOSH models, the FEMA 1 percent annual chance inundation was more extensive, and therefore, more conservative from a risk perspective. While the FEMA models were used to define the zones for the pilot communities, other municipalities may want to consider SLOSH data as an alternative when establishing risk-based overlay zones.

Figure 11: Wind Speed for the 100-year Mean Return Period Event



Source: HAZUS-MH v.2.1

[13] The Community Rating System (CRS) recognizes and encourages community floodplain management activities that exceed the minimum NFIP standards.

The project team also considered data that informed where additional growth might be supported in the pilot communities outside of areas that will be at risk for inundation. Using NJDEP's Land Use/Land Cover dataset, as well as the MOD IV property tax data, to determine which parcels were vacant or under-used, NJDEP compiled preliminary shapefiles that started the process of identifying vacant parcels (see **Appendix 5** for a description of the analysis procedures). These draft datasets were provided to the towns to "ground-truth the information. However, the project team concluded that the time required conducting a detailed evaluation of parcel-level density yield and population growth would be considerable, and the parcel data could only offer a snapshot of the town's development potential and economic characteristics. As a result, the project team concluded that this information would not be useful to identify future growth areas conclusively.

The project team believes that the state should create overlay maps for all municipalities based upon uniform minimum criteria for the risk protection zones outlined in **Section 6.d.** below. The methodology for establishment of the zone boundaries should be consistent for all towns. However, each town should use data that are most appropriate to its characteristics (for example, SLOSH versus FEMA flood maps). In addition, the objectives and implementation options recommended for the zones in each town could vary based on the community's risk tolerance. As noted above, the scenarios allow each community to choose the most appropriate objective for its zones based on its risk tolerance and development aims. This community-driven approach is consistent with current implementation of land use planning tools.

As part of its plan endorsement process, Toms River Township had developed its vision of future growth areas and centers prior to inception of this project. Those proposed centers were reviewed in terms of the potential risk development in those areas might experience. The final extent of those centers is included in the Toms River preferred scenario as potential areas of future growth. For Tuckerton and Little Egg Harbor, there was no established vision to determine where growth may be directed in the future. As these communities reconsider their center designations, which are set to expire in 2018, visioning for the growth areas may become more concrete. For the purposes of this project, all areas outside of the 0.2 percent flood zone are considered potential growth areas.

c. Planning Scenarios

The project team developed three planning scenarios. As noted above, each scenario envisions the establishment of four flood hazard zones of diminishing development limitations and varying conservation objectives as they proceed landward from the shoreline. They include: the MHHW zone, 10 percent flood zone, 1 percent flood zone, and 0.2 percent flood zone. In practice, the zones should be applied as an overlay to current zoning.[14] Although all three scenarios are based on these risk zones, the objectives for each zone and their associated implementation options vary based on assumptions of risk tolerance, as summarized in **Table 2** below. Scenario no. 1 seeks to minimize risk to the greatest extent possible by 2050; Scenario no. 2 proposes implementation options for moderate risk tolerance; while Scenario no. 3 prioritizes maintenance of character and allows for the greatest degree of risk. The implementation options intended to achieve the development/conservation objectives in each zone include those from the preceding lower-risk zone. The implementation options, regulatory, and policy strategies that municipalities can consider to reshape existing and future development patterns to achieve the objectives of each development scenario are introduced in **Section 7** and described in detail in **Appendix 1**.

[14] Overlay zones allow local governments to superimpose additional regulatory requirements on an existing zone in order to protect areas with special characteristics. They allow greater flexibility because they don't require the locality to disrupt existing zoning classifications.

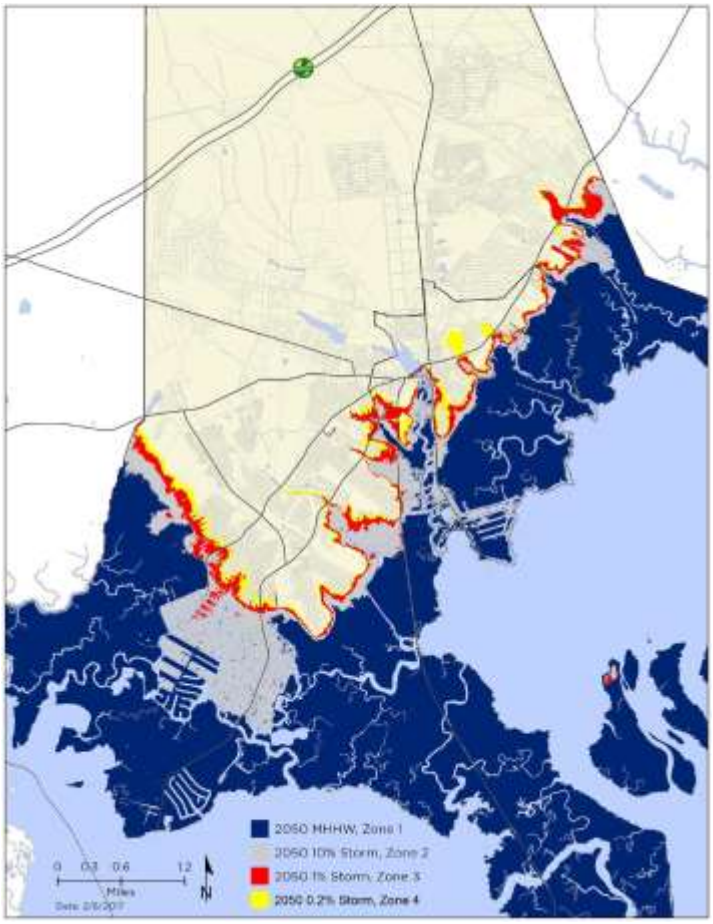
Table 2: Planning Scenarios and Potential Implementation Options

	Scenario #1 Maximum Risk Reduction	Scenario #2 Moderate Risk Reduction	Scenario #3 Minimum Risk Reduction
Zone 1: All land seaward of the MHHW line.	***Objective:*** **Conservation Zone. Gradually shift/reduce existing development, limit or prohibit new growth.** Ensure minimal properties experience frequent tidal flooding in 2050 and allow for marsh migration.	***Objective:*** **Conservation Zone. Gradually shift/reduce existing development, discourage new growth.** Ensure minimal properties experience frequent tidal flooding in 2050 and allow for marsh migration.	***Objective:*** Prioritize the maintenance of existing character and tax base.
	Implementation Options: 1. Limit shoreline armoring; rolling easements 2. Restrict rebuilding 3. Sea-level rise overlay zone 4. Highest priority for targeted acquisitions 5. Special tax district 6. Transfer of development rights 7. Acquisition of development rights 8. Disclosure requirements 9. Limit public infrastructure investment	*Implementation Options:* 1. Limit shoreline armoring; rolling easements 2. Restrict rebuilding 3. Sea-level rise overlay zone 4. Targeted acquisitions 5. Special tax district 6. Transfer of development rights 7. Acquisition of development rights 8. Disclosure requirements 9. Limit public infrastructure investment	*Implementation Options:* 1. Evaluate permitted uses 2. Encourage elevations and voluntary acquisitions 3. Explore financing options for capital investments in high-risk areas 4. Disclosure requirements
Zone 2: All land within the FEMA 10% flood zone in 2050, but landward of MHHW line.	***Objective:*** **Gradually shift/reduce existing development.** Minimize the damage sustained during coastal storms and the cost to the community during recovery; reduce risk of tidal flooding in 2100.	***Objective:*** **Manage/reduce new growth.** Reduce property damage sustained from coastal storms.	***Objective:*** Comply with state and federal standards/increase transparency by disclosing all known hazards.
	Implementation Options: 1. Limit shoreline armoring; rolling easements 2. Restrict rebuilding 3. Sea-level rise overlay zone 4. Targeted acquisitions 5. Special tax district 6. Transfer of development rights 7. Acquisition of development rights 8. Disclosure requirements	*Implementation Options:* 1. Limit building size/density; adjust building setbacks 2. Downzone 3. Restrict rebuilding 4. Target acquisitions 5. Increase freeboard requirements 6. Resilient design guidelines 7. Special tax district 8. Disclosure requirements 9. Modify substantial damage threshold/calculation	*Implementation Options:* 1. Evaluate all permitted uses 2. Encourage elevations and voluntary acquisitions 3. Explore financing options for capital investments in high-risk areas 4. Disclosure requirements

	Scenario #1 Maximum Risk Reduction	Scenario #2 Moderate Risk Reduction	Scenario #3 Minimum Risk Reduction
Zone 3: All land within the FEMA 1% flood zone in 2050, not included in zones above.	***Objective:*** **Manage/limit growth.** Minimize the damage sustained during coastal storms and the cost to the community during recovery.	***Objective:*** **Manage growth**. Reduce property damage sustained from coastal storms.	***Objective:*** Comply with state and federal standards/increase transparency.
	Implementation Options: 1. Limit building size/density; adjust building setbacks 2. Downzone 3. Restrict rebuilding 4. Target acquisitions 5. Increase freeboard requirements 6. Resilient design guidelines 7. Disclosure requirements 8. Modify substantial damage threshold/calculation	*Implementation Options:* 1. Restrict rebuilding 2. Target acquisitions 3. Increase freeboard requirements 4. Resilient design guidelines 5. Disclosure requirements 6. Modify substantial damage threshold/calculation	*Implementation Options:* 1. Evaluate all permitted uses 2. Encourage elevations and voluntary acquisitions 3. Explore financing options for capital investments in high-risk areas 4. Disclosure requirements
Zone 4: All land within the FEMA 0.2% flood zone in 2050, not included in zones above.	***Objective:*** **Manage growth**. Reduce property damage sustained from coastal storms.	***Objective:*** **Manage growth**. Limit public investment and critical infrastructure in areas that may have increased flood risk in the future.	***Objective:*** Comply with state and federal standards/increase transparency.
	Implementation Options: 1. Freeboard requirements 2. Resilient design guidelines 3. Disclosure requirements 4. Modify substantial damage threshold/calculation 5. Evaluate all permitted uses 6. Encourage elevations and voluntary acquisitions	*Implementation Options:* 1. Evaluate all permitted uses 2. Encourage elevations and voluntary acquisitions 3. Disclosure requirements	*Implementation Options:* 1. Evaluate all permitted uses 2. Disclosure requirements
All Lands not included in zones above	***Objective:*** Growth zone	***Objective:*** Growth zone	***Objective:*** Comply with local regulations

d. Risk Protection Zones

Figure 12: Little Egg Harbor/Tuckerton Proposed Risk Zones



NOTE: Full-page versions of the proposed risk zone maps, Figures 12 and 13, are provided in **Appendix 6**

Zone 1: Mean Higher High Water

The Mean Higher High Water line is based on the average of the higher high water height of each tidal day over a 19-year cycle. Generally, the extent of land between the Mean High Water line and the Mean Higher High Water line is accepted as the estimated area of inundation during sunny-day or lunar tidal flooding. The boundary of this proposed protection zone is based on the location of the Mean Higher High Water line with 1.4 feet of sea-level rise. Land seaward of this MHHW line is vulnerable to frequent nuisance flooding, erosion and overtopping of shoreline protection structures. Because of its proximity to bays or the ocean, this area is highly vulnerable to wave action and storm surge from coastal storms. Land area within this zone is not suited for center designation.

Zone 2: 10 Percent Flood Zone

This zone encompasses the land area between the landward extent of the Mean Higher High Water and the boundaries of the estimated 10 percent Flood zone in 2050. This area of land has a 1 in 10 annual chance of coastal flooding with 1.4 feet of sea-level rise. This flood zone is not currently included on regulatory flood maps. It is produced by FEMA and NJDEP as a non-regulatory product. It has been included in the planning scenarios as a surrogate for land that has a higher flood risk from smaller, more frequent, coastal events such as Nor'easters. In many coastal communities, this area likely contains properties at risk for repetitive flood losses. Land area within this zone is not suited for center designation.

Zone 3: 1 Percent Flood Zone

This zone includes the area of land between the estimated 2050 10 percent flood zone and the 2050 1 percent flood zone. This area has a probability of between 1 in 10 and 1 in a 100 annual chance of flooding from a storm event. The boundaries of this zone are based on the extent of FEMA 1 percent flood zone as shown on Ocean County's Preliminary Flood Insurance Rate Map (PFIRM) with 1.4 feet of sea-level rise. The 1 percent flood zone is the most familiar risk zone for property owners, because in this area they are required to purchase flood insurance on a federally backed mortgage. In addition to NFIP requirements, state and local regulations are in effect in this risk zone to protect structures. In each scenario, the objective for Zone 3 is to extend these protective measures to areas that will likely be at risk for flooding during severe events with sea-level rise. Land area within this zone is not suited for center designation.

Zone 4: 0.2% Flood zone

This zone encompasses the land area between the landward extent of the 2050 1 percent flood zone and the estimated 2050 0.2 percent flood zone. This zone has a 1 in 500 annual chance of flooding from a coastal storm event. The present-day 0.2 percent flood zone is mapped by FEMA, but is not regulated under the NFIP. Often referred to as the "500-year" floodplain, properties within this zone are not required by statute to have flood insurance on a federally backed mortgage. In each scenario, this zone would extend flood protections, though the regulations vary based on risk tolerance, to an area of land that will experience an increase in flood risk as sea levels rise and storms intensify.

Scenario 1: Maximum Risk Avoidance

The only way to eliminate exposure to flooding, erosion, and sea-level rise is to remove all infrastructure and development from at-risk areas. Scenario 1 seeks to minimize risk by shifting land use patterns to low-intensity uses compatible with frequent inundation from tidal and storm flooding seaward of the estimated 2050 10 percent flood zone. The primary objective of this scenario is to ensure that land at risk from moderate sea-level rise, referred to as the Conservation Zone, remains undeveloped to the maximum extent feasible. This scenario prepares the community most effectively to minimize the expense and hardship of recovering after a flood event and allow for natural shoreline migration. The remaining zones in Scenario 1 expand regulations to protect structures from encroaching sea levels and from increases in the extent, frequency, and depths of flooding from coastal storm events.

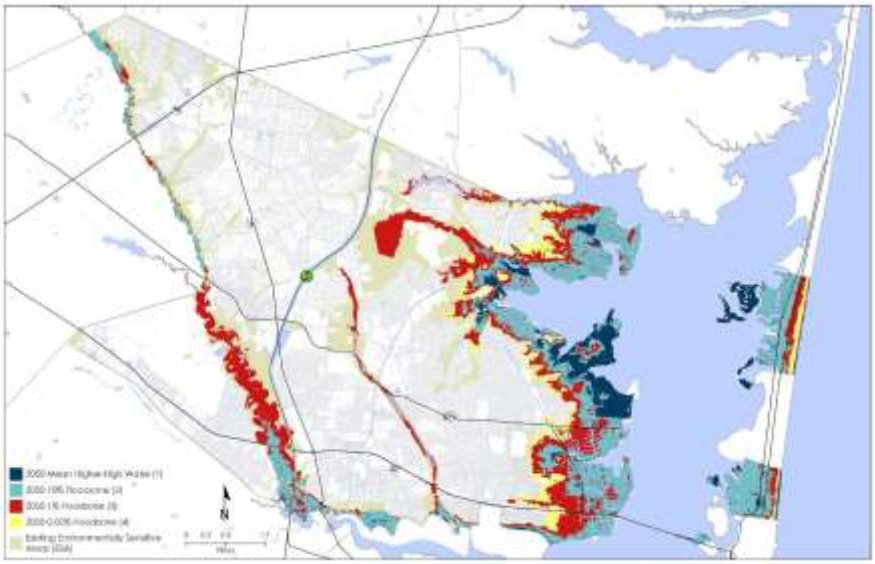
Zone 1: Mean Higher High Water

The objective of this scenario in Zone 1 is to reduce the number of structures at risk from sunny-day tidal flooding as sea levels rise more than 1.4 feet. This objective will be achieved by gradually reducing and/or shifting existing development, while limiting new development or redevelopment to compatible uses. Once existing development and infrastructure are removed, the land can be restored to wetlands or other natural features that reduce the impacts of coastal risk on adjacent developed areas, and provide area for natural marsh migration.

Zone 2: 10 Percent Flood zone

The main objective in Zone 2 is to promote conservation and restoration of at-risk lands by reducing the risk of exposure to repetitive, severe flooding as well as frequent tidal flooding as sea levels rise more than 1.4 feet. The zone objective could be achieved by using the same techniques that are listed under Zone 1, above. For towns that want to minimize risk, it would be advisable to consider this a CAFRA Fringe Planning Area, even though it may currently be within a sewer service area.

Figure 13: Toms River Proposed Risk Zones



Zone 3: 1 Percent Flood zone

In riverine floodplain management practices, it is common to recommend that all development be relocated out of the 1 percent floodplain to reduce risk to property and life. In New Jersey's low-lying coastal communities, the 1 percent flood zone covers an extensive area. In this zone, flood elevations vary from three or more feet of wave action to eight inches of still-water flooding. The scenario objective in this zone is to limit the risk of exposure and reduce property damage sustained from coastal storms for existing and future development. This can be achieved by enacting more stringent flood protection regulations and adopting practices that increase compliance with NFIP requirements for all structures in the zone. For towns hoping to minimize risk, this may be considered a Coastal Suburban Planning Area, though it would be advisable not to plan a CAFRA center within this zone.

Zone 4: 0.2 Percent Flood zone

The objective of Zone 4, the 0.2 percent flood zone, is to extend flood protection requirements in areas that are not currently regulated, but may have flooded during Sandy, and will likely experience flooding related to severe events in the future. For towns seeking to minimize risk, it would be advisable not to plan a CAFRA center within this zone. Any dense development a town may seek to encourage should only occur outside of all the risk zones.

Scenario 2: Moderate Risk Avoidance

This scenario recognizes that some communities may find it more challenging to designate zones 1 *and* 2 (the area within the extent of the 10 percent flood zone with 1.4 feet of sea-level rise by 2050) as conservation areas, given the implicit development limitations within these areas. To acknowledge this difficulty, this scenario seeks to balance the need to minimize losses from a prospective storm with a community's need to maintain its tax base. It allows for some risk in development patterns, but discourages development in areas that may experience routine sunny-day flooding as sea levels rise more than 1.4 feet. Like Scenario 1, Scenario 2 promotes increased regulation in areas subject to current and anticipated flood risk to minimize exposure for existing and potential redevelopment.

Zone 1: Mean Higher High Water

The objective of this zone in Scenario 2 is the same as Scenario 1, which is to reduce the number of structures at risk from sunny-day tidal flooding with 1.4 feet of sea-level rise projected for 2050. As in Scenario 1, this objective will be achieved by gradually reducing and/or shifting existing development, while limiting new development or redevelopment to compatible uses. Since the objectives are the same in zones 1 and 2, the techniques that can be applied to remove development and infrastructure are the same. For this scenario, it is still advised to consider this zone a CAFRA Environmentally Sensitive Area, since it will be increasingly important to support critical coastal ecosystems.

Zone 2: 10 Percent Flood zone

The objective for Zone 2 under the Moderate Risk Scenario is to manage or reduce development. In addition to storm risk, parts of this zone may experience frequent tidal flooding as sea levels rise more than 1.4 feet. Reducing exposure can be achieved by either removing structures or flood-proofing them. The recommended implementation strategies in this zone are intended to accomplish both.

Zone 3: 1 Percent Flood zone

As this zone extends landward, the objectives shift to allowing continued development while limiting risk of exposure and reducing property damage from coastal storms to existing development. The objective for the 1 percent zone under the Moderate Risk Scenario is to manage growth. This can be achieved by enacting more stringent flood protection design standards than are typically in place in the

1 percent flood zone. For towns willing to assume more risk, it may be appropriate to designate a center within the 1 percent flood zone, although towns that do so should also consider imposing more stringent building guidelines to minimize future risk.

Zone 4: 0.2 Percent Flood zone
The objective of the 0.2 percent flood zone is to limit public investment and critical infrastructure in areas that may experience increased flood risk in the future. Under this scenario, private property owners in Zone 4 should be encouraged to mitigate future risk by elevating structures and complying with disclosure requirements.

Scenario #3: Minimum Risk Avoidance

For communities that are not risk-adverse, this scenario envisions limited land-use changes. Implementation options are intended to maintain the character of the community while offering limited protection to existing development. Zone 1 has specific objectives and implementation options, but the remaining zones can be combined into a single growth zone.

Zone 1: Mean Higher High Water
The objective of Zone 1 in Scenario 3 is to preserve the area's existing character and tax base while encouraging property owners to apply appropriate mitigation strategies. To address municipal risk for damage to infrastructure, a town could choose to evaluate capital investment strategies that maintain infrastructure and minimize nuisance flooding in this zone. Although a community may choose not to designate this area as a conservation zone, it should exercise considerable caution and minimize development intensity to the greatest feasible extent because coastal resources will be vulnerable as sea levels rise.

Zones 2; 3; and 4
The objective for the remaining three zones - Zone 2: 10 Percent Flood zone; Zone 3: 1 Percent Flood zone; Zone 4: 0.2 Percent Flood zone - is to comply with local, state, and federal standards. In keeping with the broad goal of this scenario, the objectives of Zones 2 through 4 are to maintain existing development patterns, while encouraging risk reduction initiatives such as voluntary participation in buyout programs, disclosure requirements, and financing options for capital planning and recovery in high-risk areas.

e. Preferred Scenario Selection

The three planning scenarios described above were presented to the Little Egg Harbor/Tuckerton steering committee at a meeting on July 20, 2016. The committee considered the zone concepts, the implementation options, and the potential impacts to the public. The committee declined to identify a preference, instead requesting that the scenarios be presented at a public meeting to obtain broader input and allow more people the opportunity to participate in the decision-making process. A public meeting was held on Aug. 25, 2016, described in **Section 5.c.** above. Although meeting participants and members of the steering committee acknowledged that changes of practice may be needed to respond to rising sea levels, they declined to select a preferred scenario during this project. It is likely that this reaction stems from the fact that the implications of sea-level rise remain somewhat abstract. This dilemma can be resolved as a municipality engages in the plan endorsement process, if, as a baseline requirement, the municipality is required to assess future risk and describe a specific response strategy it will employ within the term of the Planning Implementation Agreement. A more detailed description of this approach is provided in **Section 8**, Project Recommendations, below.

f. Cumulative and Secondary Impacts Evaluation

As part of the project scope, NJDEP sought to review its procedures for evaluating and addressing cumulative and secondary impacts of land use planning and development. In its 2016-2020 Section 309 Assessment and Strategy, the state assigned high priority to this question and acknowledged that center designation and the plan endorsement process present opportunities to evaluate and address cumulative and secondary impacts of future development and redevelopment along the coast. To achieve this, the project team considered different assessments to evaluate the cumulative and secondary impacts of designating a CAFRA center.

Given the project's scope and focus on coastal hazard risk, the primary impacts considered for this assessment were those on coastal ecosystems and the environment. Specifically, the project team assessed water quality impacts, changes to impervious surfaces, impacts to environmentally sensitive areas and ecological resources, impacts to stormwater quantity and quality, potential impacts to marsh migration, and the potential change in risk of coastal hazards. The project team also considered the time and expense required to perform various assessments, and, because this project is intended to serve as a model for coastal risk planning, the capability of most coastal municipalities in the state to generate similar analyses. The project team only performed desktop analyses due to budget limitations and resource demands.

However, to evaluate fully the implications of center designation on coastal communities and the environment, it is important to consider cumulative and secondary impacts. Secondary impacts are defined as those that result from, but are not directly caused by an action. Often these impacts occur later in time, such as when development and growth follow road or utility installation. In the case of center designation and plan endorsement, secondary impacts are likely to encompass growth and development within the designated center, changes to land uses and community character outside of the center, changes to property values and property taxes, as well as impacts to stormwater runoff, wetlands, plant and animal habitat, water quality and air quality.

For example, in NJDEP's Section 309 Assessment and Strategy referred to above, the state acknowledged a 2 percent increase in impervious surfaces within coastal counties between 2006 and 2011. This increase signals an intensification of development within the CAFRA area, which has implications for water quality, stormwater runoff, habitat connectivity, the integrity of coastal ecosystems, and the vulnerability of existing and new development to coastal hazards.

Secondary impacts related to a single parcel may be minimal and easily dismissed as negligible. However, when these impacts are aggregated over time and over a larger geography, their cumulative effect may be significant. For example, where a municipality approves construction of a house or structure within a flood zone, emergency services may be needed for only a single rescue; one family may be displaced, and the municipality's risk is equivalent to the tax value of only one house. However, when that municipality allows increased land use and development intensity within a flood zone and concentrates a high percentage of its building stock or building value in that area, the cumulative impact of that risk during and after a storm event will be far more difficult to manage and have far greater effect on the community's natural resources.

The cumulative and secondary impacts (CSI) assessment process the team followed for this project is outlined below. Recommendations for modifying the state's current CSI process are included in **Section 8**, and the results of the assessment are included in **Appendix 4**. The spatial extent of the analysis was

based on the proposed boundary for the designated center, as reviewed by the Office of Planning Advocacy. The analysis was conducted only in Toms River because the township had recently proposed a center boundary. For Little Egg Harbor and Tuckerton, no growth areas were designated during the scenario development process, rendering an analysis of secondary impacts irrelevant.

Environmentally Sensitive Areas

To evaluate the environmental impacts of development or land-use planning decisions, it is important to identify existing ecological and environmental resources. Many New Jersey municipalities have compiled a Natural Resource Inventory (NRIs) or an Environmental Resource Inventory (ERIs), which catalogues a community's environmental resources and describes the features and functions of each resource. Both ERIs and NRIs combine data available from NJDEP with local data and understanding. Municipalities that have not completed an ERI or NRI can use NJDEP data to evaluate existing resources. Toms River recently updated its municipal ERI, which the team used for this sample impacts analysis along with the GIS data obtained from NJDEP.

To determine the extent of overlap with environmentally sensitive areas or potential increases in fragmentation of habitat, the center boundaries were compared to NJDEP-mapped wetlands, forested land, threatened and endangered species habitat, and CAFRA critical environmental sites. The results of this analysis – which include a breakdown of the total acreage of environmentally sensitive areas and/or existing environmental resources (based on the updated ERI) that fall within the proposed center boundary – and observations regarding the fragmentation of natural corridors and lands, are found in **Appendix 4**.

Impervious Surfaces

An assessment of impervious surfaces was the second analysis performed to evaluate the secondary impacts of a change in center designation. The percentage of impervious surface within a given area and the amount of connectivity of these surfaces, provides a reasonable indicator of stormwater runoff and water quality impairments. Although the NJDEP does regulate stormwater management for what it defines as major development, it does not regulate stormwater management for all development, infill, or redevelopment projects.

The NJDEP provides an estimate of "existing" impervious surface coverage as part of its Land Use/Land Cover dataset, which is based on 2012 data. To estimate the potential impacts of the change to the designated center, the project team assumed that all areas within the CAFRA boundary could be developed to the act's maximum impervious coverage limit of 80 percent. Although it is not likely that every parcel within the center would be developed to 80 percent coverage, using the maximum limit establishes the upper threshold of change that would be possible under existing CAFRA rules.

The extent to which impervious surfaces within the study areas were connected, and the related potential increase in stormwater runoff volumes, could not be determined using existing data available from the NJDEP. Recommendations for how these indicators may be incorporated into the analysis are included in **Section 8**.

Water Quality

Though changes to impervious surfaces provide a general idea of water quality impacts, techniques are available to quantify anticipated change in nutrients and loading that may occur under proposed development. These models vary in their complexity depending on the inclusion of topography,

stormwater infrastructure data, and level of detail on land use types.

For the purposes of this analysis, the planning team used a simple model of Unit Areal Loading, which reflects the project budget constraints but also may accommodate most effectively the varying municipal capabilities that will be encountered during the plan endorsement process. For existing conditions, the planning team used 2012 Land Use/Land Cover data to assign land use categories. For proposed conditions, the planning team used the existing municipal zoning as a proxy for land use. Where zoning allowed for multiple land uses, the type that resulted in the greatest pollutant loading was selected. The model estimated changes in kilograms per year of total suspended solids, nitrogen, and phosphorus.

Marsh Migration

One potential secondary impact of increased development in coastal areas is that salt marsh migration may be limited to undeveloped upland areas. A measure called the Highest Annual Tide (HAT) can be used to estimate the landward extent that a salt marsh could sustain. The upward reach of the salt marsh would experience infrequent flushing, but would become inundated during king tides. Maine uses the HAT line to regulate the landward extent of salt marshes and has been modeling the HAT plus sea-level rise to evaluate marsh migration. By contrast, New Jersey uses a linear buffer of up to 300 feet from the existing landward extent of tidal marshes regulated under the Coastal Wetlands Act of 1970. Marshes that do not fall under the purview of that law, because they were not mapped by the 1977 Tidelands Map, are regulated by the Freshwater Wetlands Act and can have a buffer of 0, 50, or 150 feet, depending on resource value.

The project team compared the center boundaries to the current HAT line plus sea-level rise to determine if any upland areas adjacent to the marsh that may support tidal wetlands in the future fall within the center boundary. The HAT line was calculated using a geospatial tool developed by the Maine Geological Survey. Sea-level rise predictions of 1.48 feet (2050) and 3.48 feet (2100) were added to estimate the HAT under multiple sea-level rise scenarios. Given the uncertainty of the timing of sea-level rise, it seems prudent to assess at least two potential scenarios that may occur within the life cycle of a major development. The resulting HAT line for Toms River did not indicate significant difference between the HAT and the MHHW. However, this analysis may be useful if applied to other parts of the state, depending on tide variability and data availability.

Proximity to Coastal Hazard Zones

In addition to assessing the environmental and ecological impacts of changing development patterns along the coast, it is important to understand the potential these changes may have for increasing risk and vulnerability. A core recommendation of this project is that municipalities preparing for plan endorsement demonstrate an understanding of existing and potential risk and a willingness to address identified vulnerabilities through local action. One approach to evaluate risk is to calculate the maximum possible number of units that could be constructed given the existing zoning and then superimpose this "maximum buildout" scenario over risk zone boundaries to estimate the number of units that would potentially be exposed to various hazards.

For this project, the proposed center boundaries were compared to the estimated 2050 boundaries of the Mean Higher High Water; 10 percent storm; 1 percent storm; and 0.2 percent storm flood zones that were mapped under the planning scenarios described above. The area of each of the flood zones that falls within the center is estimated and summarized in the Cumulative and Secondary Impacts

Assessment, **Appendix 4**. These figures could then be used to estimate the area of remaining developable land within the flood zones, which would enable the calculation of buildout potential at risk within a given municipality. The NJDEP could use this approach in the course of conducting future studies to evaluate sea-level rise exposure.

7. Implementation Options

There are a variety of strategies that municipalities can consider to reshape existing and future development patterns to achieve the objectives of the development scenarios described in **Section 6**. The options, many of which are presently employed in municipalities and states outside of New Jersey, are specifically intended to restrict development, minimize exposure, and protect critical environmental resources, in high risk areas. These options fall into six general categories:

1. **Hazard disclosure**
   - Disclosure requirements (current and future hazards)
2. **Allowance for marsh migration**
   - Limit shoreline armoring
   - Rolling easements
3. **More stringent and/or resilient codes**
   - Increase or establish freeboard requirements
   - Adjust building setbacks
   - Restrict rebuilding
   - Evaluate all permitted uses
   - Resilient design guidelines
   - Modify substantial damage/improvement thresholds and calculations
4. **Building restrictions**
   - Limit building size/density
   - Targeted acquisitions
   - Limit public infrastructure investment
5. **Redistributing development**
   - Acquisition of development rights
   - Transfer of development
6. **Realigning capital investment priorities**
   - Capital improvement programs
   - Special tax districts

The implementation strategies – their purpose, advantages, and limitations, where they're presently being used, how they can be applied in New Jersey and some web links for additional information about each – are presented in **Appendix 1**. These options were presented to the steering committee members in each municipality and during public meetings in Little Egg Harbor and Tuckerton, as part of the planning process. Feedback received from the steering committees and the public has been captured in **Appendix 7**. This suite of options provides examples of how municipalities can demonstrate that they are addressing risk from coastal hazards.

It is important to emphasize that some of the proposed implementation options, such as increased freeboard requirements or application of resilient design guidelines, could be enacted through local regulation. However, several, such as rolling easements or modifying substantial damage thresholds, will require coordination with or guidance and support from various state or federal agencies. Options that are perceived to impede or in any way limit private property rights, such as prohibitions on rebuilding in areas at risk, will need to be coordinated with strategies that could offer offsetting compensation, such as development rights transfers and buyouts.

It will also be necessary to explore new approaches to financing acquisition of property in areas at risk of

inundation due to the effects of rising sea levels and a changing climate. The value of such at-risk property along New Jersey's coastline is unquestionably orders of magnitude greater than the amount of money that has been earmarked for acquisition through the state's Blue Acres program through either the federal disaster recovery funds or the ongoing Hazard Mitigation program. The four funding concepts, described below, offer the potential to generate self-renewing acquisition resources:

Risk insurance policy surcharge: This option entails imposing a small – 0.5 percent – surcharge on every property casualty insurance policy sold in the state. Insurance companies would collect the money and send it to the state for deposit into a risk pool for acquisition of property in flood-prone areas. The concept could operate in a manner similar to assigned risk plans commonly available in every state through automobile insurance policies for high-risk drivers.

Social impact bonds: A social impact bond (SIB)[15] enables government agencies to pay for programs that deliver some predetermined societal benefit. SIBs—also known as "social innovation financing" or "pay for success"—offer governments a risk-free way of pursuing creative social programs that may take years to yield results. Usually, governments decide what problems they want to address and then enter a contractual agreement with an intermediary or bond-issuing organization that is responsible for raising capital from independent investors including banks, foundations, and individuals, and for hiring and managing nonprofit service providers. If the project achieves its stated objectives, the government repays the investors with returns based on the savings the government accrues as a result of the program's success. (Taxpayers also receive a portion of the budget gains in the form of freed-up public resources, though the investors may need to be paid in full first.) A neutral evaluator, agreed on by both parties, is hired to measure the outcomes and resolve any disputes that arise. In the case of acquisition of at-risk property, bonds could be based on the value of municipal or state expenditures for hazard mitigation, emergency services, and storm cleanup that are not incurred.

Environmental Impact Bonds: An Environmental Impact Bond is similar to a SIB in that it is a contract between parties that says a portion of the repayment to investors will be based on the outcomes of an intervention. An EIB differs from an SIB in that it is an actual bond that is intended to finance environmental outcomes. It functions as a debt security issued to finance capital expenditures and is backed by the issuing entity, which makes regular payments of interest and full repayment of principal at the end of the term. Unlike some SIBs that finance an intervention through projected cost savings, an EIB is structured to incentivize innovation by sharing risk between the payor and the private investors.[16] These investors are then paid conditionally on the project achieving an expected outcome after a third-party evaluation has been conducted. There would be agreed-upon natural infrastructure performance tiers that may, for example, give investors additional payments if outcomes are better than expected. If the project has lower-than-expected performance, the payor could receive back a portion of the interest investors would otherwise earn.

Disaster/Catastrophe Bonds: Catastrophe bonds or "cat bonds" are financial instruments designed to help manage the financial risks associated with potentially devastating natural disasters. For example, if a hurricane strikes, the aim of a catastrophe bond is not to limit physical damages on the ground, but instead to reduce the economic disruption of financial losses. A defining aspect of cat bonds, compared to Treasury Bonds or municipal bonds, is that they are designed to be 'triggered' in the

[15] see https://www.rockefellerfoundation.org/our-work/initiatives/social-impact-bonds/

[16] For more information see https://centers.fuqua.duke.edu/case/2017/01/13/environmental-impact-bonds/

event of a disaster. This means that when a disaster reaches a predetermined threshold (such as $500 million USD in losses or a storm surge height of 10+ feet above a datum) during a bond term (usually three to five years), the bond sponsor (the insurance purchaser) keeps a portion of the bond value to pay off losses and investors lose some - or potentially all - of their principal invested. Catastrophe bonds become more valuable investments when the probability of a triggering event and/or the estimate of its total financial loss to investors goes down.[17]

Considerable research is needed to determine whether and exactly how these financing options could be implemented in New Jersey, and which governmental agency or agencies should assume responsibility for their administration. But implementation of either of them will require involvement of state-level agencies, the private sector insurance and finance industry, non-profit organizations, and municipalities.

[17] For more information see http://www.refocuspartners.com/wp-content/uploads/2017/02/RE.bound-Program-Report-December-2015.pdf

8. Project Recommendations

In New Jersey, as with other home rule states, local governments are on the front line of risk response as it relates to land use and development impacts. Local elected officials, planning boards, and boards of adjustment are the primary arbiters of the location, form, and intensity of municipal development. These local bodies exercise considerable influence over a community's development pattern and, through the planning and development approval process, hold substantial sway over the extent to which a municipality is prepared to respond to risks of future hazards. New Jersey's land use laws delegate ample discretion to municipal officials to consider sea-level rise projections in order to promote adaptation and mitigation strategies in local land use control and capital budgeting. Through local plans, land use and development decisions, and capital investments in local services and infrastructure, municipalities can minimize considerably their exposure to storms and the expense of recovery and adaptation. In fact, since Hurricane Sandy several New Jersey communities have taken initial steps to identify, quantify, and mitigate coastal risks.

On their own, however, municipal officials are often not equipped to perform risk assessments or conduct the public discussions necessary to explain to their constituents why transformations of long-standing land use patterns may be necessary. Without broad-based community support, reducing potential exposure to future risks of sea-level rise either by instituting natural or built shoreline protection strategies or redistributing coastal development patterns will be a difficult challenge. During the S&RCC project, discussions with the members of the Little Egg Harbor/Tuckerton and Toms River steering committees made it clear that competing objectives at the local level make proactive initiatives by elected and appointed officials extremely difficult. Community representatives are reluctant and unprepared to enact zoning regulatory changes that could hurt property values and depress property tax revenues.

However, the land use policy changes proposed in this report are not impossible to enact and the obstacles New Jersey is likely to encounter if it elects to pursue this report's recommendations are not insurmountable. The state will have ample company if it elects to adopt these recommendations, since states throughout the country have initiated programs, policies, and regulations described in **Appendix 1** that serve as excellent models New Jersey should consider following.

The most pivotal steps New Jersey can take to support resilient coastal development are 1) to assume a leadership role in assisting coastal municipalities to implement adaptation and mitigation options; and 2) to establish uniform, forward-looking sea-level rise standards and guidelines for mitigation planning, through policy and regulation, to drive local efforts to address coastal hazards. These policies, guidelines, and standards, outlined in detail below, will be most effective if they originate in the governor's office.

The project team's most critical recommendation is that the state needs to create a mechanism to compel every coastal municipality to assess immediately its risk and vulnerability to sea-level rise. The most recent scientific analyses underscore the urgency of initiating as soon as possible coordinated, focused actions in response to rising sea levels. This is because the land use changes that are needed to ensure that people and property are not in harm's way will require a long period of adjustment before they achieve successful outcomes. Sea levels are rising at an accelerating rate and immediate action will allow time for rational deliberation while it is still feasible to weigh alternatives. Steps that can be implemented immediately include:

1. Applying new FEMA guidance to New Jersey's municipal and county hazard mitigation plan

updates. This guidance encourages local governments to incorporate knowledge of sea-level rise and future flood hazards into land use decisions in order to minimize exposure of property to flood loss;

2. **Adopting the principles of Presidential Executive Order 13960 to guide the siting of state, county, and municipal public facilities. The order was explicitly intended to improve resilience of communities and federal assets against the effects of climate change by using the best available science to ensure that no critical facility would be located in an area subject to current and future flood risk.**
3. **Adopting sea-level rise projections detailed in *Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel*, released in October 2016, as the state's uniform standard for risk analysis and hazard mitigation planning.**

There are several reasons the state needs to take the lead in encouraging municipalities to begin planning for climate change and why that planning needs to begin immediately:

- New Jersey faces frequent storm events. Over the past two decades the state has experienced an average of one flood-related disaster per year. Projections suggest that these storms will become more severe in the future. In the absence of effective planning based on future projections of sea-level rise, municipalities will continue to rebuild as they have for generations, placing people, and property at increasing risk.
- Conventional sources of storm recovery assistance are over-extended. With the National Flood Insurance Program in considerable debt it is not unreasonable to question whether New Jersey can continue to rely on federal disaster recovery assistance.
- Following a major storm event it is highly unlikely that a community would be prepared to engage in the lengthy master plan update and zoning amendment process that would be required before enacting new regulations, and such a process would miss the opportunity of rebuilding resilience into the community (as opposed to rebuilding back the way it was). By preparing and vetting strategies to have them queued up and ready to be put into place after a precipitating event occurs, towns can make future recovery efforts easier.
- As noted above, municipal officials are typically unable to address climate change and sea-level rise threats on their own and, since property values along the coast continue to climb, currently these officials tend to be unwilling to introduce policies and plans that might inhibit this trend or prohibit coastal development in the future.
- If changes in coastal development patterns are warranted, the strongest tool available to effect them – zoning – is incremental; achieving such changes typically takes several years, if not decades.
- If the state adopts a policy requiring municipalities applying for plan endorsement to demonstrate that they have performed a detailed vulnerability and risk assessment, local officials undertaking this process will need to demonstrate the actions they are interested in taking to address vulnerability and risk and engage the public to do so.

It bears repeating that all towns need to begin planning for coastal storms and sea-level rise as soon as practicable. However, many of the zoning and land use changes that will need to be put in place to minimize risk do not need to be undertaken immediately. If master plan and zoning amendments have been pre-evaluated and publicly vetted, there are several possible events or thresholds that the state might work with a municipality to set as a trigger to enact them:

- **The next storm**: As noted above, communities along New Jersey's coastline have experienced a long history of recurring storms, with a major flood-related disaster declaration being issued almost annually over the past two decades. Studies of sea-level rise and New Jersey's changing climate conditions suggest that such storms and flood conditions will occur even more frequently and with greater severity in the foreseeable future.
- **Predetermined sea-level rise increment**: Current projections indicate that there is a 50 percent probability that sea-levels will meet or exceed 1.4 feet by 2050, with a 67 percent probability that levels will be within a range of 1 to 1.8 feet.[18] Municipal officials could decide to enact new zoning regulations once still-water elevations reach these levels. It should be noted, however, that NOAA's National Ocean Service publishes sea-level rise figures and the last update of the nation's tidal datum, from the 1960-1978 to the 1983-2001 time period, was effective May 28, 2003, more than 13 years ago. The considerable gap between periods of updated measurements makes the use of sea-level rise increments as a trigger point cumbersome, particularly given the projected rapidly accelerating rate of sea-level rise at New Jersey's coast.
- **Master Plan update**: New Jersey's Municipal Land Use Law (MLUL) requires that a governing body shall provide for the reexamination of its municipal master plan every 10 years. A community could assess current sea-level rise conditions at this interval to determine if changes in land use patterns are warranted.
- **Hazard Mitigation Plan update**: To be eligible for hazard mitigation project grant assistance under The Federal Disaster Mitigation Act, local hazard mitigation plans must be updated every five years.[19] A community could evaluate sea-level rise conditions as its hazard mitigation plan element/annex is updated and, if warranted, enact zoning controls at the time of the next master plan update to begin shifting development at that time.
- **Increment of assessed value loss**: Although not presently the case, as sea levels gradually rise and coastal properties experience recurring flooding or become permanently inundated, it is likely that these conditions will have a downward influence on property values. A community could decide that once the overall assessed value of its coastal areas loses a predetermined increment– for example, once the tax revenues are no longer sufficient to cover the cost of providing essential service to these areas –zoning changes would be warranted.
- **Multiple thresholds**: The thresholds outlined above could also be combined to serve more effectively as instigation points. For example, although the likelihood of recurring major storm events is increasing, there is no way to determine whether such storms would occur next year or 10 years from now. So, it would be reasonable to set the zoning controls enactment timer to be triggered in the event of the next major storm or when a predetermined increment of sea-level rise is reached, using whichever came first.

Timing or triggering threshold events were discussed at the second public meeting of Little Egg Harbor and Tuckerton residents. The consensus of the meeting participants was that the occurrence of a storm that generated similar damage as Sandy would be the appropriate event to trigger enactment of some of the implementation strategies described in **Section 7** and **Appendix 1**.

[18] Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel, October 2016, Table E-5, p.2

[19] See 44 CFR §201.6(d)(3)

a. Recommendations for CAFRA Center Designation and Plan Endorsement

The focus of the S&RCC project was to assess how risk of exposure to rising sea levels should influence coastal development patterns and to use that assessment as the basis for recommending changes to the NJDEP's guidance on plan endorsement and center designation. Plan endorsement is a voluntary process of collaboration among municipalities, the State Planning Commission (SPC), and state agencies. Through this process a local or regional entity can obtain recognition from the SPC that its land use plans and ordinances are consistent with the State Development and Redevelopment Plan and the State Plan Policy Map that defines planning area boundaries, including centers.[20] In the first step of plan endorsement, a municipality submits existing land use documents, such as its master plan, to the State Planning Commission. During the second stage of the process, a municipality conducts a self-assessment and, through public outreach, creates a vision for its future growth and development. Relevant state agencies then conduct an analysis of the municipality's land use plans, self-assessment, and vision, to determine whether any constraints may exist that would prevent the locality from achieving its vision. The SPC then makes a determination that the municipality's plan is consistent with the State Plan and prepares a Planning and Implementation Agreement, a 10-year accord that defines all implementation and monitoring actions necessary to achieve consistency throughout the endorsement period.

As noted in this report, the current plan endorsement process focuses on capacity-based planning of existing resources and fails to consider long-term coastal risk. The recommendations in this report advocate changes that integrate future-looking, risk-based planning into the plan review policies, the endorsement process, and the Planning Implementation Agreement.

Understanding Vulnerability, Shoreline Characteristics

An evaluation of a municipality's existing assets, exposure, and vulnerability is a necessary ingredient of risk-based planning. Municipalities applying for plan endorsement should demonstrate that they have performed a detailed vulnerability and risk assessment that identifies the extent to which existing social, economic, and natural assets are exposed currently to natural hazards, as well as future threats (this report uses a 2050 planning horizon) related to rising sea levels, storms, shoreline erosion, flooding and storm surge. At a minimum, a municipal vulnerability assessment should include an evaluation of:

1. Exposure to future sea-level rise as projected by the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel;
2. Coastal A and V zones, as well as SLOSH zones, to ensure that a proposed center boundary does not encompass areas that are likely to experience storm surge and wave action. This can be done in addition, or as an alternative, to evaluation of the risk zones proposed in this report. Municipalities in different parts of the state are likely to experience varying risk of storm surge compared to the pilot communities participating in this study;
3. Exposure to flooding associated with various storm scenarios or water elevations, for example a 1 percent flood, recent nor'easters, Hurricane Sandy;
4. Vulnerability of evacuation routes and transportation if a municipality expects that traffic patterns will change based on a proposed center. For example, if development in an area within an evacuation zone increases, impacts on the region's traffic preceding a storm event can be anticipated. Alternatively, additional evacuation routes should be considered if the number of roadways is expected to increase;
5. Vulnerability of critical municipal facilities and infrastructure, emergency response (police, fire,

[20] In 2000, New Jersey adopted rules that incorporated the SDRP into the CAFRA regulations. Consequently, the SPC is responsible to designate CAFRA centers subject to review and acceptance by NJDEP

OEM), and hospitals and community shelters.

Identifying Protection Strategies

A municipality that has the potential to experience any of the foregoing threats should describe risk response strategies in its master plan, hazard mitigation plan, shoreline protection plan, or other local plans to substantiate an application for endorsement. If these plans do not address the risks identified through the vulnerability assessment, municipalities should be required to update them prior to the state's endorsement or center designation. Alternatively, the NJDEP could establish a template of a coastal resiliency plan, and ask municipalities to submit a coastal resiliency plan during the Plan Endorsement process that describes local response to projected sea-level rise and coastal storm vulnerabilities.

Cumulative and Secondary Impacts

Understanding and minimizing cumulative and secondary impacts of coastal development is necessary to ensure the sustainability of the ecological resources that support New Jersey's coastal economy. As municipalities undertake plan review, they should demonstrate that changes to their existing development patterns will, to the greatest extent possible, not have a negative impact on water quality, stormwater management, habitat, or wetlands, or increase the vulnerability of these resources to climate change. The following recommendations are intended to help municipalities accomplish this objective.

1. As part of an endorsement application, municipalities should demonstrate that a change in the center designation will encourage groundwater recharge and minimize a) stormwater runoff from development or redevelopment that would not be captured under requirements of existing rules; b) increases in water quality impairments; c) habitat fragmentation (presently required under current rules); and d) barriers to future marsh migration.
2. When proposing centers, municipalities should evaluate municipality-wide growth impacts on water quality, habitat loss, and wetlands. This evaluation could be modeled after the cumulative and secondary impacts assessment performed in conjunction with the S&RCC project.
3. To demonstrate consideration of the cumulative and secondary impacts associated with center designation, the NJDEP should ask municipalities to submit:
    a. A summary of existing ecological resources including freshwater and saltwater wetlands, threatened and endangered species habitat, CAFRA critical environmental sites, forested land, and other natural resources as appropriate;
    b. A description of how the center boundary will affect the resources listed in item 1, above, with a quantitative assessment of the total acreage of each type that will be directly affected and any currently contiguous areas that will be fragmented. This may include anticipated expansion of road traffic through an area due to increased volume from development;
    c. An impervious-cover assessment similar to the Cumulative and Secondary Assessment included in, **Appendix 4;**
    d. A water quality modeling analysis based on potential land use changes within the proposed center. The assessment included in **Appendix 4** should be considered the minimum requirement. Municipalities in areas that have known water quality concerns should include metrics that address directly the nutrients and pollutants of concern;

e. A description of change in risk. Municipalities should quantify the potential increase in the number of structures that could be developed based on the maximum density permitted under current zoning, within each risk zone where it overlaps with the center boundary. At a minimum, municipalities should perform an assessment of developable acreage similar to the one included in this analysis.

To assist the municipalities to provide the foregoing materials the NJDEP should consider:

1. Providing impervious surface coverage maps in a raster format to enable analysis at a more refined scale;
2. Mapping the HAT line and making the data available to municipalities. Without those data, it is burdensome for towns to complete the sample analysis because the tool requires an understanding of GIS. If the data are easily accessible for towns, the proximity of the center designation to the area of potential marsh migration should be considered as part of the plan review process.

It is important to note that, in conjunction with plan endorsement, the NJDEP already assists communities to collect and assess a considerable share of the information described above, including: water quality and quantity; wastewater treatment capacity; environmental constraints; and, current and potential impervious coverage.

Shoreline Assessment

In addition to cumulative and secondary impacts, a shoreline assessment is useful to coastal communities trying to reduce future risk. A shoreline assessment describes and evaluates the integrity of shoreline features in terms of their potential to be affected by erosion, and their vulnerability to rising seas and coastal storm events. Identifying and evaluating the structures along the shoreline and the potential risks they face can help a municipality categorize and prioritize future protection efforts, and help frame long-range land use planning. Shoreline assessments can encompass several different types of analysis and various methodologies. The steps described below were taken to develop the assessment prepared for this project and they are recommended for future plan endorsement review processes.

1. The first step of the assessment was to identify and describe the features that characterize the municipality's shoreline. Towns can use existing NOAA data to identify shoreline features. As the project team discovered during the assessments, the analysis categories can be simplified into wetlands, unarmored features, and armored features. The team performed a relatively simple GIS analysis that was supplemented by local knowledge of the shoreline. Towns should demonstrate that they know where along their shorelines unarmored areas, wetlands, and armoring are located. This will help determine if the center location is appropriate and if the shore area is vulnerable to erosion.

2. The second step of the assessment was to plot the history of changes that have occurred to the extent of the salt marshes or beaches, if any. It is helpful to evaluate the reason for any loss or gain of wetland extent, whether it relates to fill for development or to erosion. Understanding the changes in extent and reasons for those changes can help inform risk. Areas that have been filled will likely be vulnerable to flooding, while areas that have experienced significant erosion may be highly exposed to wave action. This can be done using the digital shoreline aerials from 1930 and comparing them to 2015 imagery, both available online from New Jersey Geo-web[21].

[21] http://www.nj.gov/dep/gis/geowebsplash.htm

Though it is not an arduous GIS task to digitize a community's wetlands, the NJDEP may consider developing a digital layer for the 1930s wetlands. This would help reduce the burden for any town seeking to perform this analysis. It would also improve the consistency of these data along the coastline instead of having the data created piecemeal by consultants and towns.

3. The final step of the shoreline assessment was to evaluate how the shoreline has moved over time. As with the preceding elements of the assessment, this step helps to characterize risk by identifying areas of erosion and vulnerability. Not all unarmored areas are highly vulnerable to erosion; the analysis of change helps identify areas that may require stabilization measures. The USGS tool DSAS was used for the assessment performed for the S&RCC project. However, it is not necessary for towns to identify the estimated rate of loss. Simply comparing the shoreline limits from 1930 and 2012, or the most recent shoreline data available, will enable towns to visualize areas that are susceptible to change. Maps showing the 1930 and 2015 shoreline are available digitally on New jersey Geo-Web as layer files.

All towns seeking center designation should demonstrate an understanding of existing shoreline features, how they are affected by coastal hazards, and how such hazards can be managed to reduce future risk. Requiring towns to submit findings from the three assessment steps outlined above will help ensure that their plans consider their entire shoreline. The shoreline assessment will not dictate where centers or development should be permitted, but it will help inform how much shoreline protection planning should be performed. Towns that intend to establish centers along their waterfront should be required to demonstrate that existing and future development is protected from all coastal hazards within a reasonable planning horizon. Other towns with moderate to low development along the waterfront should demonstrate that they are planning shoreline protection that will minimize damage from erosion, sea-level rise, and wave action. Such protection strategies may include implementing setbacks; bulkhead maintenance planning; or living shoreline projects.

Planning Implementation Agreement (PIA) Recommendations

As noted in **Section 2**, the Planning Implementation Agreement is an understanding among a petitioner for plan endorsement and all relevant state agencies. The PIA outlines the planning implementation tasks the municipality will perform during the endorsement period to ensure the goals and the vision described in the endorsed plan are achieved. The analyses procedures described below should be incorporated into the PIA development process:

1. To ensure that CAFRA center geographic boundaries reflect and respond to future sea-level rise risks, risk boundary maps that delineate the 2050 boundaries of the MHHW, 10 percent, 1 percent, and 0.2 percent flood zones, as described in **Section 6.d.** above, should be prepared for all coastal communities. Each municipality within the CAFRA area should then select the combination of the implementation options described in **Appendix 1** that are most suited to the needs and levels of risk tolerance of its residents with respect to flooding as sea levels rise. However, as a baseline requirement, the options selected should achieve the objectives of the respective flood zone.

2. To address risks inherent in future flood inundation and sea-level rise, municipalities should incorporate sea-level rise overlay zones, described in **Section 6**, and implementation options, described in **Section 7** and **Appendix 1**, directly into their master plans (particularly in the land use, circulation, parks and open space, community facilities, and housing elements); land use regulations; design guidelines; capital improvement plans as they relate to siting and design of critical facilities, services and infrastructure; and administrative procedures, policies and decision-making. The overlay zones and implementation options should also be incorporated into municipal hazard mitigation plans, whether prepared independently or as annexes to the county's hazard mitigation

plan.

3. As flood zones are identified, municipalities should also evaluate vacant developable lands within their jurisdiction that could offer growth redistribution opportunities to preserve the community's economic viability. Municipal officials should engage the community in visioning exercises to examine future development scenarios considering land use mix, intensity, and density. This analysis needs to consider redevelopment strategies and repurposing areas that are presently at risk to determine how existing development patterns could become more resistant to future flood inundation and storm damage. Consideration should be given to the feasibility of redistributing or creating shore-like amenities and eco-tourism in inland areas. Such planning, which should be coordinated with the master planning process, will help offset impacts of the land use changes needed to accommodate sea-level rise overlay zones along the coast. This initiative would only be feasible with considerable state-level support, guidance, and possibly financial incentives to enable the community to engage professional planning assistance.
4. To confirm base flood elevation, municipalities should require surveys for parcels where the elevation is in doubt. These requirements should be included in the municipality's zoning ordinance.

b. Affiliated Recommendations

Although the S&RCC project focused on revisions to the NJDEP's process for center designation and plan endorsement, this process cannot be considered in isolation. There are several closely interrelated state and local rules, regulations, and policies that must also be considered to ensure that risk-based planning becomes integral to the land use decision-making process.

Recommendations for CZM Rules

1. When originally conceived, CAFRA boundaries were established without relationship to rising sea levels, storm vulnerability, or flood inundation hazards. In order to respond to the increasing risk these conditions pose for coastal development, CAFRA planning areas and their corresponding impervious cover limits should be defined by adjacency to inundation areas – as inundation potential increases, impervious cover limits, and related development potential, should decrease to reduce the number of buildings and people in harm's way. This implies that CAFRA center boundaries and related impervious coverage limits will need to be revisited periodically. This reappraisal should be a standard provision of the Planning Implementation Agreement negotiated through the Plan Endorsement process and updated as PIA periods expire. To address potential takings challenges inherent in reducing impervious cover allowances, this strategy would have to be coordinated with complementary strategies that would offer offsetting compensation, such as regional transfer of development rights or buyout programs.
2. The state should continue to ensure that CAFRA Centers do not encompass environmentally sensitive areas.
3. CAFRA Centers should only be permitted in existing sewer service areas that have adequate reserve capacity and do not have combined sewer overflows or a history of flooding.
4. Under current rules, barrier-island center designations do not expire. Because these are the coastal areas most vulnerable to rising sea levels and climate change, the state should negotiate a program to phase out these open-ended designations. In the course of such negotiation and as a precondition for subsequent re-establishment of center designations, the state should require municipalities either on barrier islands or that have barrier-island centers within their jurisdictions to demonstrate initiatives to evaluate, and strategies to mitigate or adapt to, future risk.

5. Residential, commercial, and community facilities are not the only community assets at risk in coastal areas. Municipal infrastructure – roadways, storm and sanitary sewer, water, and power distribution systems – often sustains considerable damage during severe storms and is undermined by increasingly regular nuisance flooding. To ensure that these systems can tolerate growing flood risks it will be necessary for municipalities to plan for and include sufficient funding in capital budgets to stormproof potentially vulnerable infrastructure that serves existing designated centers.

6. In areas that will be affected by sea-level rise, particularly within the proposed 2050 MHHW and 10 percent overlay zones, construction, reconstruction, or expansion of a single-family home or duplex should be subject to permits under the CZM Rules, irrespective of the thresholds currently set forth in N.J.A.C. 7:7-2.2; 7:7-4.6; or 7:7-15.2. The project team recognizes that this change will impose considerable administrative and cost burdens on the permitting staff of the NJDEP. However, the central objective of the S&RCC project is to pilot a comprehensive planning approach that will identify municipal actions in response to coastal hazards to help inform potential changes to the existing CZM Rules. Allowing construction or reconstruction without review of structures located in areas exposed to flood risk and/or that are repeatedly damaged by flooding is in diametric opposition to this objective. Requiring an applicant to demonstrate how such construction or reconstruction could be planned to reduce or avoid future flood risk should be a minimum permit requirement for ***all*** proposed development in areas subject to repeated inundation. To protect property owners who would no longer be allowed to rebuild their structures, it would be necessary to coordinate this changed policy with implementation options described in **Appendix 1** that would provide compensation, such as a regional transfer of development rights or a buyout program.

7. Nature-based strategies should be encouraged to preserve, protect, expand, and create wetland and salt marsh areas. These resources provide important wildlife habitat as well as critical flood hazard mitigation and protection against storm surge, and they attenuate wave action. Because the concepts are largely untried in New Jersey, the state has been reluctant to permit techniques, such as thin-layer deposition, where marsh degradation is not apparent, although a small number of such pilot projects are currently under way under the NJDEP's direction. The state's position on these projects ignores the considerable and increasing threat that rising sea levels and storm surge present to the viability of healthy, as well as degraded, marshes. The department's experience indicates that these projects are costly to design, implement, and monitor. However, the cost of such projects should be compared to the much greater expense of storm damage and loss that is likely if these marshes reverted to open water and no longer protected the extensive development along vulnerable adjacent coastal areas. The state should exercise greater flexibility in order to encourage innovative enhancement initiatives that are designed to respond to the rising sea levels that will threaten marsh vitality over time. It is hoped that the experience the state is gaining with thin-layer deposition projects it is presently undertaking will enable state permitting departments to support similar future projects.

8. The range of activities currently allowed under permits by rule[22], general permits by certification[23], and general permits[24] should be revised to require a higher level of scrutiny for any development in risk zones. Hard armoring in coastal conservation areas, where marsh migration is the objective, should be prohibited, or limited. Water-dependent uses should be designed to adapt to sea-level changes over time. Although expressly permitted under current CZM Rules (see Section 7:7-4.6

[22] Activities that may be conducted without prior written authorization from NJDEP

[23] Activities that may be conducted after an authorization is received through the NJDEP electronic permitting system

[24] Activities that may be conducted following the receipt of written authorization from the NJDEP in accordance with the requirements for application review (N.J.A.C. 7:7-26)

Permit-by-Rule 6), construction, or reconstruction of residential or commercial development within the same footprint should be limited or precluded in high-risk zones. It is understood that this will be a difficult strategy for the NJDEP to administer but, as noted in paragraph 6, above, continuing to allow at-risk structures to be rebuilt without consideration of inundation risks contradicts the fundamental premise of the S&RCC project. In response to concerns about takings challenges that this recommendation implies, it was noted in **Section 6** of this report, that implementation options that are perceived to impede or in any way limit private property rights, such as prohibitions on rebuilding in areas at risk, will need to be coordinated with strategies that could offer offsetting compensation, such as development rights transfers and buyouts.

9. The Coastal High Hazards Areas Rule prohibits development in areas identified on FEMA maps as V zones; however, it exempts single-family structures, leaving them highly vulnerable to flooding and related hazards (N.J.A.C. 7:7-9.18(b)). This exception is inconsistent with the objectives of the S&RCC project: limiting or prohibiting development in areas at clear risk due to sea-level rise and climate change. Although in practice this recommendation would evidently affect only a limited number of parcels, this exemption should be eliminated.

10. Require the maximum wetlands buffer width in areas that will be affected by sea-level rise. Currently, wetlands buffer requirements (N.J.A.C. 7:7-9.28) of the Coastal Zone Management Rules establish a wetlands transition area width of up to 150 feet for all wetlands regulated under the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) and up to 300 feet for all other wetlands, including wetlands regulated under the Wetlands Act of 1970. These subjective buffer width requirements should be eliminated and the maximum buffer widths should be specified.

Statewide Policy Recommendations

While the center designation process is one vehicle to support municipalities as they incorporate long-term coastal risk into their planning efforts, other state programs, initiatives, and policies could be implemented to reduce New Jersey's vulnerability to sea-level rise and future coastal storm events. The following recommendations encompass changes to the state's approach to coastal zone management, the integration of risk into coastal planning and permitting programs, and the use of regional planning to address the financial and regulatory challenges of losing developable land along the coast:

1. Adopt consistent sea-level rise projections for state, county, and local planning. It would be extremely valuable if the state provided explicit guidance on climate-change adaptation and preparedness. A state endorsement of scientifically informed and supported climate-change parameters, such as the adoption of a standard for measuring sea-level rise, will foster equivalent practices at all levels of government and encourage consistent application in public and private sectors. As noted above, standards included in the report released by the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel in October 2016 entitled *Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms*, can serve this purpose.

2. Complement state guidance on climate change projections by incorporating sea-level rise projections into state decision-making and into local, regional, and statewide planning (e.g., State Plan, statewide hazard mitigation planning, state Wildlife Action Plan, long-range state Transportation Plan, etc.) as well as into all state-level investment and funding decisions (e.g., infrastructure investment). Progress toward implementing this recommendation could be achieved through coordination with an effort presently under way through the New Jersey chapter of the American Planning Association to update the provisions of the state's Municipal Land Use Law.

3. Develop a long-term, coast-wide climate adaptation plan, which would set a framework and provide direction for county and municipal hazard mitigation and adaptation planning. It would ensure that

all state, county, and local infrastructure investment decisions are coordinated so that facilities are either located outside the boundaries of risk areas or elevated above anticipated base flood levels.

4. Consider formal appointment of a commission charged with advising the governor and legislature on strategies to mitigate the causes of climate change and to prepare for and adapt to its consequences. New Jersey is fortunate to have a wide array of academic, business, industry, and environmental groups, as well as government officials, who have considerable experience in evaluating and developing response strategies to climate change. Through state leadership, representatives from these organizations should be assembled to develop a statewide, coordinated resiliency policy.

5. Develop procedures for wetlands/marsh analyses that are applicable coast-wide and that specifically enumerate effective nature-based responses to the impacts of sea-level rise.

6. Revise the Municipal Land Use Law to require that risk and vulnerability analyses be incorporated into local master plan elements, including: the official map; the master plan objectives statement; land use plan; housing principles; circulation element; community facilities plan; conservation plan; economic plan; development transfer plan; capital investment plan; and the residential site improvement standards. Provide technical guidance to align municipal policies, codes and programs, natural hazard information and mitigation strategies.

7. Consider adopting requirements modeled after New York's Community Risk and Resiliency Act (CRRA). New York's CRRA requires that sea-level rise, storm surge, and flooding be factored into facility siting, permits, funding programs, and state agency guidance on implementation. It also requires that state agencies develop model local laws that enhance resiliency and provide guidance on the use of nature-based resiliency measures.

8. Align state programs and incentives to encourage or discourage development based on flood and inundation risk factors. This could be accomplished through a rekindled plan endorsement process when all state agencies participate in plan review for consistency.

9. Apply a regional perspective to the development of plans and programs that assess and address flood exposure and risks associated with sea-level rise. This context is necessary because individual municipalities, particularly the small towns that are characteristic of New Jersey, are not a broad enough jurisdictional level at which to implement adaptation strategies that can respond effectively to risks that encompass entire coastal areas, unconstrained by municipal boundaries. In addition, uncoordinated, individual responses could result in unintended adverse impacts on neighboring jurisdictions. The state (or counties) should facilitate these regional collaborations because municipalities are often unaccustomed to working with their neighbors.

10. Develop regional revenue-sharing strategies,[25] regional transfer-of-development rights, and life-rights programs that can provide incentives and offset ratable losses related to buyouts, in order to

[25] One of the most widely used programs to aid city governments was federal General Revenue Sharing. The program, which began as a method to compensate localities for property exempt from local taxation, provided a process to redistribute federal and state tax revenues to pay for welfare and education expenses. The program began in 1958 and continued into the early 1980s when it was discontinued under the Regan administration. Regional tax-sharing was also a foundational principle of the Meadowlands District, which was founded in 1969, when the Legislature created the New Jersey Meadowlands Commission. This 30-acre district (encompassing 14 municipalities) was established to protect fragile wetlands areas along the Hackensack River from overdevelopment. Municipalities in the district that were not growth-restricted - where residential, commercial and industrial development was permitted - shared tax revenues with communities where growth was limited and sensitive environmental areas were preserved. The process and policy framework of either program could be used as a starting point to design a current revenue redistribution initiative.

encourage alternatives to rebuilding in vulnerable coastal areas. In addition, the state's Blue Acres buyout program, which is New Jersey's chief mechanism for acquiring properties that have been damaged by or may be prone to damage from repetitive storm-related flooding, should set acquisition priorities based on forward-looking, risk-based criteria (i.e. sea-level rise projections[26]) and should focus buyout activity in those areas at greatest risk of future flood inundation.

11. Strike a balance between nature-based and gray infrastructure solutions to sea-level rise impacts and reconcile the permitting perspectives among the various NJDEP permitting and planning divisions to minimize hurdles that often arise in the implementation of critical protection strategies.

12. Undertake more pilot projects and engage in more widespread public education and communication to test overlay zone scenarios, implementation options, response strategies, and methods of community engagement.

[26] See *Assessing New Jersey's Exposure to Sea-Level Rise and Coastal Storms: Report of the New Jersey Climate Adaptation Alliance Science and Technical Advisory Panel*, October 2016

9. Conclusion

a. General Barriers

There are several barriers to acceptance of the imperative to alter the course of development patterns along the coast in response to risk. These hurdles influence the level of difficulty and resistance that is likely to be encountered in trying to make the needed changes in the CZM Rules and municipal land use laws to achieve the recommended scenarios. They include:

1. On their own, individual municipalities are incapable of addressing fully the issues associated with tidal flooding and sea-level rise that affect the coast of the entire state, or storm events that are unconstrained by political boundaries. However, in the absence of statewide policies, standards or response strategies, municipalities in New Jersey are largely left to develop their own adaptation or mitigation initiatives. Despite the continuing desire to live close to the ocean and indications that property values continue to appreciate, the fear of potential disinvestment and resulting tax revenue loss makes local officials reluctant to take remedial action. As a result, there has been little appetite to pursue buyout programs as a strategy to reshape coastal development patterns.
2. The lack of a shared understanding of risk and varying levels of risk tolerance is hindering effective response to the threats that come with sea-level rise. Because the state has yet to establish official sea-level rise projections, communities that are attempting to establish municipality-wide design standards must set their own targets, and the lack of regional coordination is likely to result in confusing, inconsistent, costly, and possibly unsafe remediation approaches.
3. The state presently offers a limited number of reliable, ongoing funding mechanisms to compensate municipalities, business, or private property owners for losses or to address costs that will be associated with of any of the implementation options described in **Section 8**, above. The absence of a reliable funding stream discourages municipal officials from serious consideration of difficult risk response planning. Furthermore, the operating policies of the voluntary Blue Acres program should be reconfigured to focus its buyout priorities in high-risk areas.
4. Residents of coastal communities have deeply embedded social and cultural connections to the shore. In many cases, they occupy homes and own properties that have been passed among family members for generations, and that represent the majority of family wealth. There is resistance to options that would alter the character of the community, diminish the ability to continue the tradition of passing homes to succeeding generations, and result in a loss of property with so many memories and traditions and so much value.
5. As the members of the project team discussed implementation alternatives during meetings with members of the project steering committees or the public during community meetings, people frequently mentioned what they perceive as insurmountable financial obstacles and burdens that will be associated with reducing development intensity in high-risk, flood-prone coastal areas. Currently, property values along the coast are stable and, from anecdotal evidence, continue an upward trajectory.[27] But, as is the case in many coastal states throughout the country, as the frequency and intensity of recurring flooding increases, insurance rates will inevitably rise, property values will begin to fall and property sales activity will decline. Florida's Miami-Dade County, Hampton Roads and Norfolk, Virginia are just three examples of areas that are already experiencing

[27] https://www.nytimes.com/2017/06/16/realestate/hurricane-sandy-rebuilding-jersey-shore-towns.html?smprod=nytcore-ipad&smid=nytcore-ipad-share&_r=0

these trends.[28]

6. Residents of shore communities are accustomed to regular flooding during high tides. Typically, communities respond to such events by raising structures above base flood elevations and temporarily relocating vehicles outside of inundation areas. This condition is viewed as merely a tolerable nuisance and an acceptable trade-off to living on New Jersey's coastal fringe, and not as something that requires significant action.

7. Residents acknowledge that recurring (nuisance) flooding is occurring with increasing regularity and that the extent and depth of flooding is noticeably greater. However, risks associated with sea-level rise are still seen as projections of uncertain conditions, as yet largely invisible, that are predicted to occur in a murky future. It is difficult to generate commitment to response strategies for circumstances that have not been realized.

8. Many of the strategies that could be effective in altering development patterns will be viewed as limitations on private property rights. Private property owners have historically enjoyed considerable autonomy over the use and enjoyment of their land, and property value has conventionally been controlled by market forces. At the present time, land values along New Jersey's coast are rising and people who own these properties expect that trend to continue. Consequently, enacting strategies to downzone, buy out, restrict or transfer development rights in coastal areas to accomplish protection against a future risk will be politically unpopular and very difficult to implement.

In addition to the barriers described above, which are likely to be encountered when working in any of New Jersey's coastal communities, it's instructive to note some critical differences among the pilot communities that the team identified in the course of administering the S&RCC project. Although the communities had several similarities, these differences had a strong influence on the planning process that was followed and outcomes resulting from the project.

First, each municipality faces different levels of risk, and possesses different capabilities, resources, character, and vision for its future. These differences influenced considerably the extent to which the representatives from each municipality were willing to consider sea-level rise risks and implementation options that could alter existing zoning policies, development patterns, or infrastructure investments. Second, New Jersey Future had an existing working relationship with Little Egg Harbor Township and Tuckerton Borough, because they participated in the organization's Local Recovery Planning Manager program. Since Tuckerton is surrounded on three sides by Little Egg Harbor, Local Recovery Manager program work with these two towns has been conducted through a joint steering committee and the towns participated in joint public outreach, a format that was followed through the S&RCC project. The work New Jersey Future has performed over the course of its relationship with these towns provided a level of familiarity with their vulnerabilities, critical issues, and their recognition of and concerns about future coastal hazards risks. The established relationship allowed for greater understanding and acceptance of information about the risks being evaluated through the S&RCC project, which in turn permitted the evaluation and planning process to move forward more efficiently.

The project team did not have a pre-existing relationship with officials and residents in Toms River. However, the township has undertaken a considerable amount of resiliency work since Hurricane Sandy. Additionally, the municipal staff is highly engaged and well informed about coastal hazards and potential impacts. The town initiated efforts to update its municipal planning documents prior to the start of the

[28] See http://www.nytimes.com/2016/11/24/science/global-warming-coastal-real-estate.html and https://www.nytimes.com/2017/04/18/magazine/when-rising-seas-transform-risk-into-certainty.html?_r=0

S&RCC project and undertook its plan endorsement process as the S&RCC project was under way. The timing of the township's application for plan endorsement gave the S&RCC project team and the NJDEP an opportunity to determine how modifications to the plan endorsement process might be implemented as the project recommendations were being developed, and how a risk-based evaluation would be received by a community with no prior familiarity with the project team.

Participants in the initial Toms River kickoff meeting expressed skepticism about the objectives of the S&RCC project. These concerns amplified as development scenarios and implementation options were gradually detailed and refined. Ultimately the township concluded that they would prepare a set of implementation options that they believed would be appropriate for developed coastal communities.

The township's report was prepared independently from that of the project team. A full complement of implementation options was discussed during an open meeting with the members of the township steering committee, including representatives of risk-prone barrier islands. Steering committee members expressed significant concerns about options that would curtail coastal development. As a result, the township decided to reject all recommendations from the project team prior to the production of any report draft. In late October 2016, the township council adopted a resolution to that effect. It is assumed that the township took this action to indicate clearly to its residents that it would not support recommendations that might impose additional costs and burdens on inhabitants along the coast.

The contrast between the response from the Toms River and Little Egg Harbor/Tuckerton steering committees offers an important lesson as efforts are made to inform communities of coastal risks and help them plan responsive, forward-looking adaptation and mitigation strategies. It is understandable that local elected officials will be reluctant to pursue actions they believe might be negatively perceived by their residents. In the absence of state guidance, municipal officials may feel forced to make choices between long-term protections and shorter term political expediency and potential tax ratables.

Relationship-building prior to initiating project activity helped pave the way for a constructive dialog with local officials in Little Egg Harbor and Tuckerton that was not possible to achieve in Toms River. Although a relationship does not guarantee that a town will readily accept and be willing to act on difficult recommendations, it did enable the project team to have a frank conversation in Little Egg Harbor and Tuckerton about the implications of risk and the full range of possible actions, in contrast to the far more constrained, preempted discussion in Toms River about a limited set of strategies based on an assumption of what the community would find palatable. In addition, this open relationship allowed the team to bring these options to the public in an open forum, which did not occur in Toms River. It is important to note that Little Egg Harbor Township's elected officials had a similar initial reaction to a public discussion. These officials eventually became willing to support public meetings only after a year and a half of study and discussions that occurred over the course of participation in the Local Recovery Planning Manager program.

b. Costs of No Action

In 2015 an assessment was undertaken to evaluate the health impacts of a hypothetical buyout program in the Mystic Island neighborhood of Little Egg Harbor Township, a lagoon community that suffered significant damage from Hurricane Sandy.[29] The report issued at the conclusion of the assessment provided an analysis of alternatives to property buyouts, including a qualitative assessment of the cost

[29] See http://phci.rutgers.edu/mystic-island-voluntary-buyout-hia/

consequences of taking no action to shift development out of harm's way in areas at risk of inundation. The report noted that:

"*Expenditures for marshland stabilization and shoreline reinforcement will be essential to protect property and mitigate the combined effects of sea-level rise, coastal erosion, flooding, and storm damage. If such measures are not taken, the accumulated real costs to property owners of inhabiting a vulnerable zone may ultimately result in declining property values adversely affecting the township's tax base in a manner that would be equivalent to revenue loss the municipality might experience from property buyouts. Further, if property owners can no longer pay their taxes or decide to abandon their property prior to making necessary repairs due to repeated flooding events, the township could incur additional costs associated with management of such properties.*"

If no structures are relocated in areas of high risk of inundation, property protection actions and structural projects will be required to maintain the viability of Mystic Island, including:

- Installation of bayfront energy dissipation structures to prevent coastal erosion and help to reduce undermining of bulkheads.
- Installation of riprap (rock armor to provide erosion and scouring protection) along the shoreline to reduce marsh degradation.
- Repair of existing seawalls.
- Repair/replenishment of eroded beaches and docks.
- Maintenance and repair of township bulkheads.
- Remedial dredging of lagoon inlets and channels.
- Maintenance, repair, and cleaning of storm drainage systems.
- Restoration of marsh areas and thin-layer deposits to raise marsh elevations as shoreline stabilization measures."

The analysis also noted that as storm and flooding frequency increase with rising sea levels over time, cleanup costs of silt deposits and debris in developed areas along the township's shoreline will become an increasingly significant financial burden.

A report prepared in 2010 by the New York Sea-level Rise Task Force identified several implications, noted below, associated with sea-level rise that will also be experienced by New Jersey's coastal communities, and which cannot be deferred without incurring considerable costs and potentially irreversible damage:

- The likelihood that powerful storms will hit New York State's coastline is very high, as is the associated threat to human life and coastal infrastructure. This vulnerability will increase in area and magnitude over time.
- Natural shoreline features such as wetlands, aquatic vegetation, dunes and barrier beaches currently provide large-scale services such as flood protection, storm buffering, fisheries habitat, recreational facilities and water filtration, at almost no cost. These services would be prohibitively expensive to replicate with human-built systems. New York is losing tidal marshes at a rapid pace and with them the natural infrastructure that protects the shore from floods, wave attack, and erosion.
- All shoreline ecosystems will become inundated more frequently as sea levels rise. Low-lying

locations will become permanently submerged. Habitats and the species associated with them may migrate landward; however, the density of development on much of the state's shoreline and the widespread hardening of that shoreline will impede migration.

- Over the long term, cumulative environmental and economic costs associated with structural protection measures such as seawalls, dikes, and revetments, and stop-gap techniques such as beach nourishment, are expected to be several times more expensive and less effective than mitigation techniques such as elevation of at-risk structures and non-structural measures such as living shoreline restoration and planned relocation away from the coastal shoreline.
- As water levels rise, shore protection structures along the state's coastline will limit public access to beaches as they eliminate the publicly accessible intertidal zone. This will result in a loss of the economic benefits that justified these structures in the first place.

Based on the foregoing, the evaluation of the alternatives to buyout concluded that… ***"Regardless of the barriers, taking no action is not an option, not only because rising sea levels represents a significant risk but also because ignoring such impacts carry considerable future costs."***

c. Additional Research

As the planning team worked with the three pilot towns, several questions were raised relating to managing land-use changes, municipal obligations for providing services, costs and benefits of strategies, and how to allow legally for the strategic disinvestment of a developed area. As the state considers its next steps in addressing long-term risks along the coast, it should continue to work with communities and practitioners to answer the following questions:

Municipal Responsibilities and Liabilities

1. Can towns legally withhold services and infrastructure investment in selected areas? Must they continue to invest ever-increasing amounts of money to maintain services to areas regularly inundated by flooding and/or those that are projected to flood regularly?
2. Are towns obligated to provide stormwater management infrastructure?
3. Do New Jersey municipalities have sovereign immunity from tort claims? (For example, would a resident in a town that has not upgraded infrastructure to address sea-level rise have the right to sue that town for compensation for flood damages?)
4. Is a decision to upgrade a system subject to government discretion or is it a nondiscretionary "operational" function"? (Florida courts have held that municipalities have a duty to reasonably maintain existing roads but do not have an obligation to upgrade them.) How have courts defined discretionary vs. nondiscretionary municipal obligations to provide essential services?
5. When, due to sea-level rise, a stormwater system is no longer capable of preventing flooding in areas it once protected, has the local government failed to "reasonably maintain" the system and, therefore, breached a municipal obligation? What is the town's potential liability for providing drainage services?
6. Alternatively, are damages that regularly occur that are sufficient to deprive a property owner of reasonable use of his or her land equivalent to a compensable taking? If towns have a duty to act but don't, does it present grounds to bring a constitutional taking claim?
7. If municipalities use declining tax revenues as a benchmark to warrant changes in land use to

respond to risks associated with rising sea levels or accelerating or permanent flood inundation, how should they calculate a least two critical variables:

- the tipping point when assessed values are no longer sufficient to offset the costs of services; and,
- the increment of lost revenues a municipality can no longer sustain?

What procedures should municipalities employ readily to conduct sensitivity analyses to evaluate how different values of lost revenues will affect operating costs – what inputs need to be considered and what outputs will be needed as the basis for decision-making? To employ this strategy it will be important to vet the analysis variables and the decision tipping points with local elected officials, professional staff, and community residents.

8. A decision to retreat, fortify, or adapt in areas that are experiencing increasing risk of flooding due to sea-level rise and climate change is discretionary. Infrastructure and capital investment decisions that are influenced by these decisions are enormous. Often, governments do not have adequate methods to evaluate costs and benefits of resiliency infrastructure improvements over time. For example: When does the cost to elevate bulkheads exceed the protection they provide? What is the period of protection that a given protection technique is likely to provide? Does the cost of protection exceed the benefit of retreat? More research is needed to develop both quantitative and qualitative measures to assure a better informed public, improved capital investment planning, and more cost-effective decision-making.

9. A thorough analysis of the short- and long-term costs and benefits of each of the options described in **Section 7** and **Appendix 1** is needed to evaluate the full set of positive and negative implications that will be associated with their implementation. Realigning and redistributing New Jersey's long-established coastal development patterns will be extremely costly, take a considerable amount of time to accomplish, and will certainly be controversial. It will be necessary to begin the process of change with a detailed and rigorous assessment of the economic implications. This analysis should include an assessment of how the options should be planned, managed, and implemented and which organization, agency, or institution should be responsible their administration in New Jersey. Fortunately, the state does not have to forge new paths, it can draw on the experience other states, and localities have gained from implementing these options elsewhere.

10. As noted in the introduction to the discussion of implementation options, additional research is needed to explore new approaches to financing acquisition of property in areas at risk from rising sea levels and changing climate. The current market value of such at-risk property along New Jersey's coastline is far greater than the amount of money that has been earmarked to plan for and acquire property through current state programs. New and alternative methods to generate sufficient funding, including but not limited to a risk insurance policy surcharge or social impact bonds approaches described above, will be critical.

Timing and Managing Existing Adaptation Approaches

11. New Jersey's lagoon communities are unique in their exposure to sea-level rise. More research is needed to understand how permitting regulations should address bulkhead permits and how much freeboard property owners should allow for when constructing bulkheads going forward in CAFRA areas.

12. Since Sandy, a considerable number of nature-based or green infrastructure initiatives have been launched to address the risks and impacts of sea-level rise. Living shorelines, thin layer deposition,

dune construction, beach nourishment, and natural and artificial reef development are just a few examples of projects that are being undertaken to preserve and restore ecological functions, slow and prevent erosion, and fortify wetlands and marshes that protect coastal areas. To inform the decision-making/capital investment process, monitoring and research are needed to predict the extent of protection each of these techniques will provide, over what period of time, at what cost, and how each one compares to shoreline hardening (gray infrastructure) techniques.

13. As noted in **Section 8**, above, NOAA's National Ocean Service publishes sea-level rise figures that are typically used in risk analyses. The last update of the nation's tidal datum from the 1960-1978 to the 1983-2001 time period was effective May 28, 2003, more than 13 years ago. The considerable gap between periods of updated measurements makes it cumbersome to use this information as a trigger point, particularly given the projected accelerating rate of sea-level rise along New Jersey's coast. If data cannot be published more regularly, it will be necessary to devise another method of measurement that can be applied coast-wide.

Redevelopment Areas

14. Additional research is needed to determine how the recommended implementation options described in **Section 7** and **Appendix 1** will affect and be affected by the state's Local Redevelopment and Housing Law (N.J.S.A. 40A:12A) and areas presently designated as redevelopment or rehabilitation areas. Limitations on redevelopment within areas at risk could present considerable conflicts with the authorities and objectives of the law that are not considered in the recommendations of this report. Municipalities that have created a redevelopment agency; designated a redevelopment area; established the need to redevelop and/or the need to rehabilitate; and prepared a redevelopment plan have considerable power and authority to issue bonds, acquire property, clear land, and install infrastructure. Currently the Redevelopment and Housing Law has no provisions that address threats related to sea-level rise and climate change.

Administrative Processes

15. Additional research is needed to determine specifically how some of the recommendations described in **Section 8** could be administered most effectively. For example, in the case of a municipal master plan or coastal resiliency plan referred to in the introduction to the discussion on identifying protection strategies (see **page 51**), research is needed to develop a template that municipalities can follow to ensure that flood potential and risks associated with rising sea levels are evaluated adequately. In the case of a secondary and cumulative impacts analysis, it will be necessary to develop methods to estimate groundwater recharge impacts and stormwater runoff that might be associated with development or redevelopment, or devise a process to calculate municipality-wide growth impacts on water quality, habitat, and wetlands.

Urban Context

16. The form and intensity of development in urban coastal areas (i.e. Jersey City, Hoboken, and Perth Amboy) present a distinctly different set of conditions and challenges relative to the implementation of many of the options described in **Appendix 1**, as compared to the typical shoreline municipality in New Jersey. The option principals remain applicable but the method and approach to their implementation may need to be adjusted to respond to an urban context. Efforts underway in New York and Massachusetts can offer valuable lessons for New Jersey.

Implementation Options

Models for state Action

Introduction

Many coastal states in the U.S., with populations that are as vulnerable to the impacts of sea-level rise as residents of New Jersey, are implementing a variety of strategies intended to re-shape existing development patterns and prohibit new growth in flood-prone areas. Adopting or building on the experiences, programs, and strategies employed elsewhere can equip New Jersey to respond more effectively to, and avoid potentially devastating impacts from, rising sea levels and a changing climate. Following is a description of resiliency and risk response programs being administered in several states. As noted in **Section 7** of the S&RCC report, these programs, which are detailed in the narratives that follow, fall into the six general categories:

1. **Hazard disclosure**
2. **Allowance for marsh migration**
3. **More stringent and/or resilient codes**
4. **Building restrictions**
5. **Redistributing development**
6. **Realigning capital investment priorities**

The strategy descriptions starting page 6 of this appendix are illustrative, providing a sample of an extensive array of initiatives, partnerships, and programs being sponsored in many coastal states that acknowledge and are taking actions to address climate change impacts. Several of these programs have grown out of the state initiatives, regulations, strategies, and processes described below.

New York

On Sept. 22, 2014, New York Governor Andrew M. Cuomo signed into law the Community Risk and Resiliency Act. The legislation requires the impacts of extreme weather – such as storm surge, sea-level rise, and flooding – to be considered in some state permitting, funding and regulatory decisions including smart growth assessments; funding for wastewater treatment plants; siting of hazardous waste facilities; design and construction of petroleum and chemical bulk storage facilities; oil and gas drilling; and state acquisition of open space. The act also requires that the state's Department of Environmental Conservation establish official state sea-level rise projections, which will be used as the basis for adaptation decisions by all state decision makers.

The Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State project was undertaken by the New York state Energy Research and Development Authority (NYSERDA) ClimAID science team. This vulnerability assessment considers the effects of climate change, including rising sea levels, increasing temperatures, and changing weather patterns, on New York. The project draws upon both local experience and scientific knowledge by involving numerous stakeholders in eight key sectors: agriculture, communications, ecosystems, energy, ocean coastal zones, and public health, transportation, and water resources. Assessing New York's vulnerability to climate change in these sectors is intended to provide baseline information to inform the development of adaptation strategies.

New York City[30]

In response to climate change and associated impacts to the city's infrastructure, and in order to support goals outlined in PlaNYC, the city's comprehensive sustainability plan, former Mayor Michael

[30] New York City, the only municipality included in this list, is highlighted because of its proximity to New Jersey and the breadth and extent of its climate change response initiatives.

Bloomberg convened the New York City Panel on Climate Change (NPCC) in August 2008. The NPCC, which consists of leading climate change and impact scientists, academics, and private-sector practitioners, was charged with advising the mayor and the New York City Climate Change Adaptation Task Force on issues related to climate change and adaptation as it relates to infrastructure. It produced a set of climate projections specific to New York City and the report *Climate Risk Information*, released in 2009.

In October 2013, New York City adopted zoning amendments to encourage flood-resilient building construction in designated flood zones. The amendments were intended to remove regulatory barriers that hindered reconstruction of storm-damaged structures after Hurricane Sandy and assure that reconstructed buildings comply with higher minimum flood elevations issued by FEMA after the storm. The amendments were designed to ensure that new development and redevelopment would be less at risk of damages from future flood events and to avoid increased flood insurance premiums.

The NPCC Climate Risk Information report is intended to help New York City decision-makers understand climate science better. The report contains information on key climate hazards for New York City and the surrounding region, likelihoods for occurrence of the hazards, and a list of initial implications for the city's critical infrastructure. This report offers observed climate change impacts and future projections regarding air temperature, sea-level rise, precipitation, extreme events, and coastal flood and storms, and concludes with suggestions for monitoring and assessing these impacts.

Maine

Maine Sand Dunes Rules: Under any scenario of increasing sea level, extensive development in sand dune areas increases the risk of harm to both the coastal sand dune system and the structures themselves. In adopting Maine's Natural Resources Protection Act (NRPA) (38 Me. Rev. Stat. Ann. § 480-A.), the legislature stated that the state's coastal sand dunes systems are resources of state significance and that "there is a need to facilitate research, develop management programs and establish sound environmental standards that will prevent the degradation of and encourage the enhancement of these resources." To protect these coastal features, the Maine Department of Environmental Protection established rules to provide guidance to applicants seeking permits under the NRPA for certain activities in a coastal sand dune system. Its DEP evaluates proposed developments with consideration of the projected impacts of sea-level rise, and may impose restrictions on the density and location of development.

Delaware

The Climate Framework for Delaware, released by Delaware's governor on March 2, 2015, details the state's plans for reducing carbon pollution and preparing for the future impacts of climate change. Summarizing the recommendations from the three workgroups – Mitigation, Adaptation, and Flood Avoidance – formed under Delaware Executive Order 41; the framework describes the actions that state agencies have already taken to mitigate emissions and adapt to impacts, and outlines recommendations for future actions on both fronts.

Virginia

The Hampton Roads region of Virginia represents about 20 percent of the state's economy, income, and population. The area is also home to Norfolk Naval Station, the world's largest naval base, which, like the rest of Hampton Roads, is, according to Old Dominion University's Center for Sea-level Rise, threatened not just by sea-level rise but by subsidence. The Old Dominion University Climate Change and Sea-level Rise Initiative is intended to address this issue by promoting a "whole government" and

"whole of community" approach to sea-level rise preparedness and resilience planning – coordinating efforts among federal, state and local government agencies and the private sector. Planning is intended to encompass land use planning and engineering solutions, bridging jurisdictional boundaries to ensure resilience of critical infrastructure through strategies to protect, accommodate, and retreat, and addressing impacts associated with permanent inundation, increased tidal flooding, and increased storm surge.

Massachusetts

The StormSmart Coasts Program is intended to provide coastal management decision-makers and communities with the latest and best information on coastal weather and climate hazards. The successful launch of the Massachusetts StormSmart Coasts initiative in 2008 led to the development of a national network in 2009. The network is a partnership of coastal decision makers supported by the National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center, Northeast Regional Ocean Council, Gulf of Mexico Alliance, and others.

Massachusetts's 2014 Climate Preparedness Initiative, from Governor Deval Patrick's administration, is a $50 million investment for a statewide plan to address the present and future impacts of climate change. These investments will assess and address vulnerabilities in public health, transportation, energy and the Commonwealth's built environment. The plan includes a $40 million municipal resilience grant, to be administered by the Massachusetts Department of Energy Resources (DOER), that will enable cities and towns to harden energy services at critical sites using clean energy technology. The grants will be funded through what are called Alternative Compliance Payments, which are paid by electric retail suppliers if they have insufficient Renewable or Alternative Energy Certificates to meet their compliance obligations under the state's Renewable and Alternative Portfolio Standard programs.

Connecticut

According to Connecticut Department of Energy and Environmental Protection (CTDEEP), the state is slowly sinking while sea levels rise, leading to the inundation of low-lying coastal lands and damage to natural flood protection such as dunes, beaches and wetlands, and contributing to flood hazards. In addition, storms continue to threaten Connecticut's coastline. In 2010, the Adaptation Subcommittee from the Governor's Steering Committee on Climate Change produced a final report that concluded that climate change would have an adverse impact on the state's infrastructure, natural resources, agriculture, and public health. In addition, Connecticut's Public Act 13-179, "An Act Concerning the Permitting of Certain Coastal Structures," calls for the consideration of sea-level rise as referred to in NOAA CPO-1 report in the state's plan of conservation and development and in municipal evacuation or hazard mitigation plans, and charges the Department of Marine Sciences to update the NOAA sea-level rise scenarios. The NOAA sea-level rise projections are a global average.

Connecticut is also home to the Connecticut Institute for Resilience and Climate Adaptation (CIRCA). The mission of CIRCA is to increase the resilience and sustainability of vulnerable communities along Connecticut's coast and inland waterways to the growing impacts of climate change. CIRCA is a multi-disciplinary partnership between UConn and CTDEEP. One of their current projects is the Municipal Resilience Planning Assistance for Sea-level rise, Coastal Flooding, Wastewater Treatment Infrastructure, & Policy, which develops tools to assess the vulnerability of infrastructure to inundation and provides policy and financing options for resilience projects. CTDEEP has also developed the Connecticut Coastal Hazards Viewer, an online mapping tool that allows public access to data on sea-level rise, high-resolution coastal elevation, hurricane storm surge, coastal erosion, and environmental observations such as tides, water quality, waves, and currents.

Statewide Commissions

Several coastal states have passed legislation codifying commissions or state agencies charged with advising the governor and legislature on methods to mitigate the causes of, prepare for, and adapt to the consequences of climate change. Typically, these commissions are formed around collaboration among academia, business, industry, environmental groups, and many levels of government working cooperatively to develop coordinated policies and programs. Often, affiliated academic institutions provide a portal to climate-change science and research. A few examples of these state commissions include:

1) The Maryland Commission on Climate Change
2) The Florida Coastal Partnership Initiative
3) The Southeast Florida Regional Climate Change Compact
4) The North Carolina Interagency Leadership Team
5) The South Carolina Sea Grant Consortium
6) The California Coastal Conservancy
7) The California Coastal Commission
8) The San Francisco Bay Conservation and Development Commission
9) The Maine State Climate Office

a. Hazard Disclosure

Current and Future Hazard Disclosure

Description of Option

The term *caveat emptor*, usually translated to mean "let the buyer beware" is a driving principle behind real estate transactions in the U.S. It underscores a belief that it is the buyer's responsibility to research the home and the neighborhood before purchasing the property; including any off-site conditions that may affect the property. However, in many cases governments and courts have intervened on behalf of the buyer to require sellers disclose material facts and latent defects that affect the safety, inhabitability, and value of the property.

Generally, a disclosure document provides information about risks to a property or occupants that may not be clear from a physical inspection. For the purpose of this project, disclosure is intended to mean educating potential property owners about previous flood events; the property's proximity to flood-related hazard zones; and the potential to experience future hazards, including sea-level rise and future storm events.

Disclosure policies can be implemented in one of two ways. *Private disclosures* are those in which sellers disclose hazard-related information to potential buyers. Another option is for government dissemination of risk information to occupants and property owners. This action could benefit communities that participate in FEMA's Community Rating System (CRS) because they would receive points toward their certified ranking for providing such information to owners of property located in Special Flood Hazard Areas.

Purpose and Advantages

Disclosure policies are designed to protect property owners, tenants, and potential buyers from the impacts of unknown risks. Flooding can result in destruction of property and irreplaceable valuables, and cause displacement and severe disruption. The County of Leon, Florida, cites these impacts as justification for requiring disclosure of flood hazards to potential buyers or tenants.[31] Though it may deter some risk-averse individuals from purchasing the home, it empowers those who choose to occupy property in risk zones to take steps to mitigate potential damage before an event occurs. Though commonly believed to protect only the interests of buyers, disclosure requirements can also protect sellers from litigation when they certify, at the time of the transfer of property, that there was no misrepresentation.

Disclosure also may provide a small measure of protection to a municipality where property owners are tempted to walk away from a property if its value drops below the mortgage amount. On a national level, such decisions could leave municipalities, and the financial sector, with a foreclosure crisis greater than the mortgage crisis of the mid-2000s.[32] While a disclosure policy does not guarantee a property owner will retain custodianship of the property, it assures that subsequent owners are aware of and

[31] http://www.leoncountyfl.gov/floodprotection/disclosure.asp

[32] http://www.freddiemac.com/finance/report/20160426_lifes_a_beach.html

willing to withstand the impacts of disclosed hazards, which could lend a level of stability to a municipality's housing market and its property tax revenue stream.

Concerns and Limitations

At the first Little Egg Harbor/Tuckerton public meeting, comments from community members on the disclosure option varied from agreement that it was important to share information with prospective buyers to concern that the Realtor community would reject the idea. Overall, participants expressed concern about the impact to property values that such a requirement would have. In Beaufort, South Carolina, an adaptation planning project reported similar response from the public[33] in response to a proposal for private disclosure requirements. There were no concerns from the public about governments disseminating risk information. However, in Toms River, steering committee members expressed concern that dissemination of such information might instill unwarranted fears given the uncertainty of the data and projected timelines for rising sea levels. Committee members also voiced concerns about the impacts to tax ratables and market demand if adjacent municipalities did not adopt similar policies.

Who's Using It?

California, Washington, and Oregon are among the states that require sellers to disclose whether the property is within a designated hazard area. Oregon requires that sellers disclose if the property is within a flood zone or a known slide zone; California requires a Natural Hazard Disclosure statement that informs potential buyers about the property's location relative to flood, fire, dam failure inundation, earthquake fault, and seismic hazard zones. The form notes that the mapping for these hazards is based on estimates and does not guarantee that the property will be affected/not affected by these hazards. At this time, the data used for all of these disclosures is based on current risk, not future risk.

South Carolina requires disclosure about beachfront erosion in coastal areas, which is a dynamic risk area determined by historic erosion rates. Although it does not include sea-level rise, this disclosure requirement does note that a beachfront property may experience a change in risk over the ownership period. In 2013, in lieu of mandating private disclosure of sea-level rise, Delaware decided to increase government dissemination of information that makes it easier for buyers to find out if a property is at risk.[34] Although at this time no state has adopted disclosure requirements for sea-level rise, individual communities in Florida, Maryland, and Delaware are considering adopting such requirements.

Recommendations for New Jersey

Within the state, similar to other states, real estate law in New Jersey is governed by state statute. Therefore, the state should lead on implementing hazard disclosure requiring private transactions to identify if the home may experience routine tidal flooding in the future based on established projections. This would go beyond existing regulation that sellers disclose known flooding or drainage problems, to include properties that may experience such problems within a reasonable timeframe. If the state pursues this it could be executing using state sea level rise data that absolves the potentials of localities using varying projections and methods. Intervention at the state level would protect consumers in all coastal counties.

[33] http://www.scseagrant.org/pdf_files/Beaufort-Co-SLR-Adaptation-Report-Digital.pdf
http://www.nj.com/business/index.ssf/2011/09/post_irene_houses_for_sale_in.html

[34] http://www.desdemonadespair.net/2013/04/sea-level-rise-panel-wont-require.html

Additionally, the Real Estate Commission should add sea level rise to its seller disclosure. The seller disclosure, which is usually given before an offer, is the best way to inform the buyer upfront about potential risks associated with the purchase.

Municipalities should take steps to inform the public about how sea level rise may affect properties in the near and moderate future. This outreach effort, which would qualify for CRS points, could be as simple as directing residents to www.njadapt.com or as thorough as creating mailings for properties with certain zones, as is done in many flood-prone areas within the state.

Resources

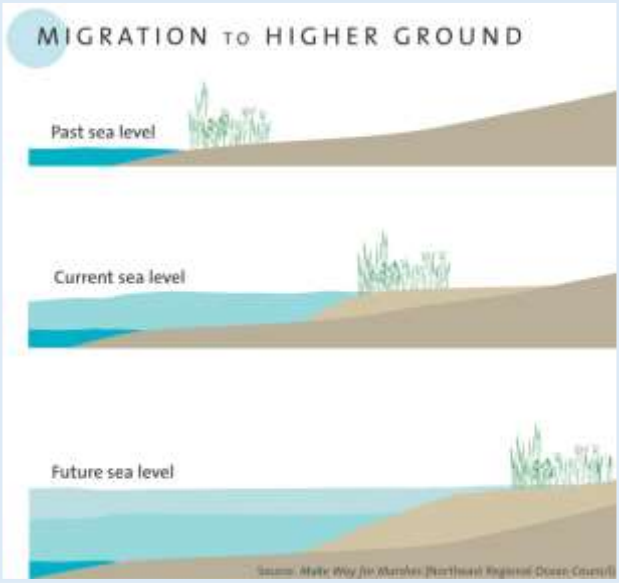
- http://www.marybajwa.com/is2/Data/AgentSites/64976/property%20disclosure.pdf
- http://www.nolo.com/sites/default/files/CAHazards.pdf

b. Allowance for Marsh Migration

Limit Shoreline Armoring

Description of Option

Under existing regulations, lawfully permitted shoreline protection structures can be replaced in-kind after a storm under a Zane letter, general permit-by-certification, or general permit. After Sandy, permit requirements for the reconstruction of legally existing bulkheads, as long as there were no design changes, were waived for those affected by the storm. This allowed individuals to mitigate the erosion risk on their property immediately to reduce risk to existing structures. However, reflexive replacement of hardened shoreline structures may not be appropriate, particularly in conservation areas where it might be preferable to encourage marsh migration to enhance nature-based shoreline protection or in areas that will be consistently overtopped by tidal flooding within the life cycle of the structure.



In areas deemed appropriate for conservation, limiting in-kind replacement of hardened shoreline structures should be coupled with rolling easements with added setback requirements. Living shoreline techniques should be the default option in coastal areas that will experience frequent flooding, but need shoreline stabilization to minimize erosion of critical resources or to the reduce the vulnerability of existing structures.

Purpose and Advantages

In some areas, limiting rebuilding of coastal armoring will allow for marsh migration and/or restoration. It also will result in reducing risk and the expense local and state jurisdictions will incur when they assume ownership of land that becomes frequently or permanently inundated by tides. One pilot community expressed reluctance to acquire shoreline property because of the responsibility to maintain the property's bulkhead. In areas that will experience frequent flooding and are deemed appropriate for conservation, shoreline armoring is unnecessary.

Concerns and Limitations

Limiting shoreline armoring should be executed in a manner that does not increase risk or liability to inhabited structures along the coast. The objective of the option is to reduce investment in areas that will be permanently inundated in the future, while encouraging immediate ecological benefits.

Who's Using It?

Maryland passed legislation that requires applicants to file for an exemption if a shoreline protection project is needed and a living shoreline is not being designed for the site. Shoreline protection projects must use living shoreline techniques in lieu of hardened armoring, unless a waiver is granted by the state. Waivers are granted if the project meets one of the following conditions:

1. The project shoreline is mapped as an area appropriate for structural shoreline stabilization measures and displayed on the Maryland Department of the Environment's website.
2. The project site is not suitable for a living shoreline due to excessive erosion, severe high-energy conditions, extreme water depths, or the fact that the waterway is too narrow for effective use of nonstructural shoreline stabilization measures.

Recommendations for New Jersey

New Jersey currently regulates coastal armoring in the CAFRA area to minimize the impact of additional shoreline armoring on critical coastal resources. Though the recommendations in this report include expanded use of permitting and oversight, it is not unprecedented to require a vetting process for shoreline protection projects prior to approval.

In areas deemed appropriate for conservation by the state or coastal municipalities, shoreline armoring should be prohibited, even when it had been lawfully permitted prior to damage.

More research is needed to develop design recommendations for bulkheads along the coast. Bulkheads, which are used in the majority of cases where coastal armoring is applied, have a unique role in future shoreline protection.

Resources:

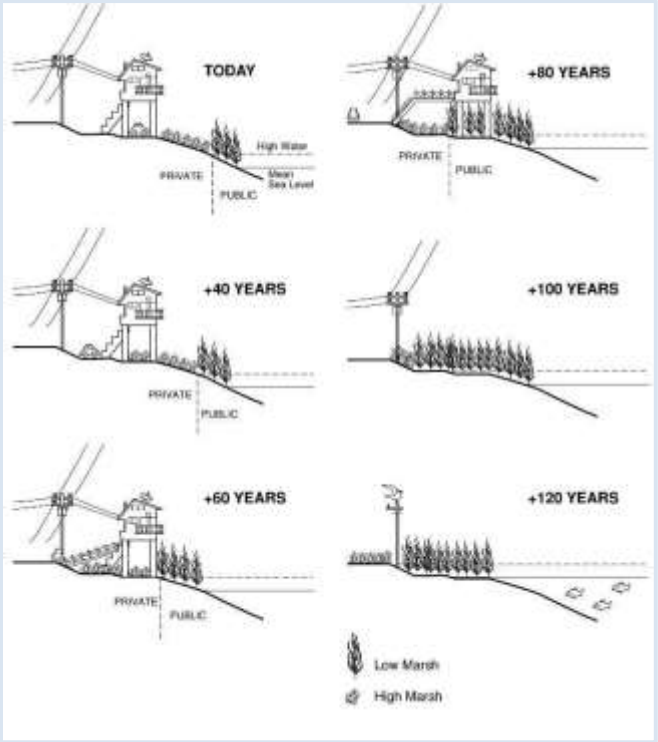
- Make Way for Marshes, Guidance on Using Models of Tidal Marsh Migration to Support Community Resilience to Sea Level Rise, Northeast Regional Ocean Council

Rolling Easements

Description of Option

A rolling easement is a coastal design boundary, usually set in reference to a tide line or other natural feature (e.g. dunes or vegetative line). Seaward of the designated line, structures and development are prohibited or removed. These restrictions move inland as the reference line migrates landward.

The image to the right illustrates how a rolling easement functions over time in areas where development currently exists. The seaward extent of land from the rolling easement line is considered the public domain.



Source: Rolling Easements Primer, EPA

Purpose and Advantages

Rolling easements are a key retreat technique. Under these easements shoreline protection measures (e.g. armoring) and other structures that prevent the landward edge of wetlands or beaches from migrating inland are prohibited, to promote natural resilience of shorelines. These easements, which are intended in part to protect the public right of access to the shore, also prohibit structures that make the shoreline inaccessible. Land can be donated for the easement or landowners are compensated for the loss of development rights, and the vulnerability of structures and infrastructure to erosion is reduced over time. This mechanism is flexible and allows for creative balancing of the needs of individual property owners with the ecological and economical needs of the region.

Concerns and Limitations

Rolling easements require that property owners transfer rights to their land to the public trust. This may be considered a taking and contested through litigation. The courts have yet to provide guidance on how rising sea levels affect a government's obligation to maintain the public trust doctrine and how that may affect property rights. This legal uncertainty could dampen a municipality's willingness to implement this measure.[35] The Columbia Center for Climate Change Law notes that inclusion of rolling easements in a state's coastal management program will offer a defense against a takings claim.[36]

Another limitation, particularly as it relates to New Jersey's coastal communities, is the fact that a considerable amount of development has already taken place at the shoreline. It would be very difficult and costly to implement rolling easements in these areas.

Although rolling easements are useful regulatory tool to enable retreat, they have limited ability to

[35] http://lawdigitalcommons.bc.edu/cgi/viewcontent.cgi?article=2203&context=ealr

[36] https://web.law.columbia.edu/sites/default/files/microsites/climate-change/files/Publications/Fellows/ManagedCoastalRetreat_FINAL_Oct%2030.pdf,

protect property against inundation damage. Additionally, rolling easement statutes and regulations must be written or coupled with other regulations to ensure shoreline protection structures are prohibited and removed to allow for inland migration of marshes and beaches.

Who's Using It?

A number of states have legislation or are considering recommendations to enable rolling easements in their CZM regulations. Presently Texas, South Carolina, Rhode Island, and Maine have coastal management statutes that include rolling easements. Texas enacts its policy through the Texas Open Beach Act of 1959. As one of the states with the highest erosion rates, Texas maintains that the public has the right of use or easement for all lands between mean low tide and the vegetation line along the gulf. The act requires disclosure during property sale and outlines a compensation mechanism for homeowners to assist with relocation expenses.[37]

The Maine Sand Dune Rule is regarded as a rolling easement program, though that is not the language used in the policy. Maine's rules regulate building along the coast based on the anticipated changes along the shoreline, including sea-level rise and erosion. The rules limit upland development to allow for dunes to migrate inland and regulate seaward development to reduce the risk to dunes along the coastline. The rules tie the regulation directly to anticipated rise in sea levels.

In addition to these existing programs, Florida, Virginia, and California are also considering including rolling easements in shoreline management.[38]

Recommendations for New Jersey

The state of New Jersey should adopt a statute that incorporates rolling easements into the CZM program. By creating a statewide regulatory program, the state ensures consistent and universal application of the rules. Rolling easements will yield considerable ecological and risk reduction benefits and consistent application of a rolling easement statute may help substantiate a defense against certain takings claims.

Any rules on rolling easements should be accompanied with disclosure requirements that inform property buyers of the risks they face and the implications of the easement over time.

Resources

- https://www.epa.gov/sites/production/files/documents/rollingeasementsprimer.pdf
- http://papers.risingsea.net/downloads/takings.pdf
- http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1140&context=student_scholarship

[37] Columbia

[38] SLR Toolkit - Georgetown

c. More Resilient/Stringent Codes

Establish or Increase Freeboard Requirements

Description of Option

Under the National Flood Insurance Program, all homes with a federally backed mortgage must be raised above the Base Flood Elevation (BFE). Freeboard requirements add an additional factor of safety, usually expressed in feet, for the design height of a structure. The elevation of a structure in relation to the BFE is a key determinant in flood insurance premium rates.

Following Sandy, New Jersey communities were required to adopt ordinances requiring one foot of freeboard for all new construction and substantially damaged structures in the 1 percent FEMA flood zone. Many communities chose to adopt this ordinance.

To achieve the scenario objectives described in **Section 6** of this report, freeboard requirements should be extended to zones and properties that are expected to be at risk from future storm events based on sea-level rise projections.

Purpose and Advantages

A locally enforced freeboard ordinance reduces the number of properties that are at risk from flooding during a storm event. Freeboard provides a buffer between the expected flood elevation during a storm event and the height of the first useable floor of the structure. This can help homeowners during events that have high storm surges, or flood events that occur at high tide. It can also reduce future risk as sea levels rise and storm patterns shift. Furthermore, since more freeboard will reduce the likelihood of flood damage and thereby reduce payout amounts, the NFIP program gives homes elevated above the BFE a higher rating than those structures built at the minimum required elevation. This difference in rating can result in considerable reductions in flood insurance premiums.

Another advantage to elevating a home above the minimum requirement is that a homeowner could use the additional space for NFIP and locally approved uses such as parking or temporary storage. However, these areas should never be used for permanent furnishings or living space.

Concerns and Limitations

There are three potential concerns with elevating homes as an adaptation option:

1. It is a short-term solution in areas that will experience severe tidal flooding inundation from sea-level rise. Elevation may convey a false sense of security for property owners who do not recognize the remaining residual flood risk to the property, even if the risk to the structure sitting on the property has been mitigated.
2. Elevation requirements have the potential to encourage homeowners to remain in their homes during a storm event. This presents a serious risk for emergency responders if floods or surges surpass anticipated levels or if emergency response is needed for any other reason.
3. Access to elevated homes is difficult for aging populations and those with mobility limitations.

Who's Using It?

After Sandy, a number of communities in New Jersey adopted the model flood ordinance with one foot of freeboard for construction and reconstruction projects. Some towns set higher freeboard requirements than the state. The Borough of Tuckerton requires three feet of freeboard. Other towns, like the City of Hoboken, vary the amount freeboard depending on use and zone. In Hoboken, critical facilities must be elevated higher than non-critical uses.

Recommendations for New Jersey

Municipalities should establish varying freeboard standards and require greater heights in V-zones and for certain uses such as critical facilities. Adjusting standards to use and location will help reduce risk to highly vulnerable structures.

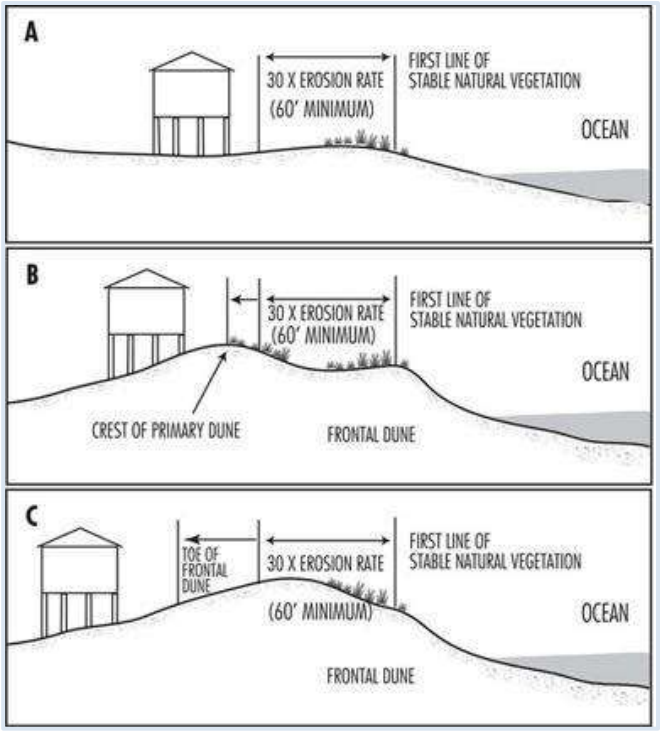
Resources

- FEMA Building Higher in Flood Zones: Freeboard Fact Sheet, https://www.fema.gov/media-library-data/1438356606317-d1d037d75640588f45e2168eb9a190ce/FPM_1-pager_Freeboard_Final_06-19-14.pdf

Adjust Building Setbacks

Description of Option

A setback is the minimum distance required between a property boundary and any buildings or improvements on the property. Typically, setbacks are established through a municipality's zoning code, but they can also be set through other regulatory measures, such as the CZM rules.



Source: https://deq.nc.gov/about/divisions/coastal-management/coastal-management-permit-guidance/development-areas-of-concern

Coastal setbacks use traditional land use regulations to prevent damage to structures from flooding and erosion, by creating a buffer between the structure and anticipated impacts. In addition, many setback regulations require landowners to leave property in the setback in its natural state to support natural functions.

According to the Georgetown Climate Center, there are several setback and buffer types:

- Fixed mandatory setbacks require that all structures, including sea walls, be set back a specific distance from a predetermined point (for example, 100 feet from the mean high tide line or the vegetation line).
- Erosion-based setbacks are determined by a projected shoreline position that assumes a specific increase in sea level and erosion rates over a specific time frame, such as the life of the structure (for example, 60 times the annual rate of erosion).
- Tiered setbacks require a smaller setback for smaller structures and a greater setback for larger structures that are more difficult to move if they become damaged and put more people at risk.

Purpose and Advantages

Coastal setbacks have economic, environmental, and administrative advantages. First, setbacks protect a homeowner or public resources effectively. They can extend the life of the structure, provide natural protection, and offer a less expensive alternative to hard- and soft-armored solutions. Second, where there is enough room for inland migration, buffers and setbacks can be used to preserve ecosystems, habitat, and water quality. Finally, many jurisdictions have already included setbacks in their zoning codes, and are therefore familiar with any associated administrative burdens.

Concerns and Limitations

As with many of the implementation tools, setbacks may not be beneficial in areas of the shore that are already developed, because existing structures are typically exempt from new regulation; however, after a storm, new setback regulations could be considered. Additionally, setbacks are best used where the lot size is sufficient to accommodate a reasonable structure. Unfortunately, many properties along the New Jersey shore tend to be small and may not provide property owners the ability to adhere to setbacks. While most local governments have authority to require setbacks, they should not be so large

as to prohibit any economic use of the property. Finally, it can be difficult to administer erosion-based setbacks since they require scientific data on rates of erosion and sea-level rise.

Who's Using It?

Maine's Coastal Sand Dune Rules (38 MRSA §§ 341 and 480) apply to activities located in a coastal sand dune system. The rules require an individual permit pursuant to the Natural Resources Protection Act. These rules recognize that under any scenario of increasing sea levels, extensive development of sand dune areas and construction of structures increases risk of harm to both the dune system and the structures. Therefore, to protect valuable coastal sand dune systems, Maine's Department of Environmental Protection (DEP) imposed restrictions on the density and location of development and on the size of structures. One standard specifically requires that a structure greater than 2,500 square feet in size be set back a distance based on its future shoreline position assuming two feet of sea-level rise over the next 100 years.

Under Hawaii's Coastal Zone Management Law, shoreline setbacks must not be less than 20 feet and not more than 40 feet inland from the shoreline (HRS § 205A-43(a)); however, counties may extend the shoreline by establishing setbacks at distances greater than 40 feet (HRS § 205A-45). In 2008, the County of Kaua'i passed a Shoreline Setback Ordinance (No. 979, Bill 2461, 2014) that was based on an annual erosion rate times a planning period of 70 years plus a buffer of 40 feet. Kaua'i passed a new Shoreline Setback Ordinance in 2014 to strengthen the requirements further. The purpose of the updated bill is to "protect life and property, ensure the longevity and integrity of Kaua'i's coastal and beach resources, and strengthen current shoreline setback requirements by incorporating science-based erosion rates established in the Kaua'i Coastal Erosion Study, and current coastal hazard mitigation best practices and strategies."

In 2006, the Town of East Hampton, New York, created a Coastal Erosion Overlay District (Res 2006-899) as part of its zoning code. East Hampton is a peninsula surrounded by the Atlantic Ocean, Block Island Sound, and Gardiners, Napeague, and Fort Pond bays. It has 23.7 miles of ocean shoreline, 38.9 miles of north bayfront shoreline, and 53.3 miles of harbors and creeks. The purpose of the Coastal Erosion Overlay District is to protect the town's natural shoreline and coastal resources. The overlay district is divided into four coastal erosion zones, each of which covers sections of the town's coast that have similar features, characteristics, and storm exposure. Depending on the location of the lot or structure, a minimum setback of between 75 and 150 feet from the bluff line or dune crest applies to all lots, lands, uses, activities, and structures.

Recommendations for New Jersey

- Implement building setbacks at the state (CZM Rules) and local (zoning code) levels that take into account rates of erosion and sea-level rise.
- Limit rebuilding or new construction where development cannot allow for sufficient setbacks to mitigate impacts from sea-level rise over the life of the structure. For this approach to succeed, it would be necessary to coordinate it with strategies that provide compensation to affected property owners, such as buyouts or transfer of development rights, to address the potential for a takings challenge.

Resources

- Schechtman, Judd and Michael Brady. "Cost-Efficient Climate Adaptation in the North Atlantic."

National Oceanic and Atmospheric Administration Sea Grant and North Atlantic Regional Team (September 2013). Accessed at http://seagrant.uconn.edu/CEANA/CEANAFull.pdf.

- Georgetown Climate Center. "Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise." Accessed at http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Adaptation_Tool_Kit_SLR.pdf
- Higgins, Meagan. "Legal and Policy Impacts of Sea-level rise to Beaches and Coastal Property." Sea Grant Law and Policy Journal, Vol. 1, No. 1 (June 2008). Accessed at http://nsglc.olemiss.edu/sglpj/Vol1No1/3Higgins.pdf
- Hwang, Dennis and Maxine Burkett. "Shoreline Impacts, Setback Policy and Sea-level rise." Center for Island Climate Adaptation (April 2009). Accessed at http://seagrant.soest.hawaii.edu/sites/default/files/publications/ICAPwhitepaperGG-10-01.pdf
- Maine Natural Resources Protection Act. http://www.maine.gov/dep/land/nrpa/index.html

Restrict Rebuilding

Description of Option

Rebuilding restrictions limit the way in which a property can be redeveloped after the existing structure has been destroyed in a storm event. These restrictions can prohibit rebuilding, limit the size and footprint of a structure, or allow reconstruction with specific conditions.

Currently, the NFIP requires participating communities to mandate that all substantially damaged structures must be rebuilt to existing codes and standards. However, NFIP standards should be considered as the minimum requirement. State and municipalities have the authority under the NFIP to institute higher rebuilding standards.[39]

- *Allow limited rebuilding*: Property owners are only permitted to build structures that are smaller and more resilient to replace damaged property. Property owners may be required to reduce building footprint, change the use, increase the freeboard, or provide greater setbacks.
- *Complete prohibition on rebuilding*: Property owners are not permitted to rebuild any structure in designated flood- or erosion-prone areas. Another option is to prohibit rebuilding of structures that have been repetitively damaged, or to allow a structure to be rebuilt only once after the regulation is in place.
- *Allow reconstruction with conditions*: Property owners are permitted to rebuild based on municipal and state codes, but with certain conditions. Examples of such conditions include not installing shoreline armoring, removing existing hard shoreline structures, or participation in a conservation easement program.[40]

Purpose and Advantages

Rebuilding restrictions are a mechanism to make the building stock more resilient, thus resulting in less community exposure and risk. Building restrictions help limit flood damages as part of a broader strategy to reduce density in coastal areas that experience frequent tidal inundation and/or are highly vulnerable to storm surge and coastal flood events. Restricting the size and footprint of a structure also has the advantage of maintaining an affordable housing stock after an older home has been destroyed.

Concerns and Limitations

Because local tax revenues could be affected, a community may be reluctant to adopt regulations that place additional restrictions on a property owner's ability to develop land. Such regulation may also face opposition from the public and development community. However, it is important to make the distinction between a regulation that reduces the development value of the property and a regulation that does not allow any economic use of the land. Any regulation that deprives a property owner of all

[39] Costs associated with higher building standards may not be covered by insurance so it may be necessary to petition the NFIP to allow coverage for more protective requirements. However, such higher standards may gain CRS credits that could reduce insurance premiums, possibly offsetting higher building costs.

[40] Toolkit http://www.georgetownclimate.org/files/report/Adaptation_Tool_Kit_SLR.pdf

economic use the land is considered a taking and the owner must be compensated for the lost value.

Who's Using It?

Several states, including South Carolina and Maine, regulate coastline construction in areas of high erosion. Virginia has the authority to decline a permit application in a coastal zone if a structure is destroyed or condemned as a result of natural events. In these cases, the applicant seeking to rebuild is required to submit plans as though the structure had never existed, and to conform to all regulations at the time of reconstruction.

Recommendations for New Jersey

In areas along the coast that have high erosion rates, are vulnerable to high storm surge, or experience repetitive loss, state and municipal officials should consider adopting ordinances intended to reduce the amount of property that will be vulnerable to tidal flooding and erosion.

Resources

- http://www.seagrant.umaine.edu/maine-beaches-conference/2013/coastal-erosion-control
- http://www.maine.gov/sos/cec/rules/06/chaps06.htm

Evaluate All Permitted Uses

Description of Option

All land uses in a hazard area should be evaluated in terms of potential exposure to risk. The purpose of this option is to encourage municipalities to identify areas that may be at increased risk as sea levels rise and evaluate whether existing permitted uses will still be appropriate under various sea-level rise scenarios.

1. Land uses within the Conservation Zone and/or areas of greatest flood risk should be limited to recreation, open space, ecological restoration, and/or water-dependent uses, as defined by CAFRA.
2. In other risk zones, uses should be evaluated in terms of whether occupancy poses a risk to public health and safety as sea levels rise. Certain uses present a greater challenge for emergency response and/or recovery, or a greater danger to the community if the structure is flooded.

As guidance for avoiding adverse impacts associated with development in floodplains, the United States Department of Housing and Urban Development defines as a "critical action" any activity for which even a slight chance of flooding would be too great. These would involve:

- Facilities that produce, use or store highly volatile, toxic, or water-reactive materials.
- Structures that provide essential and irreplaceable records or utility or emergency services that may become lost or inoperative during flood and storm events (e.g., data storage centers, generating plants, principal utility lines, emergency operations centers including fire and police stations, and roadways providing sole egress from flood-prone areas).
- Structures or facilities that are likely to contain occupants who may not be sufficiently mobile to avoid loss of life or injury during flood or storm events; e.g., patients in hospitals, and residents in nursing homes, convalescent homes, intermediate care facilities, board and care facilities, and retirement service centers. Housing for independent living for the elderly is not considered a critical action.

Purpose and Advantages

Limiting uses to those that are consistent with the conservation objectives in areas that will experience frequent or permanent flooding will reduce risks to property and safety in coastal areas. In areas that are at risk for tidal flooding or severe flooding from storm events, permitted development should not place inordinate burden on or risk to the safety or welfare of the public or emergency responders.

Concerns and Limitations

Municipalities considering changing uses permitted under zoning to accomplish the aims of a conservation zone need to assure that such changes do not deprive an owner of a property's entire economic value. Such impacts can be considered a taking unless compensation is provided.

Certain areas along the coast, such as the barrier islands, are unable to prohibit all critical actions from risk zones. This point was emphasized by the participants of a steering committee meeting in Toms River. As long as residents and businesses occupy these areas it will be necessary to site emergency response facilities there to serve them. In some municipalities, shared service agreements with adjacent municipalities may be appropriate to serve high-risk areas. However, municipal officials are in the best position to determine the most effective approach to satisfying the emergency response needs of their vulnerable populations.

Who's Using It?

Greenwich, Connecticut, has enacted a Coastal Overlay Zone (see Section 6-111) which gives highest priority and preference to water-dependent uses and facilities in shorefront areas. The objectives of the Coastal Overlay Act are to:

1. ensure that development, preservation or use of land and water resources in coastal areas does not significantly disrupt the natural environment;
2. preserve and enhance coastal resources;
3. give high priority and preference to uses and facilities that are water- or shorelands-dependent;
4. limit immediate shorefront properties to residential or water-dependent uses;
5. limit the potential impact of coastal flooding and erosion on coastal development to minimize damage to and destruction of life and property and reduce public expenditures that would otherwise be required to protect future development from hazards;
6. encourage public access to the Long Island Sound;
7. encourage development of recreational facilities in the coastal area; and
8. encourage fishing and recreational boating and related uses and facilities.

Recommendations for New Jersey

Municipalities in New Jersey should consider adopting land use controls that limit uses in areas that experience regular tidal flooding, or that are likely to experience regular tidal flooding within the current mortgage cycle, to recreation, open-space, and/or water-dependent uses, as defined by CAFRA. Where possible, municipalities should also consider shifting high-risk uses to other zones to reduce burdens on emergency services during future storm events.

Resources

- http://www.ct.gov/deep/lib/deep/climatechange/impactsofclimatechange.pdf
- http://circa.uconn.edu/projects/municipal-resilience-planning/
- http://www.ct.gov/deep/site/default.asp

Resilient Design Guidelines

Description of Option

In the wake of a storm or flood event, property owners often want to begin immediately to return their home to its pre-storm state or embark on a major improvement project they have been considering for years. Providing simple, accessible, guidance to homeowners and businesses about flood-resilient design in advance of rebuilding can help minimize future risk. This information is particularly useful in commercial and mixed-use districts where some structures may be located below the BFE.

Although municipalities cannot modify the provisions of their local building codes, which are set by the New Jersey Department of Community Affairs, they do have flexibility to vary construction materials, foundation design, freeboard, and setbacks.

Purpose and Advantages

One of the greatest advantages of preparing local design guidelines is that they can be written to include information to help residents and businesses interpret various regulations and understand review procedures on their own. NFIP communities have floodplain administrators, but those individuals typically serve simultaneously as the staff engineer, construction official, or code official. After a destructive storm event, building departments are deluged with permit requests. A concise reference document that describes clearly and graphically a community's building types, character, and dimensional standards can help simplify and streamline the review process while reducing burdens on municipal staff. Implementation of these design guidelines will result in a more resilient building stock over time, to include elements such as more flood proof construction materials, improved foundation design, higher freeboard requirements, and/or greater setbacks.

Concerns and Limitations

Because municipalities in New Jersey do not have authority to alter building codes, their ability to influence design is limited to addressing aspects of structural risk in flood-prone areas. Given this constraint, municipalities need to ensure that design guidelines do not conflict with state construction regulations.

Who's Using It?

In 2014, the City of Hoboken applied for a post-Sandy planning grant to develop design guidelines for its flood-prone structures. Many of the ideas and approaches in Hoboken's guidelines were based on the City of New York's Designing for Flood Risk guidance document, which highlights challenges in flood-resistant urban design. New York City, which controls its own building codes, has diverse urban neighborhoods with different types of housing and a wide variety of structures. New York and Hoboken created their own guidelines because they concluded that the NFIP guidance did not always reflect the character of their communities.

New York's and Hoboken's design guidelines help property owners understand NFIP, state, and city regulations and identify additional steps they can take to minimize future flood risk to property. Hoboken's guidelines also include details about the building permit and review process, to provide a reference to future applicants who will need to navigate the system in the wake of a storm.

Recommendations for New Jersey

The New Jersey Department of Community Affairs should continue to adopt building codes that reflect best practices for reducing flood and wind risk. Regardless of state action, municipalities should consider adopting customized guidelines to help developers and homeowners reconcile various regulations with the need for adequate protection in flood zones and areas of projected sea-level rise.

Resources

- City of Hoboken Resilient Design Guidelines: http://www.hobokennj.gov/docs/communitydev/Resilient-Buildings-Design-Guidelines
- City of New York Designing for Flood Risk: http://www1.nyc.gov/site/planning/plans/sustainable-communities/climate-resilience.page?tab=
- NFIP Technical Bulletins: https://www.fema.gov/floodplain-management/nfip-technical-bulletins

Modify Substantial Damage/Improvement Thresholds and Calculations

Description of Option

The NFIP's substantial damage and substantial improvement rules are intended to bring older structures into compliance over time. According to these rules, a structure that sustains damages that exceed 50 percent of its market value to repair must be rehabilitated to meet current code. However, since many flood losses do not meet or exceed 50 percent of the value of the structure, the cycle of flood-repair-flood remains unbroken except in the case of severe events.

To increase the resilience of a community's building stock, municipalities can lower the substantial damage or substantial improvement threshold to less than 50 percent of a structure's pre-damage market value. Municipalities may also implement cumulative accounting. In this practice, each improvement within a certain time period, usually 10 years, is counted cumulatively. When the addition of an improvement brings the cumulative total equal with or above the improvement threshold, the structure is deemed substantially damaged or improved.

Purpose and Advantages

When a community adopts a lower threshold, or cumulative accounting, it increases the resilience of its building stock by forcing older structures into compliance with current standards and regulations sooner than under the NFIP threshold. As an added advantage, a community that adopts either or both of these practices will gain points under the Community Rating System for adopting standards that exceed NFIP minimum requirements.

Concerns and Limitations

Lowering the threshold or including previous damage assessments in determining a substantial damage or substantial improvement estimate will result in more property owners elevating their structures or installing flood-proofing measures. While this is a sound strategy to help a community reduce its collective risk, it does increase the cost to homeowners who may otherwise not have needed to conform to existing regulations. To help offset costs, FEMA can offer Increased Cost of Compliance funding to NFIP policyholders that need to elevate or mitigate their non-conforming structures.[41]

As with all regulations, this strategy is only effective when enforced. It is important that municipal NFIP floodplain administrators are aware of local and federal requirements.

Who's Using It?

The Borough of Longport in Atlantic County adopted an ordinance to enable cumulative accounting, and lowered its substantial damage threshold to 40 percent. The Borough of Pompton Lakes in Passaic County uses cumulative accounting to track substantial improvements and damage repairs. Toms River Township also indicated that it is using cumulative substantial damage accounting.

[41] Funding under ICC is applicable only to NFIP 50 percent damage threshold costs

Recommendations for New Jersey

The substantial damage threshold and the calculation for cumulative substantial damage are regulated through local floodplain ordinances. Meanwhile, the State follows FEMA guidelines and checks for substantial improvement in the flood hazard rules. It is recommended that municipalities codify a lower threshold or cumulative accounting methods within the local floodplain ordinance. The 2016 Model Flood Damage Prevention Ordinances for New Jersey include optional language for municipalities to consider cumulative accounting or a 40 percent threshold. Municipalities can refer to these ordinances for specific language to use in modifying their local floodplain ordinances.

In addition, because substantial damage estimates are based on the structure life and are not tied to the individual property-owner, any municipality that adopts cumulative accounting or a lower substantial damage threshold should also enact disclosure provisions that require informing potential purchasers of the existing damage estimates on record.

Resources

- "A Guide for Higher Standards in Floodplain Management," ASFPM Floodplain Regulations Committee, June 2011: http://www.floods.org/ace-files/documentlibrary/committees/Higher_Stds_Ref_Guide_07-12-11.pdf
- NJDEP Model Flood Damage Prevention ordinances: http://www.nj.gov/dep/floodcontrol/modelord.htm

d. Restrict Rebuilding

Limit Building Size/Density

Description of Option
Local zoning ordinances may specify permitted uses and the design requirements for development in each district, including building size, height, location, and floor space. This implementation option uses local zoning ordinances or state coastal rules to limit a property owner's ability to rebuild structures destroyed by natural hazards, by restricting building size and density.

Purpose and Advantages
Limiting building size and density in coastal hazard areas will minimize property damage, protect beach, dune, and other natural systems, and reduce the amount of infrastructure at risk.

Land use restrictions, such as post-hazard building limits, have numerous advantages, including decreased structural damage and therefore, fewer insurance claims and lower costs. In addition, by instituting rebuilding restrictions in advance of impacts, governments can give landowners time to adjust their expectations for continued use of a coastal property, thus potentially avoiding takings challenges. In fact, courts have upheld rebuilding restrictions in many jurisdictions (see Resources, below).

Concerns and Limitations
There are numerous disadvantages to limiting building size and density, which reinforce the importance of using this option in coordination with other strategies to address coastal hazards and sea-level rise. First, this option takes a long time to implement. Pursuant to current NFIP minimum standards and some state regulations, rebuilding restrictions are only triggered when structures are substantially damaged. Therefore, in developed areas like the New Jersey shore, a stricter limit on building size and density will not achieve results until a coastal storm or large-scale erosion event occurs. Second, property tax revenues would be affected when structures are damaged: If rebuilding is restricted, the resulting structure will have a lower assessed value than did the property prior to the event. Finally, political leaders may encounter opposition to tighter building restrictions from developers and property owners, and possibly legal challenges involving private property rights.

Who's Using It?

State of Maine Coastal Dune Rules (38 MRSA §§ 341 and 480)
Maine's Coastal Sand Dune Rules apply to activities located in a coastal sand dune system and which require an individual permit pursuant to the Natural Resources Protection Act. These rules recognize that under any scenario of increasing sea levels, extensive construction of structures in sand dune areas increases risk of harm to both the coastal sand dune system and the structures themselves. Therefore, in order to protect valuable coastal sand dune systems, Maine's Department of Environmental Protection imposed restrictions on the density and location of development and on the size of structures. Specifically, the Dune Rules prohibit buildings greater than 35 feet in height or a footprint greater than 2,500 feet within the coastal dune system unless applicant can demonstrate that the site

will be stable with two feet of sea-level rise within 100 years and the height will not affect existing uses, including native dune vegetation and recreational beach use.

State of South Carolina, Beachfront Management Act (SC Code §48-39-10 et. seq.)
The South Carolina Beachfront Management Act of 1988 amended the state Coastal Tidelands and Wetlands Act to define beachfront policies, expand state jurisdiction, and establish new permitting and planning support through the South Carolina Coastal Council. The law limited new structures to 5,000 square feet of heated space. It further specified that structures damaged beyond repair (50 percent of structural integrity) may only be replaced with structures of the original size and must be moved as far landward on the lot as possible. Unfortunately, as noted above, there are no mechanisms to relocate or remove structures prior to damage, unless they were originally authorized by a special permit and, due to erosion, became located on the "active beach."

Recommendations for New Jersey

- Use state CZM Rules or local zoning codes to implement rebuilding restrictions in a sea-level rise context:
  - If structures in hazard areas are damaged by flooding, allow limited rebuilding by prohibiting an increase in size or density and encouraging construction of smaller, more resilient structures.
  - Require mandatory landward relocation during redevelopment where possible.
- Consider amending local land use ordinances to limit the amount, type, and location of new development and redevelopment along the immediate oceanfront.
- Require low density or prohibit developments with high density directly on undeveloped land next to the water.

Resources

- Georgetown Climate Center. "Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise." http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Adaptation_Tool_Kit_SLR.pdf
- Maine Natural Resources Protection Act. http://www.maine.gov/dep/land/nrpa/index.html
- South Carolina Comprehensive Beach Management Act. http://www.scdhec.gov/HomeAndEnvironment/Docs/state_BFMP.pdf.
- South Carolina Department of Health and Environmental Control. "Adapting to Shoreline Change: A Foundation for Improved Management and Planning in South Carolina." Final Report of the Shoreline Change Advisory Committee (April 2010). http://www.scdhec.gov/library/CR-009823.pdf.
- South Carolina Department of Health and Environmental Control. "An Assessment of Shoreline Management Options Along the South Carolina Coast." Office of Ocean and Coastal Resource Management (August 2009). http://www.scdhec.gov/HomeAndEnvironment/Docs/Shoreline_Options_SC.pdf.

Targeted Acquisitions

Description of Option

Acquisition of at-risk property that results in the removal of a damaged or flood-prone structure is arguably the most effective method for eliminating flood risk. Under this option, acquisitions would be targeted to areas that will experience frequent inundation as sea levels rise and have been rezoned for conservation uses.

In addition, developed areas of the community that experience repetitive flood damage and cannot be protected adequately through other mitigation measures would be targeted for acquisition.

Purpose and Advantages

Acquisition permanently reduces property, health, and safety risks by allowing land to revert to natural flood storage. It is the only implementation option that eliminates exposure for existing structures. Furthermore, acquisition provides a financial alternative for property owners facing stringent building requirements who cannot afford to, or are not interested in, rebuilding after a storm event. In many Sandy-affected communities along the coast, there are still homes that have not been rebuilt or rehabilitated. Dozens if not hundreds of homes have been sold as is or remain for sale as is because property owners cannot absorb the financial or emotional expense of rebuilding. Where markets are not quick to rebound, local and state-led acquisition programs provide a method for these property owners to sell their properties for pre-damage market value, without the effort of rebuilding.

Concerns and Limitations

In many communities in New Jersey, there is a perception that acquisitions are expensive for governments to administer and time-intensive for property-owners, particularly because the market for coastal properties remains strong. In a report entitled *New Jersey and The Surging Sea*, Climate Central estimated that the total value of property located no more than five feet above sea level is approximately $112 billion.[42] While this figure is not a direct surrogate for the value of properties that would be targeted in an acquisition program, it offers an understanding of the financial burden of purchasing all of the at-risk real estate in the state at this time.

To date, New Jersey's acquisition programs, and the federal programs that support acquisitions, have targeted properties based in part on risk, but also on a cost-benefit analysis of the acquisition. There are more at-risk properties in New Jersey than the state could possibly purchase with the funds it has for acquisition. Therefore it makes sense to target properties where the benefit-to-cost ratio is high. Unfortunately, this approach leaves many properties owners unable to take advantage of the acquisition program because their properties are too expensive or have yet to flood frequently enough.

Another concern associated with using acquisition to reduce risk is the loss of the municipal tax base. For many communities that have participated in the large-scale acquisition projects in New Jersey, the

[42] http://sealevel.climatecentral.org/uploads/ssrf/NJ-Report.pdf

burden of servicing or maintaining the flood-prone properties through repetitive losses has become too costly. However, conversations with representatives of the pilot communities participating in the S&RCC project reveal that this has not yet been their experience. These communities continue to express deep concern about the loss of tax revenue through acquisition and expansion of open space, especially given the current market value of their waterfront properties.

Who's Using It?

In recent years, New Jersey has expanded its efforts to purchase flood-prone lands. These acquisitions have been funded predominantly through the Blue Acres program, the FEMA Hazard Mitigation Assistance programs (HMGP, PDM, FMA[43]), or HUD's Community Development Block Grant program.

Several states have incorporated acquisition into their coastal adaptation approaches. Florida encourages municipalities to create acquisition policies as part of their local adaptation plans. Maryland has a statewide initiative to use sea-level rise projections to prioritize designation of conservation lands. Louisiana's program encourages voluntary acquisition of coastal properties that need to be elevated more than 14 feet.

Recommendations for New Jersey

Local jurisdictions should consider options to finance or increase open-space acquisition funding programs to acquire properties that become uninhabitable due to sea-level rise or coastal storm vulnerability.

Acquisition should remain voluntary, but risk for tidal flooding should be a consideration in prioritizing where projects are undertaken and funding is allocated.

Resources

- FEMA HMGP Property Acquisitions: https://www.fema.gov/media-library/assets/documents/85455
- Louisiana Coastal Protection and Restoration Authority, 2017 Coastal Master Plan, Flood Risk and Resilience Program Framework: http://coastal.la.gov/a-common-vision/2017-master-plan-update/ccrp/nonstructural-projects/

[43] **HMGP** - Hazard Mitigation Grant Program assists in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration; **PDM** – Pre Disaster Mitigation Program provides funds for hazard mitigation planning and projects on an annual basis; **FMA** – Flood Mitigation Assistance provides funds for planning and projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis. See https://www.fema.gov/hazard-mitigation-assistance

Limit Public Infrastructure Investment

Description of Option

Municipalities have a responsibility to their citizens to provide core services such as access to the public road network, but as sea levels rise coastal municipalities will have to balance the cost of providing services against the public revenues generated through the local tax base. As sea levels rise and the costs to service areas that sustain increasingly repetitive loss escalate, municipalities will need to consider long-term options to reduce maintenance and recovery expenses in areas that are vulnerable to tidal flooding and coastal storm risk. The primary methods proposed under this option include:

1. Avoid building schools, municipal buildings, public works, community, and emergency services in high-risk areas; and examine future sea-level rise and storm scenarios when establishing boundaries of high-risk areas.
2. Consider shared service agreements and other mutual aid arrangements to share expenses and save costs.
3. Choose low-maintenance or portable investments as development alternatives where possible (i.e., parks with portable restrooms).
4. Consider flood risk when evaluating capital improvement projects such as road repaving.

Purpose and Advantages

Municipalities around the state experienced emergency management challenges during hurricanes Sandy and Irene as floodwaters reached unprecedented levels. Fire stations, first aid squads, emergency operations centers, schools, and shelters became unusable as flood waters rose. After Sandy, FEMA obligated $140 million in public assistance funds to restore damaged public buildings in New Jersey.[44] Several municipalities applied for funds to relocate emergency response or municipal buildings outside of floodplains. As municipalities consider these options, they should also factor sea-level rise and storm surge scenarios into siting decisions. Selecting a new location that is likely to remain outside of a risk zone for the life cycle of the building will be less expensive in the long term than relocating the facility again due to flood impacts.

Concerns and Limitations

In some coastal communities, the entire town is located in a hazard area and it is not possible to site emergency services, municipal offices, or educational facilities outside a flood zone. In these cases, communities should attempt to leverage mutual aid and enter into shared services agreements to reduce exposure to public assets. This option should be explored for all communities with public buildings and critical facilities in high-risk zones.

Who's Using It?

To a certain extent, the National Flood Insurance Program and the state Flood Hazard Area Control Act Rules currently require consideration of flood risk when siting critical facilities. This siting criterion was

[44] http://nj.gov/comptroller/sandytransparency/funds/tracker/, http://nj.gov/comptroller/sandytransparency/funds/tracker/

also the focus of Executive Order 13960, signed in January 2015, which established a federal flood risk management standard that applied to construction, retrofits, or repairs of structures or facilities in and around floodplains, to ensure that such structures are resilient, safer, and longer-lasting. These standards gave agencies the flexibility to select one of three approaches for establishing the flood elevation and hazard area they use in critical-facility siting, design, and construction. They could:

- Use data and methods informed by the best available, actionable climate science;
- Build two feet above the 100-year (1-percent-annual-chance) flood elevation for standard projects, and three feet above for critical buildings like hospitals and evacuation centers; or
- Build to the 500-year (0.2-percent-annual-chance) flood elevation.

New York's Community Risk and Resiliency Act (CRRA) requires that permit applicants or funding recipients in a number of specified permitting and funding programs demonstrate that they have considered future risk due to sea-level rise, storm surge and flooding, and that these factors be incorporated into siting decisions and regulations.

Recommendations for New Jersey

1) Municipalities pursuing plan endorsement should demonstrate that public and critical facilities investments account for sea-level rise through the local capital planning, vulnerability analysis reports and hazard mitigation actions.

2) Municipalities looking to reduce risk should use sea-level rise and storm projections when considering locations for future public and critical facilities.

Resources

- http://www.dec.ny.gov/energy/102559.html

e. Redistribute Development

Acquisition of Development Rights

Description of Option

Purchasing development rights (PDR) restricts future development of a parcel of land. This option is related to but distinct from the *transfer* of development rights (TDR) and conservation easements described below. Like TDR, PDR is a non-regulatory tool that relies on market forces and voluntary actions rather than regulation to prevent development in areas subject to sea-level rise and other coastal hazards. However, with a PDR program, public entities or private parties acquire development rights associated with a property and then retire them, rather than using them to increase development in a receiving area, as is done with TDR.

As options to respond to risk associated with sea-level rise and climate change in communities along New Jersey's coastline, TDR and PDR could be used as a method to shift development potential of:

- parcels that are currently vacant;
- parcels that have not been developed to the potential that could be achieved under applicable zoning;
- parcels with substantially damaged structures that have yet to be rebuilt.

Development rights are usually purchased by a government agency or a land trust. The value of the development rights is the difference between the value of the land as restricted and its value if it were developed to the maximum intensity allowed under local zoning. The value of a property's development rights is typically established by a real estate appraisal or local easement valuation point system. The organization or agency that administers the PDR program then pays this amount to the property owner. For TDR purchases, development rights are then sold, typically allowing a higher intensity of development elsewhere. The sales proceeds are used to purchase additional development rights.

Purpose and Advantages

There are numerous advantages for a community to pursue a PDR program for the purposes of restricting development in coastal hazard areas, including:

- Permanence: PDR programs are generally a permanent form of land protection, although some programs do have termination or "buy-back" clauses.
- Voluntary participation: PDR is a completely voluntary incentive, rather than a mandatory or regulatory program. Therefore, PDR may be more palatable to landowners.
- Market-based compensation: PDR programs give property owners the benefit of cash payment for the development rights, as well as reduced property tax liability because of decreased property value. Meanwhile, owners can continue to enjoy ownership and use of the property.
- Avoided costs of municipal service: In PDR programs, the landowner retains responsibility for upkeep

of the property. These programs can also save communities money in the long run by reducing municipal costs to maintain infrastructure and provide services.

Concerns and Limitations

In New Jersey shore communities, most developable waterfront property was built on decades ago. But local planning authorities must still address the issues of development rights of existing owners of property that may have additional development potential, or those properties with structures that have been substantially damaged and have yet to be reconstructed. Much of this land is currently among the most valuable property in the state because of its proximity to the water, the exact benefit that can become a hazard when sea levels rise and storm events occur. In view of the high costs, it is not feasible for the state – even with the assistance of private land trusts – to purchase development rights for all vulnerable coastal properties. Therefore, the primary challenge to a successful PDR program relates to funding. Typically, properties identified under a PDR program have high market value, so it is difficult to secure sufficient public or private financing to purchase the development rights of all threatened coastal properties. For this reason, to assure that a PDR program is successful it will be necessary to assign priority to the highest-hazard properties, recognizing that other implementation options will have to be used as well.

Another community concern will be the long-term impacts on tax revenues. One option to resolve this issue is to offer incentives for development rights to be relocated within the boundaries of the affected community. This may be possible in municipalities with sufficient remaining developable land. However, it will be necessary to explore regional strategies to share tax revenue impacts as PDR programs are developed.

Who's Using It?

Purchase of Development Rights (PDR) is a program enabled under Georgia's Land Conservation Act. It allows local governments to participate in acquisition of conservation easements to protect agricultural lands, environmental, and cultural resources. Similar programs are in place in several other states, including California, Hawai'i, New Jersey and Virginia. While these PDR programs are almost always used to preserve open space or farmland, they could also be used to purchase development rights of improved coastal properties. The Coastal Regional Commission of Georgia, a multi-county planning and development agency, in conjunction with the Georgia Department of Natural Resources, Coastal Resources Division, provides funding and assists local governments in establishing land protection programs, including PDR programs.

Recommendations for New Jersey

- Establish a PDR like the one already in effect for farmland preservation that would use state funds to purchase development rights for flood-prone coastal properties. However, the existing program is complicated, requiring considerable time for up-front planning and cost-benefit analysis. To expand the program, it will be necessary to explore strategies to simplify and accelerate the planning process.
- Identify criteria for public-agency acquisition of development rights in flood-prone areas.
- Encourage cooperation with non-governmental organizations, such as land trusts or other non-profits, to acquire development rights in flood-prone areas.
- Integrate language into municipal master plans that encourages or requires gradual migration of development rights away from low-lying, oceanfront and other flood-prone areas.

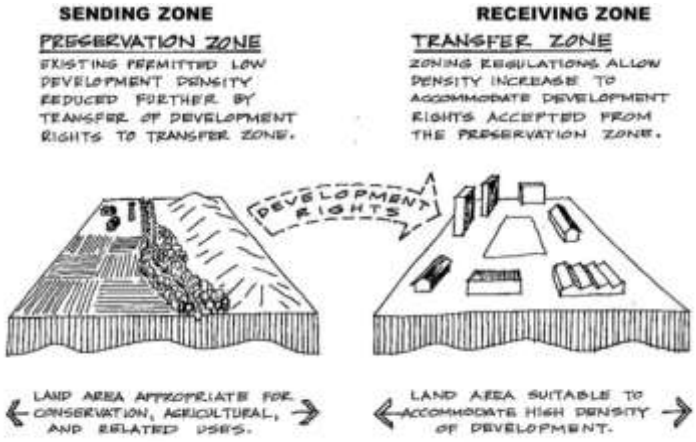
Resources

- American Farmland Trust. "A Study of PDR and TDR for Boone County, Kentucky." Boone County Planning Commission (December 2001). Accessed at http://www.boonecountyky.org/document_center/PlanningCommission/PDRTDR.pdf
- Cheshire, Kevin. "Market-Based Planning Tools: An Overview of TDRs and PDRs." North Carolina Coastal Resources, Law, Planning and Policy Center (February 2007). Accessed at https://ncseagrant.ncsu.edu/ncseagrant_docs/coastallaw/pubs/cheshire.pdf
- "Conservation Strategy for the Mississippi Gulf Coast." Conservation Legacy (December 2011). Accessed at http://ltmcp.org/wp-content/uploads/2015/01/TDR_Study.pdf
- Grannis, Jennifer. "Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise." Georgetown Climate Center. December 2011. Accessed at http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Adaptation_Tool_Kit_SLR.pdf
- Krieger, Douglas and Gayle Miller. "Purchase of Development Rights: Preserving Farmland and Open Space." *Planning Commissioners* Journal (Winter 2004). Accessed at http://plannersweb.com/wp-content/uploads/2012/08/140.pdf

Transfer of Development Rights

Description of Option

Transfer of development rights, or TDR, is a market-driven mechanism that gives landowners the ability to transfer the right to develop their property to areas where development is preferred. It is commonly used to preserve open spaces, farms and forests, or critical environmental areas. This is accomplished by selling the development potential of one parcel of land, the "sending site," for use at another parcel of land in an area that is capable of absorbing and supporting additional density, the "receiving site." Once the transfer has occurred, most TDR systems require a legal restriction on the sending site, prohibiting any future use of the transferred development potential. The receiving site is then permitted to increase its allowed development potential by the additional number of dwelling units or floor area to which it is entitled as a result of the TDR transaction.



Moskowitz & Lindbloom; The Latest Book of Development Definitions; New Brunswick: Center for Urban Policy Research, Rutgers–The State University of New Jersey, 2004, page 411.

The benefits of transfer of development rights can also be achieved through noncontiguous clustering, where multiple sites are treated as one for the purpose of clustering their combined development potential. The property or properties left open are permanently preserved, while the growth property is developed more intensely than ordinarily permitted. The properties do not need to be adjacent: they may be located miles away from one another. Non-contiguous clustering has been available to New Jersey municipalities since authorized by a 1996 amendment to the state's Municipal Land Use Law.

Purpose and Advantages

TDR programs can be used to prohibit development, or redevelopment of parcels with substantially damaged structures, in areas at risk of flooding due to sea-level rise and coastal storms. Under these conditions, TDR programs are generally upheld in court against takings challenges. The development credit is viewed as part of the retained property rights of the landowner, and courts consider the development credit when assessing the potential economic use of the property (see below).

The New Jersey state Agriculture Development Committee identifies the following benefits to TDR:

- TDR can be an effective means of limiting development while providing affected property owners with some economic benefit.
- Ownership of the property is maintained even as development potential is sold.
- TDR provides an alternative to losing land equity, which could result from future downzoning or regulation.
- TDR provides a real alternative to enacting politically volatile downzoning.
- Growth can be targeted where it is desired and where appropriate infrastructure exists.
- With private money fueling preservation, critical environmental resources can be protected with little

public investment.

- Development in pre-planned TDR receiving areas can create a more predictable and expedient development approval process at the local and state level.
- Concentrating development in compact receiving areas can reduce the cost of providing infrastructure.

Concerns and Limitations

According to the Georgetown Climate Center, TDR programs can be difficult to design and administer and, as a result, have not been implemented by many jurisdictions. Part of the difficulty is in determining which areas should be preserved and where increased densities should be allowed. In order to be effective, TDR often requires local governments to downzone sending areas to ensure that the land remains undeveloped, and to upzone receiving areas to ensure that there is a market for the increased density that comes when rights are transferred. Downzoning and upzoning often spark political opposition because citizens oppose both development restrictions and increased densities.[45]

A 2010 report prepared by New Jersey Future noted that communities considering TDR in New Jersey must plan simultaneously for considerable infrastructure and public services. Complicated and cumbersome statutory planning requirements add extra and often unnecessary burdens increasing a municipality's costs. And successful TDR implementation requires considerable state agency assistance coordination. Regional TDR presents additional issues associated with attendant costs of growth, such as education expenses, traffic and affordable housing obligations, all of which are difficult to resolve.

Other concerns include:

- TDR programs are technically complicated and require a significant investment of time and staff resources to implement.
- TDR is an unfamiliar concept. A lengthy and extensive public education campaign is generally required to explain TDR to citizens.
- The pace of transactions depends on the private market for development rights. If the real estate market is depressed, few rights will be sold, and only a small amount of land will be protected.

Who's Using It?

State of New Jersey and the Pinelands Area

In 2004, New Jersey enacted the state Transfer of Development Rights Act (N.J.S.A. 40:55D-13.7 *et seq.*). This legislation made New Jersey the first state in the nation to enact comprehensive TDR enabling legislation. The state TDR Act authorizes municipalities to develop and participate in intra-municipal and inter-municipal programs. This law also established a formal planning process to enact a TDR ordinance and authorized the state TDR Bank Board to provide planning grants to communities. To date, however, TDR has not been widely used or successfully employed in New Jersey communities outside the Pinelands.

In the Pinelands region, there is a Pinelands Development Credit (PDC) program, one of the oldest and most successful transfer of development rights programs in existence. The PDC Bank assists Pinelands property owners who wish to sell development credits for their land and preserve it in perpetuity.

[45] Adaptation Tool Kit: Sea-level rise and Coastal Land Use, How Governments Can Use Land-Use Practices to Adapt to Sea-level rise. Georgetown Climate Center. October, 2011. page 57, Table 18: Advantages and Disadvantages of Transferable Development Credits

Developers buy and use PDCs to increase building densities in designated regional growth areas, thereby promoting efficient use of land and preventing sprawl. As of June 2016, 52,194 acres in the Pinelands area have been permanently preserved through the PDC program.

Collier County, Florida

Collier County, on Florida's southwest coast, implemented a transfer of development rights program in 1974. The county established a Special Treatment Overlay Zone across 80 percent of its area, requiring stricter environmental standards in exchange for development permits. The overlay zone also created the TDR program, stipulating that one dwelling unit per two acres within the zone could be transferred outside of the zone as long as the receiving parcel was at least two acres. When property owners sell development rights in the sending area, they either have to place a conservation easement on the property to ensure that the land will remain undeveloped, or deed the land to the county for management. Minor development, such as a nature trail or boardwalk, is still permitted. To prevent unchecked growth outside of the overlay zone, the TDR program placed a cap on the maximum density of the receiving parcel; the density bonus could not exceed 20 percent of the zoned density.

It is notable that Florida's planning guidebook for local governments indicates[46] that mandatory TDR programs can help avoid the constitutional takings constraints of downzoning, and possible claims under Florida's Bert Harris Act,[47] if the affected property owners in the sending area can be assured of an adequate compensation for their lost development rights through creation of a development credit bank or exchange.

Recommendations for New Jersey

Replicate existing TDR programs in place for the Pinelands and Burlington County as pilot programs in coastal communities affected by flooding from sea-level rise and storms.

Resources

- American Farmland Trust, Farmland Information Center. "Fact Sheet: Transfer of Development Rights." http://www.farmlandinfo.org/sites/default/files/TDR_04-2008_1.pdf
- Georgetown Climate Center. "Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use How Governments Can Use Land-Use Practices to Adapt to Sea-Level Rise." http://www.law.georgetown.edu/academics/academic-programs/clinical-programs/our-clinics/HIP/upload/Adaptation_Tool_Kit_SLR.pdf
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- Pace, Niki. "Resilient Coastal Development through Land Use Planning: Tools and Management Techniques in the Gulf of Mexico." Mississippi-Alabama Sea Grant Legal Program. University of Mississippi School of Law. http://seagrant.noaa.gov/Portals/0/Documents/what_we_do/social_science/ss_tools_reports/resilient-planning_web.pdf
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[46] http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2014/09/final-report-aaa.pdf http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2014/09/final-report-aaa.pdf

[47] https://www.floridabar.org/DIVCOM/JN/JNJournal01.nsf/Articles/F12A0D8677374D7A85257EAB006CCD77 https://www.floridabar.org/DIVCOM/JN/JNJournal01.nsf/Articles/F12A0D8677374D7A85257EAB006CCD77

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- Preserving Land Through Compact Growth: Noncontiguous Clustering in New Jersey, Chris Sturm, Nicole Heater, 2012. http://www.njfuture.org/wp-content/uploads/2012/05/NJ-Future-Non-Contiguous-Clustering.pdf

f. Realign Capital Investment Priorities

Capital Improvement Programs

Description of Option

As sea levels rise, critical infrastructure - including roads, sewer systems, and stormwater management systems – serving low-lying communities will be subject to greater wear and stress. This is particularly true during coastal storm events. Governments can use the process they follow to develop Capital Improvement Programs as a key opportunity to evaluate infrastructure investments in coastal high-hazard areas.

Purpose and Advantages

Local governments regularly use a Capital Improvement Program (CIP) to plan for growth and future development. However, coastal communities can also use the capital improvement process to plan for infrastructure degradation due to sea-level rise, extreme weather events, and other climate hazards, and thereby become more resilient to extreme weather and sea-level rise. This can be accomplished by integrating hazard planning into the CIP process to evaluate whether to repair damaged infrastructure or replace it; retain infrastructure in its current form or redesign it to be more resilient to future storms and sea-level rise; keep critical infrastructure and facilities in their current location or relocate them; or discontinue expenditures to maintain and repair infrastructure that is repetitively damaged. In addition, a community that integrates hazard planning and capital investment planning can accumulate points under FEMA's Community Rating System.

Who's Using It?

New Jersey already provides for the creation of a Capital Improvement Plan as an optional element of any master plan. According to the Municipal Land Use Law (N.J.S.A. 40:55D-29), a governing body "may authorize the planning board … to prepare a program of municipal capital improvement projects projected over a term of at least 6 years, and amendments thereto. Such program may encompass major projects being currently undertaken or future projects to be undertaken, with federal, state, county, and other public funds or under federal, state or county supervision."

However, other states have a taken this a step further by linking capital improvement planning for public infrastructure directly to known vulnerabilities. For example, Florida's Department of Community Affairs requires that communities include in their capital improvements element the elimination of public hazards as a criterion for evaluating local capital improvement projects. Requiring this criterion serves to redirect development away from hazardous areas by limiting public investment in infrastructure that would otherwise support it.

NOAA has provided funding to the Association of state Floodplain Managers and the American Planning Association to help communities adapt to and mitigate coastal hazards. This project seeks to mainstream a variety of techniques to help practitioners incorporate climate, flood, and hazard data into local and regional capital improvement plans. The project has four primary goals:

1. Identify and develop tools, techniques, and guidance documents that can be used by practitioners involved in the capital improvement process.

2. Improve and enhance community capacity to incorporate data, research, and information related to coastal hazards and extreme weather into capital improvement planning.
3. Implement resilience and adaptation measures in coastal infrastructure and public buildings.
4. Understand and quantify the costs associated with the replacement, protection, or improvement of public buildings and infrastructure when coastal hazards and extreme weather are taken into account.

Recommendations for New Jersey

- Coordinate development of a Capital Improvement Plan for critical infrastructure and facilities along with master plan re-examination, and integrate information on vulnerability and known hazards into the CIP.
- Include hazard mitigation projects identified in the county hazard mitigation plan in the Capital Improvement Plan or element.
- Incorporate green infrastructure into Capital Improvement Plans in order to protect and integrate natural systems further.
- Discourage construction of new infrastructure in known hazard areas.

Resources

- Building Coastal Resilience Through Capital Improvements Planning, a joint project of the Association of state Floodplain Managers (ASFPM) and the American Planning Association (APA). https://planning.org/research/coastalresilience/
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- Schwab, James. *Hazard Mitigation: Integrating Best Practices into Planning.* The American Planning Association, (June 2010). https://www.fema.gov/media-library-data/20130726-1739-25045-4373/pas_560_final.pdf

Special Tax District

Description of Option

Municipalities seeking long-term adaptation strategies that maintain existing or similar development patterns in areas subject to coastal hazards should demonstrate how they expect to finance structural protection initiatives. They could consider establishing a special tax district to shift tax burdens to areas at risk that will require a level of support services that is disproportionate that required by the remainder of the community.

A special tax district is a designated area in which property owners agree to allow the government to levy a dedicated property tax to pay for a specific service. In the context of the S&RCC project, a special tax could be levied to support resiliency initiatives, including beach nourishment projects; improving flood protection for property owners; reducing risk by removing unstable and abandoned structures; supporting marsh enhancement and restoration; protecting and maintaining key transportation routes; and flood-proofing critical buildings and infrastructure.

Purpose and Advantages

Following Sandy, some New Jersey communities received considerable Hazard Mitigation Grant Program assistance, appropriations from the United States Army Corps of Engineers, and grants through NOAA and HUD to enhance resiliency. These funds are made available at the discretion of the U.S. Congress and are not guaranteed or controlled by local governments or the state. It is uncertain whether such assistance will be available to address future storm damage. A special tax district could generate a reliable local funding stream to pay for critical resiliency initiatives that benefit property owners in high-risk areas. Dedicated tax revenues could also be used to fund the incremental costs of maintenance of infrastructure in a flood-prone area as compared to other areas of the community.

Concerns and Limitations

Resiliency efforts along the coast provide benefits to community residents as well as the large number of tourists that frequent the shore. Property values on barrier islands and along the waterfront are higher than those of inland properties in the same municipality. Therefore, these owners are already paying higher taxes *pro rata* than owners of inland properties. The argument against a special district along the coast is that it is perceived to penalize coastal property owners. Because of their greater tax burden, these owners believe that they already pay a disproportionate share of the costs of services for others within their jurisdiction. They are likely to oppose even higher taxes to fund projects that they are likely to view as benefitting not only their community but the tourism economy of the entire state. In addition, if this option is used in conjunction with other strategies – such as rebuilding restrictions, purchase of development rights, or targeted acquisitions – a shrinking tax base within the district will be expected to pay for ever-increasing infrastructure maintenance costs.

In public and steering committee meetings, this was by far the most unpopular implementation option considered, and is likely to meet with considerable resistance.

Resources

- In California: Ballotpedia. Measure AA: San Francisco Bay Restoration Authority "Clean and Healthy Bay" Parcel Tax
- In Texas: Harris County's Flood Control District
- In Arizona: Pima County Regional Flood Control
- In Florida: Flagler County Commission

Review of Plans and Studies

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES PROGRAM

LITTLE EGG HARBOR TOWNSHIP

DATA REVIEW SUMMARY

BACKGROUND

In 2015, the New Jersey Department of Environmental Protection (NJDEP) awarded a grant to New Jersey Future to support the development of a Sustainable and Resilient Coastal Communities (SRCC) Planning Program. The goal of this program is to develop a comprehensive land use planning strategy for Toms River Township in Monmouth County and Little Egg Harbor Township and Tuckerton Borough, in Ocean County, that can serve as a model for use by coastal communities throughout New Jersey to shape long-term growth and development patterns.

The strategy will explicitly consider the risks of coastal hazards and projected sea-level rise, in order to achieve resilient community design. This model will also serve as the basis to recommend revisions to the Coastal Zone Management Rules to ensure that development that is approved in accordance with these rules is more resilient to coastal hazards.

PURPOSE

The purpose of this Data Review Summary is to provide a review of existing data and reports, such as Natural Resource Inventories, local land use regulations and building permit data, water quality reports, all-hazards master plans and recovery plans, in order to prepare the assessment of vulnerability and recommendations for future hazard mitigation.

A comprehensive list of documents reviewed for the Little Egg Harbor Township Data Review Summary is provided below:

Documents Consulted for SRCC Data Review Summary – Little Egg Harbor Township

- Comprehensive Master Plan and Re-examination
- Getting to Resilience Report
- Growing Smart and Water Wise Report
- Land Use Land Cover Map
- Ocean County Cross-Acceptance Report
- Ocean County Hazard Mitigation Plan
- Ocean County Wastewater Management Plan
- Recovery Management Plan (FEMA)
- Stormwater Management Plan
- Strategic Recovery Planning Report

- Vulnerability Assessment
- Zoning Code and Map

REVIEW OF PAST PLANS AND STUDIES

MUNICIPAL OVERVIEW

The Township of Little Egg Harbor is the southernmost mainland municipality in Ocean County, New Jersey. The township is bordered by the Barnegat Bay on the east, Eagleswood and Stafford Townships to the northeast and Burlington County to the west. Little Egg Harbor also completely surrounds the Borough of Tuckerton, which is another municipality participating in this project.

Little Egg Harbor Township has a total land area of 49.5 square miles, much of which consists of state- and federally-protected lands, such as the Bass River State Forest and the Edwin B. Forsythe National Wildlife Refuge. A portion of the township is located in the Pinelands Comprehensive Management Plan Area, and the rest is located within the boundaries of the Coastal Area Facility Review Act or CAFRA zone.

In 2010, the U.S. Census recorded Little Egg Harbor's population as 20,065 people. The township experienced explosive growth over the last 40 years, with an increase in population from 2,972 residents in 1970 to over 20,000 residents in 2010. The 2010 Census also counted a total of 10,324 housing units, of which 2,264 (or 22%) were vacant. Approximately 1,701 of these vacant units (over 75%) were seasonal vacancies, a similar figure to Tuckerton Borough.

CENTER DESIGNATION

Little Egg Harbor contains all or part of three designated Centers:

1. Parkertown Village Center
2. Mystic Island Town Center
3. Greater Tuckerton Town Center

Pursuant to the 2004 amendments to the State Planning Rules, the Center Designation process was replaced by the Plan Endorsement process, which seeks to ensure that planning throughout the entirety of a municipality is consistent with the goals and policies of the State Development and Redevelopment Plan (SDRP). Plan Endorsement generally entails comparing existing zoning and land use practices town-wide to the key concepts and policies of the State Plan and its Policy Map.

The 2004 Cross-Acceptance Report for Ocean County outlines the Township's progress on the "Planning Implementation Agenda for Designated Centers." Relevant action items from that report are shown below.

Center Recommendations:

- Plan for where and how the municipality will absorb future housing and employment increases and how future growth will affect public service costs, traffic, affordable housing costs and overall community character.
- Provide for employment areas within nodes in the approved sewer service area.
- Research, prepare and adopt land use ordinances that promote by-right and flexible/conditional mixed-uses into Centers.
- Review existing master plan and land use ordinance for consistency with SDRP objectives and revise accordingly.
- Integrate greenspace into urban environment. Develop a program for public park spaces in centers. Establish and implement street tree and landscaping planting.
- Continue cooperation/participation in watershed management planning.
- Develop additional techniques to protect large areas of open space and wetlands.
- Coordinate water and sewer service areas with planning and zoning.

LAND USE PLANS

Land use in the Township is primarily identified through the Township's 1999 Comprehensive Master Plan and 2007 Master Plan Re-Examination Report. Other plans and planning documents build upon these documents to provide further guidance to the municipality on how to direct future land use in the pattern. Recommendations of the Comprehensive Master Plan, Master Plan Re-Examination Report and other relevant planning documents are discussed below by land use type.

RESIDENTIAL USES

According to the 1999 Master Plan, 57% of the township's land area and 90% of the non-Pinelands portion of the township is zoned for residential. As of the 2010 U.S. Census, there were a total of 10,324 housing units in Little Egg Harbor Township, of which 1,701 units (16%) were for seasonal occupancy.

Most residential units were single-family dwellings ranging in density from 1-7 units per acre. The older housing developments (Mystic Island and Parkertown) are the most densely developed. Mystic Island also sustained the majority of property damage during Sandy, and are extremely vulnerable to storm events and sea level rise, as it discussed in the *Disaster Resiliency* section below.

Less than 1% of the township's land area is zoned for multi-family residential, and these parcels are located along Radio Road and Center Street.

Finally, it is important to consider the financial implications of maintaining and encouraging future residential development in Little Egg Harbor. Significantly, residential development provides for 83% of the township's tax revenues, but contributes to increased municipal costs because of education costs. In addition, the Ocean County All-Hazard Master Plan, discussed below, states that the vast majority of repetitive losses through the National Flood Insurance Program have been single-family residential dwellings.

Residential Recommendations:

- Reduce permitted residential densities, where appropriate, consistent with planning efforts aimed at minimizing the fiscal impacts of new residential development.
- Concentrate new residential and commercial development in planned centers or other growth corridors where infrastructure is available or comprehensively planned.
- Adopt land use regulations that encourage a better balance among residential, commercial, and industrial land uses, so as to promote improved municipal fiscal planning efforts.
- Promote better coordination and consistency between State and Municipal planning efforts.

COMMERCIAL USES

According the 1999 Master Plan, just 1% of the Township's total land area was zoned commercial, and these properties were concentrated along NJ-9, CR-539, Radio Road and Mathistown Road. There is also one industrial zone, with two sections located along CR-539. These are mostly light industrial uses with some gravel operations.

The Plan articulates that a critical issue facing the Township was the creation of ratable development to support municipal services. The Master Plan suggests pursuing ratable development in the following sectors: ecotourism, seaport-related businesses, back office services for Atlantic City casinos and assisted living and senior health care facilities. The Plan also suggests reducing expenses by entering into Interlocal Service Agreements or cost sharing agreements with adjacent municipalities.

Commercial Recommendations:

- Promote land use policies and regulations that encourage economic development and redevelopment that improve the Township's property tax base.

OPEN SPACE USES

According to the 1999 Master Plan, the most obvious characteristic of existing Land Use in Little Egg Harbor Township is the amount of federal and state lands, which are maintained for conservation purposes. These primarily consist of the Pinelands Reservation (north of the Garden State Parkway), the Great Bay Wildlife Management Area, the Edwin B. Forsythe National Wildlife Refuge and the Bass River State Forest. Altogether, local, state and federal properties used for conservation and government facilities comprises 60% of the total township land area.

Little Egg Harbor Township's Natural Resources Inventory dates to 1978; however, several more recent planning documents discuss the township's natural resource characteristics. For example, the Ocean County Wastewater Management Plan indicates that most of Little Egg Harbor Township's land to the south of Route 9 is covered by wetlands. Meanwhile, the land to the north of Route 9 is mostly forested, with freshwater wetlands along the Township's numerous streams. Much of these inland forests lie within Natural Heritage Priority Sites, including the East Plains Fireshed Natural Heritage Priority Site. Information on environmental resources areas of the Township are shown in table below.

Table: Environmental Resource Areas in Little Egg Harbor Township

Environmental Feature	Acreage	Land Area (%)
Wetlands	11,721.56	24.76%
Public Open Space/Recreational Areas	19,537.90	41.27%
Habitat Threatened and Endangered	26,217.25	55.38%
Natural Heritage Priority Sites	7,267.64	15.35%
Riparian Zones	1,266.90	2.68%
Preserved Agriculture	0.00	0.00%
Surface Water	16,322.47	34.48%

Source: Ocean County Wastewater Management Plan, 2015

Open Space Recommendations:

- To promote the conservation of open space and valuable natural resources and to prevent urban sprawl and degradation of the environment that would occur through the improper use of land.

ZONING CODE AND MAP

After subtracting all land that is permanently preserved or protected from future development, more than 90 percent of the remaining area of the municipality is already developed.

According to the Ocean County Wastewater Management Plan, there are 1572.51 acres of developable land in Little Egg Harbor Township, of which 1035.61 acres are zoned as residential, 386.82 acres are zoned as commercial, and 23.47 acres are zoned as industrial. An additional 126.62 acres of developable land lies to the west of the Garden State Parkway, and is under the jurisdiction of the Pinelands Commission.

The zoning districts that comprise the largest amount of developable land remaining in Little Egg Harbor Township are General Business (348.63 acres), R-1A residential (261.32 acres), R-3A residential (191.18 acres) and R-5A residential (209.59 acres).

All of the Township's zoning categories are shown in the table below.

Table: Zoning Categories and Available Land, Little Egg Harbor Township, New Jersey

Zone Name	Zone Description	**Municipal Area** (ac)	**Available Land** (ac)
FA	Forest Area	1575.33	16.27
FAC	Forest Area Cluster	83.16	0.32
GB	General Business	1316.66	348.63
HB	Highway Business	255.38	27.64
LI	Light Industrial	105.99	23.47
MC	Marine Commercial	99.63	0.00
MF	Multi-Family Residential	168.20	1.55
NB	Neighborhood Business	16.05	0.00
PA	Preservation Area	9180.70	110.03
PRC	Planned Retirement Community	408.39	11.04

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NB	Neighborhood Business	16.05	0.00
PA	Preservation Area	9180.70	110.03
PRC	Planned Retirement Community	408.39	11.04
PRD	Planned Residential Development	397.99	54.18
PV	Pinelands Village	81.22	16.07
R-1A	Residential	9788.39	261.32
R-100	Residential	566.56	75.89
R-150	Residential	276.33	26.40
R-200	Residential	429.62	87.33
R-3A	Residential	995.42	191.18
R-400	Residential	147.88	50.67
R-5A	Residential	1898.17	209.59
R-50	Residential	778.08	20.56
R-75	Residential	242.18	12.19
R-75A	Residential	325.54	17.65
SC/GB	Senior Citizen/General Business	2.46	0.00
WFD	Waterfront Development	159.00	10.55

WASTEWATER MANAGEMENT PLAN

According to the Ocean County Wastewater Management Plan, the Township's public water infrastructure is capable of providing potable water to the Township's residents in excess of daily, monthly, and yearly demands. Current infrastructure capacity will continue to prove sufficient in the foreseeable future. The system is operated by the Little Egg Harbor MUA, and is capable of pumping 5.400 MGD. There is only one development located in the Township that is served by an NJPDES permitted facility with discharge to ground water greater than 2,000 GPD, located at 230 Willets Avenue.

The Ocean County Wastewater Management Plan also calculates future wastewater demands by applying 75 gallons per day per person to the permanent year round population increase over the next twenty years, consistent with municipal population projections prepared by the NJTPA. The North Jersey Transportation Planning Authority (NJTPA) projects that Little Egg Harbor's population will grow to 26,554 people by 2035, an increase of 24.44% over 2010 U.S. Census figures. While these changes in seasonal and base population will be substantial, the Township's wastewater infrastructure is capable of accommodating them.

STORMWATER MANAGEMENT

The Township's Municipal Stormwater Management Plan was originally adopted in 2005 and last revised in 2007. The 2007 revision was reviewed during the preparation of the Strategic Recovery Planning Report (discussed below). The Municipal Stormwater Management Plan outlines the strategy that the township will employ to address stormwater related impacts, and was prepared pursuant to state regulations for municipal stormwater management (NJAC 7:8).

Stormwater Management Goals:

- Reduce flood damage, including damage to life and property.
- Minimize, to the extent practical, any increase in stormwater runoff from any new development.
- Reduce soil erosion from any development or construction project.
- Assure the adequacy of existing and proposed culverts and bridges, and other in-stream structures.
- Maintain groundwater recharge.
- Prevent, to the greatest extent feasible, an increase in nonpoint pollution.
- Maintain the integrity of stream channels for their biological functions, as well as for drainage.
- Minimize pollutants in stormwater runoff from new and existing development to restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the state, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, and recreational, industrial, and other uses of water.
- Protect public safety through the proper design and operation of stormwater basins.

WATER QUALITY

The "Growing Smart and Water Wise: Protecting Water Resources in the Growth Areas of the New Jersey Pinelands" Report (2014) examines the impact of development on water resources on Pinelands communities, including Little Egg Harbor Township. The report makes its finding and recommendations based on a comprehensive survey of water indicators conducted by Daniel Van Abs, Ph.D. of Rutgers University, including water quantity, water quality watershed integrity, stormwater and public drinking water supply.

This report found that development has caused significant environmental impacts including loss of natural lands and vegetation that absorb stormwater, including forest land, groundwater recharge areas and tidal wetlands. Parts of Little Egg Harbor are also experiencing noticeable effects from excessive water withdrawals, threatening plant and animal habitats, potable water supplies and saltwater intrusion.

This report provides recommendations at levels of government, including opportunities for municipal action in the Township. Relevant recommendations are provided below:

Water Quality Recommendations

- Advance green infrastructure implementation
    - Undertake and impervious cover assessment
    - Identify and prioritize key sites for green infrastructure
    - Partner with community groups and non-profits to install green infrastructure demonstration projects at public locations
    - Use permitting and enforcement authorities to promote broad use of green infrastructure to reduce flooding risks
    - Maximize the use of green infrastructure designs in all publicly-funded capital projects including transportation, buildings and parks.
    - Access grants to development long-term green infrastructure plans
- Promote and install native plantings.
- Reduce the impact of future development through compact development and preservation
    - Review master plan to identify areas where preservation and compact growth are desired.
    - Consider revising zoning ordinance to authorize noncontiguous clustering in these locations (Additional info on New Jersey Future website).
- Identify ways to balance preservation and development of Prime Groundwater Discharge Areas (PGWDAs) in Designated Growth Areas.
    - Identify the most productive PGWDAs in the municipal master plan land use or conservation element.
    - Promote partial or complete protection of these areas.
    - Encourage developers to steer development and impervious surfaces away from PGWRAs through site design, onsite clustering or noncontiguous clustering.
- Integrate Low-Impact Development (LID) into Rebuilding Activities.
    - Planning and Zoning Boards and staff should attend training on (LID).
    - Incorporate LID techniques into land development ordinances.
    - Provide educational materials on LID and training sessions to residents who are rebuilding.

HAZARD MITIGATION

The Ocean County Multi-Jurisdictional All Hazard Mitigation Plan (2014) identifies mitigation goals and actions to reduce or eliminate long-term risk to people and property in Little Egg Harbor Township and other municipalities in Ocean County. The All-Hazard Mitigation Plan identified that Little Egg Harbor is at risk for coastal erosion, floods, flash floods, ice jams, hurricanes, tropical storms, Nor'easters, climate change, wildfires and nuclear incidents.

One of the greatest hazards is from flooding caused by extreme rainfall, tidal surges and se-level rise. The Plan states that Ocean County ranks third among the twenty-one counties in the State of New Jersey when it comes to repetitive losses, and that within Ocean County, Little Egg Harbor Township was one of the municipalities with the most repetitive loss events and amount of paid losses through the National Flood Insurance Program (NFIP). As of 2013, NFIP counted 441 repetitive loss events and $9,094,573 in total repetitive loss payments. The Plan also provided multiple specific incidents of flooding and flash flooding events over the past twenty years that led to loss of life and property.

The Plan also provides a worksheet for Little Egg Harbor to identify specific plan recommendations.

Hazard Mitigation Recommendations:

- Elevate 826 homes to mitigate impact of flood related hazards while maintaining residents in community.
- Complete flood protection project at E. Sailboat and Dorey streets to protect from flood related hazards.
- Improve mapping capability to increase access to information to inform and plan for mitigation, preparedness, response and recovery.
- Install of bay-front energy dissipation structure; prevent coastal erosion and help to reduce undermining of bulkheads.
- Install riprap along the shoreline to protect from erosion and flood related hazards.
- Repair/replenish eroded beach along Dock Road to protect a natural resource that also protects property and is a community and economic resource.
- Repair and improve Iowa Court seawall to protect from flood related hazards.
- Repair and install bulkheads to protect from coastal erosion and flood related hazards.
- Dredge inlet to remove debris and sand thus providing space for water to prevent and mitigate flooding in low lying areas.
- Dredge lagoon to remove debris and sand thus providing space for water to prevent and mitigate flooding in low lying areas.

The Ocean County All-Hazard Master Plan also identifies critical threats to the Little Egg Harbor Municipal Utilities Authority (MUA), particularly the risk of power outages and inundation during storm events. In order to prepare for hazard events that could cause serious damage to utility infrastructure, impede the work of emergency responders and slow storm recovery efforts, the All-Hazard Master Plan proposes the following recommendations for the Little Egg Harbor MUA.

Hazard Mitigation Recommendations – Utilities:

- Purchase, install and maintain three (3) generators to continue critical community services during utility interruptions and storm events.
- Update and elevate the pump station to maintain access to critical community resources during flooding related hazard.

The Little Egg Harbor Township Vulnerability and Exposure Assessment (2015) evaluates the Township's vulnerability to likely hazards, and serves as a framework for identifying and prioritizing those actions

that most effectively reduce or avoid future losses. As noted above, one of the primary hazards facing Little Egg Harbor Township is flooding caused by extreme rainfall events, storm surge and sea-level rise.

The report concludes that if no action is taken to minimize future risk, by 2050, 55% of the area of Township, or over 9,000 acres 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 $237.5 million dollars, or 8% of the net taxable assessed value of the community, based on the Township's present day valuation.

Further, by 2050, a 1% storm, coupled with projected sea level rise would almost quadruple the number of parcels that would be at risk of inundation to over 4,700, exposing 34% 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 $358 million to $884 million, or from 13% to 32% of the total assessed value of the community.

This report does not make any recommendations but concludes with some questions for further discussion, including the following:

- 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 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?

RECOVERY MANAGEMENT

On October 29, 2012, Little Egg Harbor Township sustained major damage from Superstorm Sandy. Little Egg Harbor reported that approximately 4,000 residential properties and a number of small retail

businesses and marinas suffered damage. Additionally, the Township reported that seven roadways were damaged, and that electricity, water, and sewer service were disrupted. Superstorm Sandy also resulted in damage to the Little Egg Harbor Township Community Center and the Parkertown Dock Recreation Facility, and trees and power lines fell throughout the Township.

The Township of Little Egg Harbor Strategic Recovery Planning Report (2014) serves as a blueprint to address conditions created or exacerbated by Sandy, identifies approaches to rebuilding that will be more resistant to damage from future storm events, and encourages 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:
    - Flooding of homes and businesses in low-lying areas and close to waterways;
    - Power loss and problems with emergency communication and service;
    - Pump stations and wells caused back-ups of sewer service;
    - Limited options for relocating debris from the storm;
    - Weakened bulkheading and eroded shorelines.
4. Articulates planning goals, strategies, and actions to improve public safety, develop resistance to future storms, and stimulate economic recovery; and,
5. Describes each proposed project at a level of detail that:
    - Demonstrates how it relates to the storm's impacts;
    - Explains why it is important to the Township's economic and environmental health;
    - Lists the major tasks with which it may be associated;
    - Includes an estimation of the cost of implementation;
    - Identifies potential or actual funding sources; and
    - Provides a timeline for implementation.

The Strategic Recovery Plan also includes recommendations for action items from previous plans, including many of the ones discussed here, as well as some additional projects proposed by the Consultant. These include the following:

- employ storm-resistant building strategies in all future municipal construction in areas to the south of the Garden State Parkway;
- construct storm resistant infrastructure including equipment, pumps and buildings elevated above the flood hazard elevation and berms or levees to protect capital facilities; and
- promote recovery from Superstorm Sandy and resiliency to future storms by taking the actions that are detailed in the 2013 Multi-Jurisdictional All Hazard Mitigation Plan.

Finally, Little Egg Harbor Township completed a Recovery Management Plan with FEMA in 2013. The recovery strategy recommended the following three (3) priority items:

- Replace bulkheading on a number of lagoon ends, where the property is under public ownership.

- Dredge channels and lagoons due to the heavy silting from Hurricane Sandy; and
- Develop a sea-wall/jetty system in the Osborne Island area at Iowa and Ohio Roads to prevent a possible washout.

DISASTER RESILIENCY

In the course of preparing the SRPR, Little Egg Harbor Township also participated in the Getting to Resilience (GTR) process, developed by NJDEP and adapted and enhanced by the Jacques Cousteau National Estuarine Research Reserve (JCNERR). Through the GTR process, the Township was able to identify specific actions to enhance long term resiliency by linking planning, mitigation and adaptation.

This plan highlighted Little Egg Harbor's vulnerability during future disaster events, primarily due to sea level rise. As much of Little Egg Harbor 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.

Similarly, just one foot of sea level rise will cause partial inundation of most streets in Mystic Island. This report estimated the arrival of one foot of sea level rise by 2050, with acceleration to three feet of sea level rise likely before 2100. 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.

CONCLUSION AND NEXT STEPS

Following this review of plans, it is evident that Little Egg Harbor Township must address several critical issues that impact current residents and limit future development. Some of these issues are physical and others are regulatory, and include the following:

- **Zoning regulations**: There is limited developable property available in certain zoning districts and in the Township in general.
- **Environmental regulations**: Development is limited or prohibited in certain environmentally-sensitive areas of the Township, including wetlands, floodplains and critical wildlife habitats.
- **Soil limitations**: Much of the Township's soil is too sandy or flood-prone to support future land development.
- **Groundwater vulnerability**: The aquifer supplying water to the Township and other adjacent municipalities are prone to future saltwater invasion.
- **Sewer system**: Lack of power during major storm events renders sewer system inoperable and creates backups in system.
- **Sea Level Rise:** If no action is taken to minimize future risk, by 2050, 55% of the area of Township, or over 9,000 acres would be exposed to inundation from Sea Level Rise.
- **Tidal Surge:** Tidal surges endanger approximately 1500 homes along the bay in Little Egg Harbor Township.

- **Flood Hazards**: Little Egg Harbor Township is among the municipalities in Ocean County with the most repetitive loss events and amount of paid losses through the National Flood Insurance Program (NFIP).
- **Other Natural Hazards:** The County All-Hazard Master Plan determined that Little Egg Harbor Township is also at risk for coastal erosion, ice jams, hurricanes, tropical storms, Nor'easters, climate change, wildfires and nuclear incidents.
- **Utility vulnerability:** Little Egg Harbor is susceptible to flooding from coastal storms on the bay front side which can lead to power outages and damage to utility infrastructure. The MUA does not currently have generators to operate during and after a storm event.
- **Water Quality:** Development has caused significant environmental impacts including loss of natural lands and vegetation that absorb stormwater and a degradation of water quality.

Members of the Sustainable and Resilient Coastal Communities project team will use the results of this analysis to identify critical issues these towns must address in order to respond to likely future coastal flood hazards. Additional next steps include evaluation of future growth projections based on analyses from New Jersey Future and Water Quality Management Plans and evaluation of future sea-level rise and storm surge impacts on land-based features and shoreline conditions. The overall goal is to influence changes to the methodology of identifying CAFRA centers.

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES PROGRAM

TUCKERTON BOROUGH

DATA REVIEW SUMMARY

BACKGROUND

In 2015, the New Jersey Department of Environmental Protection (NJDEP) awarded a grant to New Jersey Future to support the development of a Sustainable and Resilient Coastal Communities (SRCC) Planning Program. The goal of this program is to develop a comprehensive land use planning strategy for Toms River Township in Monmouth County and Little Egg Harbor Township and Tuckerton Borough, in Ocean County, that can serve as a model for use by coastal communities throughout New Jersey to shape long-term growth and development patterns.

The strategy will explicitly consider the risks of coastal hazards and projected sea-level rise, in order to achieve resilient community design. This model will also serve as the basis to recommend revisions to the Coastal Zone Management Rules to ensure that development that is approved in accordance with these rules is more resilient to coastal hazards.

PURPOSE

The purpose of this Data Review Summary is to provide a review of existing data and reports, such as Natural Resource Inventories, local land use regulations and building permit data, water quality reports, all-hazards master plans and recovery plans, in order to prepare the assessment of vulnerability and recommendations for future hazard mitigation. A comprehensive list of documents reviewed for the Tuckerton Borough Data Review Summary is provided below.

Documents Consulted for SRCC Data Review Summary – Tuckerton Borough

- Comprehensive Master Plan and Master Plan Re-examination Report
- Getting to Resilience Report
- Growing Smart and Water Wise Report
- Joint Circulation Plan – Little Egg Harbor Township and Tuckerton Borough
- Land Use Land Cover Map
- Natural Resources Inventory (NRI)
- Ocean County Cross-Acceptance Report
- Ocean County All-Hazard Mitigation Plan
- Ocean County Wastewater Management Plan
- Recovery Management Plan (FEMA)
- Stormwater Management Plan

- Strategic Recovery Planning (SRP) report
- Tuckerton Borough Revitalization Plan (Stronger New Jersey)
- Zoning Code and Map

REVIEW OF PAST PLANS AND STUDIES

MUNICIPAL OVERVIEW

The Borough of Tuckerton is located in southern Ocean County and consists of approximately 2,360 acres or 3.78 square miles of area. According to the 2010 U.S. Census, Tuckerton had a population of 3,347 residents. This number increased slightly to 3,370 according to 2014 ACS Estimates. In addition, the 2010 U.S. Census identified a total of 1,902 housing units in the Borough, of which 506 (or 27%) were vacant. Of these vacant units, 382 (or 75%) were seasonal vacancies.

The Borough is unique in that its land is surrounded on all sides by Little Egg Harbor Township, while nearly half of the Borough consists of portions of the Edwin B. Forsythe National Wildlife Refuge. In addition, the entire land area of the Borough is located within the boundaries of the Coastal Area Facility Review Act or CAFRA zone. The Borough is designated as two separate CAFRA planning areas: CAFRA Coastal Environmentally Sensitive Area (PA5) and CAFRA Coastal Suburban Area (PA2).

Finally, a portion of the Borough is a designated "Town Center" per the New Jersey State Development and Redevelopment Plan. Designated jointly with portions of Little Egg Harbor Township, the "Greater Tuckerton Town Center" recognizes the common, interrelated issues facing both municipalities.

LAND USE

Land use in Tuckerton is primarily identified through the Borough of Tuckerton Master Plan (2002) and subsequent Re-Examination Report (2007). The Borough vision is identified as "a 21st century Borough that is economically prosperous, environmentally sustainable and socially stimulating."

Tuckerton has a fairly well-organized land use pattern with commercial development located along the Borough's only two major roadways surrounded by residential neighborhoods. In addition, large areas of the Borough are dedicated to open space uses. The Borough has largely avoided the unmitigated growth and suburban sprawl experienced in other parts of Ocean County due to its limited highway access and regulations for environmentally sensitive areas such as CAFRA.

Other plans and planning documents build upon these documents to provide further guidance to the municipality on how to direct future land uses to achieve a balance between the needs of current and future residents, economic development and environmental conservation. Recommendations of the Comprehensive Master Plan, Master Plan Re-Examination Report and other relevant planning documents are discussed here by land use type.

RESIDENTIAL USES

As of the 2010 U.S. Census, there were a total of 1,902 housing units in Tuckerton, of which approximately 20% were seasonal units. The majority of houses in the Borough are single-family detached homes, with small pockets of multi-family dwelling units. Density ranges from 4-8 units per acre.

According to the 2014 "Getting to Resilience" report, a large portion of Tuckerton's residential properties are contained in the Tuckerton Beach section of town. The land in this section of town was constructed by dredging and filling intertidal saltmarsh and converting it to usable land. This method of construction was banned by federal legislation by the 1970's but not before expansive areas of wetlands were built upon.

Over time, these built up areas have experienced a slow and steady settling of their sediments due to compaction resulting in the subsidence of streets and lots. The Borough has elevated roadways that have become frequented by tidal flooding, but this has created problematic runoff issues as precipitation pours off the elevated roadway and onto private lots, causing flooding.

Relevant Residential Recommendations

Master Plan

- Incorporate sustainable, environmentally-friendly and green design standards as appropriate into the Zoning and Land Use Ordinances as part of new development.

COMMERCIAL USES

Tuckerton's Main Street commercial corridor (located along NJ-9) is the only compact walkable downtown in the surrounding area, and is distinguished for its historic maritime buildings, the Tuckerton Seaport museum complex, and opportunities for shopping, dining, boating and fishing. Other commercial is scattered along the rest of NJ-9 and CR-539. The Borough Master Plan discusses the downtown area in detail, specifically its maritime character, historic disinvestment and the opportunity to rehabilitate the area's buildings to serve the business needs of visitors and residents.

During recovery for Hurricane Sandy, the Borough was also able to work with FEMA and Stockton to develop the Tuckerton Borough Revitalization Plan, which seeks to integrate revitalization of the downtown and other commercial areas with best practices for increasing resiliency following storm events. According to this plan, the economic restructuring period that follows a major disaster is critical because a community with a diverse and robust economy stands a better chance of recovery and can better withstand future disasters.

Relevant Commercial Recommendations:

Master Plan

- Create a mixed-use community of place downtown that addresses the current needs of residents while preserving and enhancing the distinctive physical and historic character of the Borough.
- Support a mix of retail, commercial and marine uses and encourage an orderly and balanced growth that serves both Borough residents and visitors.

- Support appropriate economic development within the limitations of the Borough's size and scale.
- Establish new design standards that ensure the architectural character of new development is consistent with and promotes the historic character of the Borough.

Revitalization Plan

- Develop a commercial district revitalization program that supports core businesses and helps to expand a niche market in the recreation and tourism sectors.
- Promote traditional, small town customer service with a seafaring theme.
- Provide small business support in coordination with various development recovery projects.
- Encourage coordinated, distinctive, and attractive development of the borough core.

OPEN SPACE USES

More than half of Tuckerton is covered with coastal wetlands, much of which has been incorporated into the Edwin B. Forsythe National Wildlife Refuge. Located further inland are Tuckerton's forests and freshwater wetlands. Each of these is discussed in further detail in the *Natural Resources Inventory* section below and a table of environmental features in the Borough is provided below. There are no Natural Heritage Priority Sites or preserved farms in the Borough.

Table 2: Environmental Resource Areas in Tuckerton Borough

Environmental Feature	Acreage	Land Use (%)
Wetlands	1,237.01	52.46%
Public Open Space/Recreational Areas	955.96	40.54%
Habitat Threatened and Endangered	1,187.48	50.36%
Natural Heritage Priority Sites	0.00	0.00%
Riparian Zones	120.59	5.11%
Preserved Agriculture	0.00	0.00%
Surface Water	177.48	7.53%

Relevant Open Space Recommendations:

- Explore creating a Borough greenway along Tuckerton Creek for flood protection, recreation and open space. Identify key parcels for flood protection, recreation and open space. Identify key parcels for acquisition or establishment of easements.
- Identify key parcels for preservation as open space, such as along Route 539 corridor.
- Promote sustainable development through amendments to the Zoning Ordinance, including regulations for lot and building coverage, buffers and setbacks and increased landscaping.
- Promote use of native species in landscaping and tree planting. Discourage planting of invasive species, which can endanger sensitive environmental areas.
- Incorporate sustainable storm water management practices into new design through the use of pervious surfaces, increased native landscape buffers and increased plantings.
- Secure additional Borough-owned open space and support efforts of other non-profit groups and government agencies to acquire or secure conservation easements for environmentally sensitive lands.

CENTER DESIGNATION

The Borough of Tuckerton Master Plan discusses the Greater Tuckerton Town Center designation in detail. This Center designation encompasses all of the land in the Borough *except* the lagoon developments along Route 9, the Edwin B. Forsythe Preserve, the Tuckerton Beach neighborhoods and the public open space and wetland corridors along Tuckerton Creek. The Center designation is significant because it permits a significant reduction in CAFRA impervious coverage limitations: impervious coverage limitation is increased from 3% to 70% in Planning Area 5.

Pursuant to the 2004 amendments to the State Planning Rules, the Center Designation process was replaced by the Plan Endorsement process, which seeks to ensure that planning throughout the entirety of a municipality is consistent with the goals and policies of the State Development and Redevelopment Plan. Plan Endorsement generally entails comparing existing zoning and land use practices town-wide to the key concepts and policies of the State Plan and its Policy Map.

The 2004 Ocean County Cross-Acceptance Report outlines the Borough's progress on the "Planning Implementation Agenda for Designated Centers." The following are relevant action items from that report.

Center Recommendations:

- Plan for where and how the municipality will absorb future housing and employment increases and how future growth will affect public service costs, traffic, affordable housing costs and overall community character.
- Provide for employment areas within nodes in the approved sewer service area.
- Research, prepare and adopt land use ordinances that promote by-right and flexible/conditional mixed-uses into Centers.
- Review existing master plan and land use ordinance for consistency with SDRP objectives and revise accordingly.
- Integrate greenspace into urban environment. Develop a program for public park spaces in centers. Establish and implement street tree and landscaping planting.
- Continue cooperation/participation in watershed management planning.
- Develop additional techniques to protect large areas of open space and wetlands.
- Coordinate water and sewer service areas with planning and zoning.

ZONING CODE AND MAP

The Borough of Tuckerton Zoning Code provides a set of land use regulations governing where and how land can be developed and used throughout the municipality, while the Official Map depicts the location of each of the zoning districts.'

Accorsding to the 2002 Borough zoning map, the Borough of Tuckerton is divided into twelve zoning districts, which are shown in the table below.

Table 3: Zoning Districts and Area in Tuckerton Borough

Zone	Zone Description	Municipal Area (ac)	Percentage of Land Total
B1	Village Commercial and Office Professional	52.5	2.6%
B2	Highway Business	181.8	8.8%
B3	Marine Commercial	108.3	5.3%
B4	Marine Commercial/Waterfront Cluster	19.1	0.9%
MF	Multi-Family Residential	0.2	0.0%
PSC	Planned Senior Citizen Residential	105.8	5.1%
R100	Single Family Residential	199.1	9.7%
R50	Single Family Residential	109.1	5.3%
R75	Single Family Residential	166.8	8.1%
R200	Single Family Residential	123.4	6.0%
R400	Wetlands Conservation Residential	946.1	45.9%
SV	Seaport Village	48.3	2.3%
TOTAL		2,060 acres	100.0%

There are presently approximately 80 acres of developable land in Tuckerton, of which a quarter is zoned residential and three-quarters are zoned commercial. There is no developable land zoned for industrial uses in the Borough. Most of the available developable land is in the B2 Highway Business District, whereas all other zoning categories combined have less than ten (10) acres of developable land available.

TRANSPORTATION AND CIRCULATION

The Tuckerton Borough Master Plan (2002) contains a Circulation Element which describes the Borough's transportation infrastructure in detail and identifies critical issues and recommendations for meeting the current and future needs of Borough residents related to circulation. Tuckerton has a simple road network: every road is a local road, except for NJ-9 (principal arterial) and CR-539 (major collector).

- NJ-9 (also known as Main Street) serves as the primary access road for the Borough. Most commercial uses are scattered along this Route and in the downtown, it contains the City's civic and commercial uses.

- CR-539 is the secondary access route through the Borough and connects area residents to the Garden State Parkway.

Neither of these roads was designed to handle the current or projected traffic volumes, much of which is commuter traffic from Little Egg Harbor Township residents accessing the Garden State Parkway. Traffic issues are exacerbated in summer months by the increase in seasonal visitors.

In addition, the limited roadway access in the Borough is a serious problem in emergency and evacuation scenarios. The "Getting to Resiliency" report discussed in the *Disaster Resiliency* section below determined that any hurricane-strength storm will flood the critical evacuation routes of NJ-9 and CR-539. In addition, immediately following Hurricane Sandy's landfall in Tuckerton, the Borough became inaccessible because of the large numbers of boats and large mounds of debris blocking the roadways.

A joint Circulation Plan was conducted in 2010 for both Tuckerton Borough and Little Egg Harbor Township. This plan recommended sidewalk, bikeway, trail and roadway improvements. Most of these recommendations pertain to improving safety, flow of traffic and user experience, rather than addressing hazard mitigation or disaster resiliency.

NATURAL RESOURCES

Tuckerton Borough's Environmental Commission completed a Natural Resources Inventory (NRI). This document complements the Borough's Comprehensive Master Plan and Re-Examination Report by taking inventory of the municipality's natural resource characteristics thereby informing the future planning and development of the municipality.

Specific sections of this document that were found to be relevant to the work of SRCC include the following:

Soil: The soils in the Borough range from well-drained Hammonton Loamy Sand to very poorly drained Sulfaquents and Sulfihemists. A majority of the soils in the eastern portion of the Borough are restricted for urban uses due to flooding. Soils in the central and northern portion are limited to recreational use due to sand content. Water table limitations also exist in the eastern and central portions of the Borough. Soil limitations will affect future development in the Borough.

Groundwater: Depth to the seasonal high water table within the Borough ranges from zero to five feet, depending on the area, soil type and time of year. All of the soils within the Borough have generally shallow depth to seasonal high water, which presents limitations to development throughout the Borough, especially construction of basements, septic systems and stormwater basins. Additional information regarding the Borough's groundwater is contained in the 'Public Water Supply' section below.

Wetlands: There are seven classes of Palustrine wetlands located in the Borough, including a large area of coastal wetlands. The Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) protects these wetlands by requiring a permit from the NJDEP for nearly all activities which will be carried out either

within a wetland, wetland transition area or State open water such as filling, excavation, placement of pavement and construction of structures. The Freshwater Wetlands Protection Act supersedes all municipal land use law and zoning ordinances.

Flood Hazard Areas: According to FEMA Flood Insurance Rate Maps (FIRM), the majority of Tuckerton Borough lies within the AE zone. These are land areas typically located immediately adjacent to streams, brooks or other natural waterways, that are subject to inundation by flood waters or areas of 100-year flood with base flood elevations and flood hazard factors determined. The rest of the Borough is in the X500 zone, which is between the limits of the 100-year and the 500-year floodplain. Areas within the X zone are areas of minimal flooding located outside of the 500-year flood area. No coastal high hazard/ high velocity areas (V-zones) exist within the Borough of Tuckerton.

According to the NRI, the majority of the Borough's waterways have large undeveloped floodplains that do not raise concern when flooded. However, the floodplain of Tuckerton Creek is the most susceptible to flooding impacts since a large number of people live along or adjacent to the creek. In addition, areas with tidal influence of the Little Egg Harbor Bay, such as Tuckerton Beach, also experience periodic flooding. Floodplains are regulated by the New Jersey Department of Environmental Protection under the Flood Hazard Area Control Act.

Recreational Areas: The Borough has reserved large sections of open spaces for recreational use, including environmentally-sensitive areas that are not suitable for development. These include smaller parcels like City Parks as well as larger preservation areas like the Edwin B. Forsythe National Wildlife Preserve. This Preserve comprises more than 43,000 acres and covers approximately 60% of the Borough's land area. The Preserve was established to protect and manage coastal habitats for migratory birds, while also protecting a significant portion of the Borough's wetlands from development. The Borough is also home to the Jacques Cousteau National Estuarine Research Reserve, which comprises an additional 114,665 acres of federal and state lands managed in partnership through a variety of agencies, including the Edwin B. Forsythe National Wildlife Preserve.

CAFRA: The Borough is designated as two separate CAFRA planning areas: CAFRA Coastal Environmentally Sensitive Area (PA5) and CAFRA Coastal Suburban Area (PA2). Approximately 1,140 acres lie within the Environmentally Sensitive Planning Area and the remaining 1,190 acres lie within the Coastal Suburban Planning Area. In accordance with the impervious coverage requirements of the CZM Rules, 3% of the Environmentally Sensitive Planning Area or 34.2 acres can be developed with impervious coverages and 30% of the Suburban Planning Area that is serviced by a regional sewerage system or 357 acres can be impervious.

WATER SUPPLY

There are three public community water supply wells serving Tuckerton Borough. These water supply wells are owned by the Tuckerton Water and Sewer Department and are located throughout the Borough. These wells all access the lower member of the Kirkwood Formation, which is one of the most intensely developed aquifers in Ocean County. The Kirkwood Formation is located throughout the entire Borough and is relatively

deep being located at a depth of more than 400 feet having a water yield over 500 gallons per minute (Borough of Tuckerton Natural Resources Inventory).

The current infrastructure capacity for supplying public water is presently capable of providing potable water to the Borough's residents in excess of daily, monthly, and yearly demands, and will continue to prove sufficient in the foreseeable future (Ocean County Wastewater Management Plan); however, since groundwater levels are below sea level, the Borough's water supply is subject to saltwater intrusion.

WASTEWATER FACILITIES

Most existing development in Tuckerton outside of the Edwin B. Forsythe National Wildlife Refuge is connected to the existing sewer system. Wastewater is collected through the Borough's municipal system, which connects to an OCUA. There are eleven pump stations in the Borough. All of the developed and developable land in the Borough is included in the designated sewer service area. There are no septic systems in Tuckerton (Ocean County Wastewater Management Plan).

However, Superstorm Sandy knocked out power to the Borough for up to 14 days, rendering the sewage system inoperable (Strategic Recovery Plan).

Future wastewater flows were determined by applying 75 gallons per day per person to the permanent year round population increase over the next twenty years consistent with municipal population projections prepared by the NJTPA. This equates to a 0.061 MGD increase in wastewater flow being directed to OCUA's SWPCF**.** This is a not an overly significant amount of additional flow, and will not have a significant impact on the SWPCF.

The "Growing Smart and Water Wise" report discussed in the "Water Quality" section below also found that drinking water, wastewater and stormwater infrastructure requires better asset-management practices and a greater investment in upgrades and maintenance. Specifically, this report found that corrosive soils and infiltration have stressed wastewater pipes located near Tuckerton's beach and replacement is needed.

WATER QUALITY

The "Growing Smart and Water Wise: Protecting Water Resources in the Growth Areas of the New Jersey Pinelands" Report (2014) examines the impact of development on water resources on Pinelands communities, including Tuckerton Borough. The report makes its finding and recommendations based on a comprehensive survey of water indicators conducted by Daniel Van Abs, Ph.D. of Rutgers University, including water quantity, water quality watershed integrity, stormwater and public drinking water supply.

This report found that development has caused significant environmental impacts including loss of natural lands and vegetation that absorb stormwater, including forest land, groundwater recharge areas and tidal wetlands. Parts of Tuckerton are also experiencing noticeable effects from excessive water withdrawals, threatening plant and animal habitats, potable water supplies and saltwater intrusion.

This report provides recommendations at levels of government, including opportunities for municipal action in the Township. Relevant recommendations are provided below:

Water Quality Recommendations

- Advance green infrastructure implementation.
    - Undertake and impervious cover assessment.
    - Identify and prioritize key sites for green infrastructure.
    - Partner with community groups and non-profits to install green infrastructure demonstration projects at public locations.
    - Use permitting and enforcement authorities to promote broad use of green infrastructure to reduce flooding risks.
    - Maximize the use of green infrastructure designs in all publicly-funded capital projects including transportation, buildings and parks.
    - Access grants to development long-term green infrastructure plans.
- Join Sustainable Jersey, to gain access to training and grant opportunities.
- Promote and install native plantings.
- Reduce the impact of future development through compact development and preservation
    - Review master plan to identify areas where preservation and compact growth are desired.
    - Consider revising zoning ordinance to authorize noncontiguous clustering in these locations (Additional info on New Jersey Future website).
- Identify ways to balance preservation and development of Prime Groundwater Discharge Areas (PGWDAs) in Designated Growth Areas.
    - Identify the most productive PGWDAs in the municipal master plan land use or conservation element.
    - Promote partial or complete protection of these areas.
    - Encourage developers to steer development and impervious surfaces away from PGWRAs through site design, onsite clustering or noncontiguous clustering.
- Create educational opportunities about water conservation, green infrastructure and resilient design at the Tuckerton Seaport.
- Integrate Low-Impact Development (LID) into Rebuilding Activities.
    - Planning and Zoning Boards and staff should attend training on (LID).
    - Incorporate LID techniques into land development ordinances.
    - Provide educational materials on LID and training sessions to residents who are rebuilding.

RECOVERY MANAGEMENT

The Tuckerton Recovery Management Plan (2013) outlined how the Federal Emergency Management Agency's (FEMA) Community Recovery Assistance (CRA) team could support the Borough recover from Hurricane Sandy.

On October 29, 2012, Tuckerton sustained major damage from Hurricane Sandy. More than half the town was flooded, including the police headquarters and historic buildings. In addition to the flooding, damage was caused by sewer overflows, broken sewer lines, failure of pumps, loss of power, and strong winds. Numerous ratables, including restaurants, an oyster farming plant, and marinas were also destroyed. The southern part of the borough, including a principal artery to the most impacted area was inaccessible for weeks due to flooding and boat pile-up.

The recovery plan's primary recommendation was to consolidate municipal services and address other issues of concern, including to:

- Secure funds for a new municipal building;
- Secure funding to lease the building with an option to buy;
- Add a second floor or expand the ground floor of current Borough Hall;
- Acquire land or a building for new police/construction/OEM building;
- Consolidate police, construction and OEM functions with Little Egg Harbor;
- Jointly purchase a mobile command response vehicle with a neighboring municipality; and
- Implement an economic development plan with emphasis on tourism and local business expansion.

The Borough has since completed the move to a new, consolidated Town Hall building that houses administrative functions, police, construction, and OEM. Similarly Tuckerton Borough's 2015 Strategic Recovery Planning Report (SRPR) serves as a blueprint to address conditions created or exacerbated by Hurricane Sandy, identify approaches to rebuilding that 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 Borough faces from significant storm events, and sea-level rise;
4. Articulates planning goals, strategies, and actions to improve public safety, develop resistance to future storms, and stimulate economic recovery; and,
5. Describes each proposed project at a level of detail that:
    - Demonstrates how it relates to the storm's impacts;
    - Explains why it is important to the Borough's economic and environmental health;
    - Lists the major tasks with which it may be associated;
    - Includes an estimation of the cost of implementation;
    - Identifies potential or actual funding sources; and

- Provides a timeline for implementation.

The Strategic Recovery Plan includes lists of potential projects from previous plans, including many of the ones discussed here, as well as some additional projects proposed by the Consultant. Each project was given a resiliency score to reflect the extent to which it would enhance the resiliency of the towns.

Potential Projects:

1. Elevate Pump Houses and Equipment
2. Water Supply Infrastructure Study and Replacement of Interconnection with Little Egg Harbor Municipal Utilities Authority
3. Infiltration and Inflow Study of Sewers and Necessary Improvements
4. Waterproof Manholes in Flood prone Areas
5. Little Egg Harbor Boulevard Flood Protection Project
6. Crowning of Parker Road
7. Crowning of Little Egg Harbor Boulevard
8. Extension of Barrier into Marsh off Kingfisher Road
9. Dredging of Thompson Creek
10. Restoration of Green Street Park Amenities
11. Buy Washed out Properties
12. Demolition of Police Department
13. Dredging of Paradise Cove
14. Beach Nourishment at Green Street Park

DISASTER RESILIENCY

In the course of preparing the SRPR, Tuckerton also participated in the Getting to Resilience (GTR) process, developed by the NJDEP and adapted and enhanced by the Jacques Cousteau National Estuarine Research Reserve (JCNERR). Through the GTR process, the Borough was able to identify specific actions that to enhance long term resiliency by linking planning, mitigation and adaptation.

This plan highlighted Tuckerton's vulnerability to future disaster events, primarily due to sea level rise. As much of Tuckerton is at or near current sea level, fluctuations in sea level through surge events and trends toward 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.

Similarly, just one foot of sea level rise will cause regular inundation of almost every street of Tuckerton Beach. This report estimated the arrival of one foot of sea level rise by 2050, with acceleration to three feet of sea level rise likely before 2100. Three feet of sea level rise will result in regular tidal inundation of all of Tuckerton Beach and areas bordering Tuckerton Creek. 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.

Disaster Resiliency Recommendations:

- Adapt the latest version of FEMA's flood maps and ensure public is aware of any changes from the last version each time they are updated.
- Rewrite elevation building code and freeboard requirements as based upon the Best Available Flood Hazard Data rather than individual titles or versions of FEMA's flood maps.
- 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.
- Identify sea level rise as a hazard in municipal plans and consider disclosing hazard risks to potential buyers and real estate agents.
- Create a detailed mitigation plan for areas that experience repetitive loss.
- 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.
- 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.

HAZARD MITIGATION

The Ocean County Multi-Jurisdictional All Hazard Mitigation Plan (2014) identifies mitigation goals and action to reduce or eliminate long-term risk to people and property in Tuckerton Borough and other municipalities in Ocean County. In addition to the hazards discussed above, the All-Hazard Mitigation Plan identified that Tuckerton is at risk for Coastal Erosion, Flood, Flash Flood, Ice Jam, Hurricane, Tropical Storm, Nor'easter, and Climate Change. The Plan also provided a worksheet for Tuckerton Borough to identify specific plan recommendations. Relevant recommendations that have not yet been implemented are shown below.

Hazard Mitigation Recommendations:

- Complete flood protection project for land end of Little Egg Harbor Boulevard to protect from flood related hazards.
- Elevation project for Tuckerton Beach to build to higher standards and elevation that will mitigate impact of flood related hazards while maintaining residents in community.
- Dredge lagoon mouths to remove debris and sand thus providing space for water to prevent and mitigate flooding in low lying areas.
- Acquire 131 homes to protect from flooding related hazards.
- Elevation project for 653 homes to build to higher standards and elevation that will mitigate impact of flood related hazards while maintaining residents in community.
- Purchase and maintain generators to continue critical community services during utility interruptions and storm events.

- Continue to participate in the NFIP to support pro-active floodplain management that will protect property from flood related hazards, clearly inform property owners about the risks of being in and near the SFHA, and promote flood insurance.
- Continue to enforce building codes to require building, renovations, and re-building meets or exceeds the Uniform Construction Code thus protecting homes from risk related to hazards including flooding, fire, wind, earthquake, and winter storm.
- Develop FEMA 361 Shelter for New Police Department Station to protect community members during all disasters requiring evacuation.
- Join CRS program to complete pro-active floodplain management and assist residents with flood insurance costs.

CONCLUSION AND NEXT STEPS

Following this review of plans, it is evident that the Borough of Tuckerton must address several critical issues that impact current residents and limit future development. Some of these issues are physical and others are regulatory, and include the following:

- **Zoning regulations**: There is limited developable property available in certain zoning districts.
- **Environmental regulations**: Development is limited or prohibited in certain environmentally-sensitive areas of the Borough, including wetlands, floodplains and critical wildlife habitats.
- **Soil limitations**: Much of the Borough's soil is too sandy or flood-prone to support future land development.
- **Groundwater vulnerability**: The aquifer supplying water to the Borough and other adjacent municipalities are prone to future saltwater invasion.
- **Sewer system**: Lack of power during major storm events renders sewer system inoperable.
- **Road access:** There are only two major roads in the Borough, and neither of these was designed to handle the current or project traffic volumes. These issues are exacerbated in an emergency or evacuation scenario when the roads become impassable.
- **Sea Level Rise:** One foot of sea level rise will result in regular tidal inundation of every street in Tuckerton Beach. Three feet of sea level rise will result in regular tidal inundation of all of Tuckerton Beach and areas bordering Tuckerton Creek.
- **Tidal Surge:** As much of Tuckerton Borough is at or near current sea level, tidal surge equivalent to a Category 1 hurricane will produce flooding on a similar scale to Sandy, with surge impacts increasing with more severe storms.
- **Natural Hazards:** The County All-Hazard Master Plan determined that Tuckerton was at risk for Coastal Erosion, Flood, Flash Flood, Ice Jam; Hurricane, Tropical Storm, Nor'easter; and Climate Change hazards.
- **Water Quality:** Development has caused significant environmental impacts including loss of natural lands and vegetation that absorb stormwater. Parts of Tuckerton are also

experiencing noticeable effects from excessive water withdrawals, threatening plant and animal habitats, potable water supplies and saltwater intrusion.

However, there are other areas, where the Borough is on solid footing and there is opportunity to integrate best practices for disaster recovery and resiliency with community stability and future growth, including the following:

- **Economic development**: Tuckerton has developed a recovery-focused economic development plan that draws upon existing community assets and mitigates against the damage caused by Hurricane Sandy and other future storm events.
- **Wastewater infrastructure**: The availability of wastewater infrastructure and facilities is sufficient to meet current and projected future needs.
- **Open Space**: the Master Plan provides for multiple opportunities to use land use regulations to guard against future storm events including identification of key parcels to acquire for flood protection, using the Zoning Code to promote sustainable development; promoting the use of native species in landscaping; incorporating sustainable storm water management practices into new design standards; and securing conservation easements for environmentally sensitive lands.

Members of the Sustainable and Resilient Coastal Communities project team will use the results of this analysis to identify critical issues these towns must address in order to respond to likely future coastal flood hazards. Additional next steps include evaluation of future growth projections based on analyses from New Jersey Future and Water Quality Management Plans and evaluation of future sea-level rise and storm surge impacts on land-based features and shoreline conditions. The overall goal is to influence changes to the methodology of identifying CAFRA centers.

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES PROGRAM

TOMS RIVER TOWNSHIP

DATA REVIEW SUMMARY

BACKGROUND

In 2015, the New Jersey Department of Environmental Protection (NJDEP) awarded a grant to New Jersey Future to support the development of a Sustainable and Resilient Coastal Communities (SRCC) Planning Program. The goal of this program is to develop a comprehensive land use planning strategy for Toms River Township in Monmouth County and Little Egg Harbor Township and Tuckerton Borough, in Ocean County, that can serve as a model for use by coastal communities throughout New Jersey to shape long-term growth and development patterns.

The strategy will explicitly consider the risks of coastal hazards and projected sea-level rise, in order to achieve resilient community design. This model will also serve as the basis to recommend revisions to the Coastal Zone Management Rules to ensure that development that is approved in accordance with these rules is more resilient to coastal hazards.

PURPOSE

The purpose of this Data Review Summary is to provide a review of existing data and reports in order to prepare the assessment of vulnerability and recommendations for future hazard mitigation. A comprehensive list of documents reviewed for the Toms River Data Review Summary is provided below.

Documents Consulted for SRCC Data Review Summary – Toms River Township

- Strategic Recovery Planning Report (2014)
- Getting to Resilience Report (2015)
- Ocean County Hazard Mitigation Plan (2015)
- Ortley Beach Neighborhood Plan (2016)
- Toms River Municipal Public Access Plan (Draft 2015)
- FEMA Repetitive Loss Analysis report (2011)
- Toms River Municipal Master Plan (updated through May 2009)
- Ocean County Long-term Community Recovery Plan (2015)
- Ocean County Wastewater Management Plan (2015)
- Toms River Floodplain Management Ordinance
- Ocean County Cross-Acceptance Report (2004)

In addition to the above studies, spatial and non-spatial data were used to explore and identify potential critical issues. These data include:

Data Consulted for SRCC Data Review Summary – Toms River Township

- Effective FIRM (FEMA)
- Preliminary FIRM (FEMA)
- Hurricane Sandy Fund Tracker (State of NJ)
- NFIP claims, aggregate (FEMA)
- USGS Highwater Marks
- NOAA SLOSH MOMS
- Township of Toms River Zoning
- Ocean County Sewer Service Area
- US Census Data
- Evacuation Routes (NJDEP)
- Critical Facilities (NJDEP)

The Township of Toms River is currently updating several plans and studies at the municipal level. The reports listed below have not been reviewed to date. Some of these plans will inform the planning process as this project proceeds.

Data Gaps for SRCC Data Review Summary – Toms River Township

- Community Vulnerability Assessment
- Resilient Capital Improvement Plan
- Municipal Hazard Mitigation Plan
- Environmental Resource Inventory
- Master Plan Reexamination
- Downtown Redevelopment Plan

REVIEW OF PAST PLANS AND STUDIES

MUNICIPAL OVERVIEW

Formally known as Dover Township, the Township of Toms River is located in Ocean County and consists of approximately 41.62 square miles of area. It is the second oldest, and the second most populated municipality in the County. According to the 2010 U.S. Census, Toms River had a population of 91,239 residents. This number increased slightly to 91,664 according to 2014 ACS Estimates. In addition, the 2010 U.S. Census identified a total of 43,334 housing units in the Township, of which 8,574 (or 19.8%) were vacant. Of these vacant units, 6,974 (or 81.3%) were seasonal vacancies.

Toms River is unique in that its land is split between the mainland and the barrier island. The Township is comprised of eight neighborhoods. Toms River, East Dover, West Dover, North Dover, Pleasant Plains, Silverton, Ortley Beach and Dover Beaches North (which includes Chadwick Beach, Ocean Beach, and Normandy Beach). Ortley Beach and Dover Beaches North are located on the barrier island and are separated by the Borough of Lavallette. Approximately 3 miles of land has ocean frontage and 31 miles of land is adjacent to the bay.

CAFRA/ CROSS ACCEPTANCE

Almost the entire land area of the Borough is located within the boundaries of the Coastal Area Facility Review Act or CAFRA zone. There is approximately 14 acres of the Township within the Pinelands Region in the Northwesterly corner of the Township. The Township has three Coastal Centers, Toms River Coastal Regional Center, the Normandy Beach/Chadwick Coastal Town, and the Ortley Beach Coastal Town. All three centers, which is the entire coverage of the planning area on the barrier island includes about 13,700 acres. All of this area is considered to be Coastal Environmentally Sensitive Planning Area. There is an additional 3,642 acres of Environmentally Sensitive Planning Area on the mainland. There is also Coastal Fringe Planning Area in the northern border of the Township (41.79 acres) and two sections of land designated as Coastal Park (30.53 acres). The remaining area of the Township is considered Coastal Suburban Planning Area (4,563.41 acres).

CENTER DESIGNATION

The Toms River Coastal Regional Center was designated in part because of Toms River's position as the County Seat, its effort to revitalize the downtown, and to accommodate the significant development that had already occurred within the municipality. The Regional Center designation allows for 80 percent impervious surface coverage, compared to other areas of the Suburban Planning Area within the Sewer Service Area that is allowed 30 percent coverage, or 5 percent outside of the sewer service areas. The Center designation remains a key concern for the Township as they have a strong interest in maintaining the reduction in impervious surface requirements.

The designation of the barrier island as both Environmentally Sensitive Areas, but also Coastal Towns is indicative of the challenge barrier island communities face. These areas are highly sensitive environments, but as reflected in the 2004 Ocean County Cross-Acceptance Report, most are highly developed and do not fit the P5 category.

LAND USE

Toms River has an established land use pattern that has resulted from significant development between 1950 and 1980. Largely suburban in character, the Township has areas of denser development along the northern border and on the barrier island. Commercial development is largely concentrated to Downtown Toms River and along major roadway corridors.

Other plans and planning documents build upon these documents to provide further guidance to the municipality on how to direct future land uses to achieve a balance between the needs of current and future residents, economic development and environmental conservation. Recommendations of the Comprehensive Master Plan, Master Plan Re-Examination Report and other relevant planning documents are discussed here by land use type.

RESIDENTIAL USES

According to the 2010 U.S. Census, there were a total of 43,334 housing units in Toms River. This does not reflect the homes that have been demolished or abandoned since Hurricane Sandy. The 2014 American Community Survey estimates the total housing units in Toms River to be 43,081. According to the Master Plan, approximately 50 percent of the developed land within the Township is used for

residential lots. The majority of houses in the Borough are single-family detached homes, with small pockets of multi-family dwelling units.

According to the 2014 "Getting to Resilience" report, approximately 3,000-4,000 residences in the Township are secondary homes. These homeowners are not eligible for certain types of funding from FEMA. However, these homes are eligible for flood insurance policies, even if it is not required.

One notable statistic for Toms River is the number of homes that do not carry a loan. Almost 24 percent of housing units are owned by the homeowner and would therefore not carry a mandated flood insurance policy.

COMMERCIAL USES

The Township of Toms River has concentrated commercial development along Route 37, Route 9, Fischer Boulevard, Hooper Avenue, and in Downtown Toms River. Commercial uses on the barrier island are geared towards small scale tourist businesses. There is significant emphasis in the Master Plan on improving commercial viability in the downtown area.

It is unclear from the studies reviewed how much contribution commercial zones have to the waterfront ratables in the Township. According to the Strategic Recovery Planning Report, only 30 of the properties that were substantially damaged were commercial and 1 was industrial.

OPEN SPACE USES

As part of the Master Plan update, the Township is also updating its Open Space Management Plan and Natural Resource Inventory. In the absence of these two recent studies, information from the Wastewater Management Plan, GIS data obtained from NJDEP, and the municipal Master Plan were reviewed to understand the type and extent of open space uses within the Township.

Toms River has preserved farmland within the Township. There is a 7.3-acre farm on Silverton Road that has been preserved. There are no Natural Heritage Priority Sites within the Township. table of environmental features in the Borough is provided below.

Table 2: Environmental Resource Areas in Tuckerton Borough

Environmental Feature	Acreage	Land Use (%)
Wetlands	3,768.94	11.18
Public Open Space/Recreational Areas	1,064.62	3.16
Habitat Threatened and Endangered	4,105.78	12.17
Natural Heritage Priority Sites	0	0
Riparian Zones	974.82	2.89
Preserved Agriculture	7.48	.02
Surface Water	7,764.80	23.02

As noted in the Master Plan promotes the continual acquisition of open space, but does not outline any goals or policy objectives by which to achieve this. The Master Plan does suggest Transfer of Development Rights or a similar zoning mechanism to steer development away from environmentally sensitive areas.

The Toms River Zoning Code provides a set of land use regulations governing where and how land can be developed and used throughout the municipality.

Toms River is divided into 44 zoning districts, which are shown in the table below. This data is from the Toms River Zoning GIS data layer.

Table 3: Zoning Districts and Area in Toms River

Zone	Description	Area (Acres)	Percent of total
DS	Downtown Service Zone	18.60	0.07
EMF-10	Existing Multi-Family Zone	33.12	0.13
EMF-18	Existing Multi-Family Zone	83.49	0.32
GB	General Business Zone	79.01	0.30
HB	Highway Business Zone	1041.76	3.97
HMS	Hospital-Medical Service Zone	87.38	0.33
I	Industrial Zone	1389.52	5.30
LI	Light Industrial Zone	44.11	0.17
MF-10	Multi-Family Zone	13.24	0.05
MF-10-AH	Multi-Family-Affordable Housing Zone	45.83	0.17
MF-12-AH	Multi-Family-Affordable Housing Zone	21.42	0.08
MF-16	Multi-Family Zone	75.09	0.29
MF-4	Multi-Family Zone	61.03	0.23
MF-6	Multi-Family Zone	364.47	1.39
MF-8	Multi-Family Zone	257.86	0.98
MHP	Mobile Home Park	199.32	0.76
O-10	Office Zone	251.14	0.96
O-10C	Office Zone	14.43	0.06
O-15	Office Zone	87.80	0.33
OS-SWM	Open Space/Storm Water Management	7.78	0.03
PRC	Planned Retirement Community Zone	534.89	2.04
PRC-3	Planned Retirement Community Zone	402.28	1.53
PRC-4	Planned Retirement Community Zone	305.67	1.17
R-100	Residential Zone	351.06	1.34
R-120	Residential Zone	1331.91	5.08
R-150	Residential Zone	1612.02	6.15
R-200	Residential Zone	1147.85	4.38
R-400	Residential Zone	899.38	3.43
R-400C	Conservation Residential Zone	2469.84	9.42
R-40A	Residential Zone	173.82	0.66
R-40B	Residential Zone	544.49	2.08
R-50	Residential Zone	817.90	3.12
R-75	Residential Zone	2092.34	7.98
R-800	Residential Zone	370.64	1.41

Zone	Description	Area (Acres)	Percent of total
R-90	Residential Zone	2492.84	9.51
R/C-3	Conservation/Residential Zone	1546.12	5.90
RC	Regional Commercial Zone	304.16	1.16
RHB	Rural Highway Business	1244.08	4.75
RURAL	Residential Zone	2965.44	11.31
SC-AH-1	Senior Citizen Affordable Housing-1 Zone	12.03	0.05
SC-AH-2	Senior Citizen Affordable Housing-2 Zone	17.09	0.07
VB	Village Business Zone	122.48	0.47
VO	Village Office Zone	232.66	0.89
VS	Village Seaport Zone	49.97	0.19

ECONOMIC DEVELOPMENT

The Toms River Master Plan included an Economic Element. Given the critical implications of CAFRA and Coastal Zone Management Rules on economic development, it seemed important to identify the key findings, goals, and recommendations from this element. The key findings from the Element cite the North Jersey Transportation Authority population project of 112,720 by the year 2030. This element emphasized the large senior population within the Township. This element also highlighted that the majority of the housing was built before 1980. These homes would therefore be pre-FIRM. The Economic Development Element also noted that a major weakness to the Township's economy is the lack of public transportation options within the Township.

Core goals outlined include: to create jobs and activities for the Township's large senior population. Promote core retail destinations, create employment within the municipality for residents, and encourage new businesses to establish in the Township.

Recommendations:

1. Create Business Improvement Districts
2. Capitalize on existing economic clusters such as medical/healthcare, higher education, cultural/entertainment/tourist attractions, and government services.
3. Encourage mixed use centers, additional restaurants, and commercial development along major roadway corridors
4. Support the expansion of existing industrial park
5. Improve access to beaches and other waterfront areas, improve trail amenities.
6. Improve public transportation
7. Develop better highway access to Garden State Parkway

TRANSPORTATION AND CIRCULATION

The Municipal Master Plan (2006) contains a Circulation Element which describes the Borough's transportation infrastructure in detail and identifies critical issues and recommendations for meeting

the current and future needs related to circulation. Toms River is a part of a critical regional road network that connects several coastal communities, including the barrier island.

Freeways: Garden State Parkway

Principal Arterial Highways: Route 37, Route 166

Minor Arterial Highways: Main Street between Highland Parkway and Water Street, Hooper Avenue South of Route 37, and Washington Street east of Hooper Avenue

Minor Collector Streets: Water Street east of Hooper Avenue

The Master Plan illustrated traffic congestion as a critical issue for downtown Toms River, largely because of constricted passage across the Toms River via a single bridge.

Additionally, the Township has concerns about circulation with respect to evacuations and access. After Sandy, Toms River was the only access point to the barrier island. It is unknown at this time how many roads may be subject to inundation from sea level rise or storm surge.

Circulation Plan Recommendations:

1. Reestablish convenient, safe, and comfortable pedestrian connections through the downtown, which particular emphasis that link downtown to the Riverfront.
2. Capitalize on the full potential of the bypass bridge project to reduce traffic pressure and enhance connectivity.
3. Enhance use of remote parking resources.

GTR Recommendations:

1. Evaluate which roadways may be vulnerable to flooding during coastal events and high water

WATER SUPPLY

There are 24 water supply wells serving Tom River. The majority of the system is owned and operated by United Water Toms River. These wells access the Kirkwood-Cohansey Aquifer, the Piney Point Aquifer, and the Potomac-Raritan-Majothy Aquifer. The northern section of the barrier island is serviced by New Jersey American Water Company, which also uses groundwater for its water supply in this section of its supply system. There are also private wells within the Township, according to the Municipal Master Plan. It was not articulated how many homeowners rely on personal or community water systems.

The County Water Quality Management Plan (WQMP) determined that current infrastructure capacity for supplying public water is presently capable of providing potable water to the Township's residents in excess of daily, monthly, and yearly demands, and will continue to prove sufficient in the foreseeable future.

There was no mention of saltwater intrusion or aquifer depletion in the (WQMP), but this was mentioned in the Township Master Plan. It was highlighted as a significant concern for the Township with respect to overdrawing the aquifers, not the potential for increased intrusion due to rising sea levels.

WASTEWATER FACILITIES

All existing development in the Township is connected to the existing separated sewer system. The Townships Municipal Utility Authority manages wastewater collection throughout the Township. The wastewater system is connected to Ocean County Utility Authority in Berkeley Township. There are 810.14 acres of developable land within the sewer service area. The Township has not expanded this area since adoption, though some small undeveloped parcels have been removed from the adopted sewer service area.

Future wastewater flows were determined by applying 75 gallons per day per person to the permanent year round population increase over the next twenty years consistent with municipal population projections prepared by the NJTPA. This equates to a 1.453 MGD increase in wastewater flow being directed to OCUA's SWPCF**.** Although it results in a 14 percent increase, the County found this as not an overly significant amount of additional flow, and determined that it will not have a significant impact on the SWPCF.

PUBLIC ACCESS PLAN

In 2015 Toms River also completed the draft of the Township's Public Access Plan, which was posted for public comment by NJDEP. The Township identified 245 existing and proposed Township Public Access locations. These include parcels or street ends that are utilized for drainage, fire lots, fire lanes, and fire hydrants (which are all considered visual access only). Physical locations include sites that the allow the public to participate in active or passive recreation on site. Of the 243 identified existing public access locations, 119 of these sites are considered "visual-only" sites with limited improvements. The remaining 136 sites were identified as physical locations, 52 of which provide access to the Atlantic Ocean. However, Ortley Beach is the only section of Toms River with publically-owned beach access. The North Beaches of Toms River permit access only through private beach club associations.

Public Access Plan Priorities:

4. Maintain existing public access
5. Adding a boat ramp for motorized boats to an existing park on Jackson Road
6. Adding a bicycle/pedestrian path connecting Water Street to Robbins Parkway, Huddy Park, and Downtown Toms River

POST-SANDY RECOVERY

Toms River was one of the most affected municipalities in the State by Hurricane Sandy. There are several reports and studies that have looked at the impact of Sandy and the Township's vulnerability and risk for future storm events. These include the Strategic Recovery Planning Report, the Ocean County Long-term Recovery Plan, the ongoing Community Vulnerability Assessment, and the Getting to Resilience process.

The SRPR reports that Sandy damaged approximately 4,000 homes on the mainland and 6,500 homes on the barrier island. The SRPR went into great detail about the specific damage to residences, specifically on Ortley Beach and the lagoon communities, from Sandy. The SRPR did emphasize the inadequacy of

the drainage infrastructure to deal with lunar high tides and storm events in low lying areas. This report also noted the importance of engineering dune protection for the barrier island.

Determining the actions to mitigate risk and improve recovery are not guarantees to recover though. The Ocean County Long-term Recovery Plan highlights potential recovery threats including economic climate, funding shortages, and ongoing flood risk.

The Township did reassessments immediately following the storm, given the significant level of damage and the number of homeowners impacted. This resulted in a severe loss in revenue for Township as property values depreciated. The Township has continued to place critical emphasis on the importance of rebuilding to the vitality of the municipality. The Township has leveraged numerous aid programs in order to perform recovery operations and assist homeowners in rebuilding to the appropriate standards.

GETTING TO RESILIENCE

In 2015 Toms River completed the Getting to Resilience (GTR) process, developed by the NJDEP and adapted and enhanced by the Jacques Cousteau National Estuarine Research Reserve (JCNERR).

This plan made recommendations for the Township based on municipal response to the questionnaire. Many of the recommendations reflect consistent policy recommendations that are being suggested to all coastal communities, such as integrating coastal hazards into long-term planning and restoring acquired lands to natural lands with active flood storage capacity. The GTR report highlighted the Township's vulnerable low lying areas, including the barrier island. Ortley Beach is regarded to be one of, if not the most, severely impacted oceanfront community in the State.

Disaster Resiliency Recommendations:

- Improve outreach programming for residents including flood related information on the Township webpage and a coastal flooding disclosure policy.
- Use sea level rise and storm surge data to identify roadways at risk to sea level rise.
- Restore acquired properties to improve flood storage (TR has not and does not plan on acquiring properties).
- Consider rezoning upland properties to accommodate growth and shift away from high risk areas.
- Consider creating erosion protection programs or instituting higher regulations for buildings in area subject to coastal erosion.
- Make the commitment to maintain the dune system post-replenishment and bolster it with additional plantings.
- Consider partnering for opportunities to create living shoreline projects.

- Begin long-term planning process to prepare for sea level rise.
- Incorporate future risk and coastal hazard in the 2016 Master Plan Update.

HAZARD MITIGATION

Toms River is currently undergoing a municipal hazard mitigation plan that will reflect more detailed risk assessments and mitigation strategies than was able to be performed at the County level. The Township also participated in the Ocean County Multi-Jurisdictional All Hazard Mitigation Plan in 2014. The All-Hazard Mitigation Plan identified that Toms River is at risk for Coastal Erosion, Flood, Flash Flood, Hurricane, Tropical Storm, Nor'easter, Sea Level Rise, and Wildfire.

The most significant hazard facing Toms River is coastal flooding associated with hurricanes, tropical storms, nor'easters, storm surge, and sea level rise. According to the Hazard Mitigation Plan, Toms River Borough has 18,744 or approximately 34.23% of its parcels in the Special Flood Hazard Area, including nine critical facilities.

As part of the Hazard Mitigation Planning Process, the Township outlined mitigation strategies, which are listed below.

Hazard Mitigation Actions:

- Floodproof 4 facilities for the Toms River Municipal Utilities Authority.
- Elevate 2,819 homes that will mitigate impact of flood related hazards while maintaining residents in community.
- Provide generators for Toms River Regional Schools.
- Continue to participate in the NFIP to support pro-active floodplain management that will protect property from flood related hazards, clearly inform property owners about the risks of being in and near the SFHA, and promote flood insurance.
- Continue to enforce building codes to require building, renovations, and re-building meets or exceeds the Uniform Construction Code thus protecting homes from risk related to hazards including flooding, fire, wind, earthquake, and winter storm.
- Update zoning code to allow homeowners to rebuild on existing footprint without a variance as long as new design matches square feet and number of stories.
- Obtain all necessary easements to permit building of the USACE dune.

Shoreline Assessment

Shoreline Strategic Plan

Borough of Tuckerton and Township of Little Egg Harbor, Ocean County, NJ



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Contents

Introduction

The Township of Little Egg Harbor and the Borough of Tuckerton are bayfront communities located in Ocean County, New Jersey. Both communities have a rich maritime history and culture that depends on the 294 miles of shoreline within their jurisdictional boundaries. In 2012, when Sandy descended on New Jersey, both communities experienced record flooding and damage. Marinas were destroyed, houses were knocked off their foundations, and millions of dollars of infrastructure was damaged. Since Sandy, Little Egg and Tuckerton have been working to identify and understand their risk and vulnerability to future storm events and rising sea levels. As part of this effort, both towns and New Jersey Future were awarded a grant by the New Jersey Department of Environmental Protection (NJDEP) to develop a shoreline inventory and a shoreline strategic plan. This grant is part of a larger project, the Sustainable and Resilient Coastal Communities grant program administered by the NJDEP through funding provided by the United States Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA), to evaluate strategies to enhance the resiliency and sustainability of coastal communities within the state.

This shoreline assessment uses Geospatial Information System (GIS) data, as well as data collected through field visits to detail the existing shoreline types and conditions along the tidal waters within both municipalities. The assessment analyzes the vulnerability of the shoreline to coastal erosion, as well as rising seas and coastal storms. The study area for this assessment includes 294 miles of shoreline within the jurisdictional boundaries of both municipalities, as shown in Figure 1. It includes the mainland, the banks of all creeks up to the head of tide, the bay islands, and the salt marsh complexes within the bays.

Figure 1. The Study Area in the Township of Little Egg Harbor and Borough of Tuckerton includes 294 miles of shoreline.

Understanding the existing conditions, future vulnerability, and historic changes that have occurred along the shoreline is an important step to addressing critical issues facing the towns. This report and the data created through this analysis will inform strategies to stabilize and restore vital defenses against short-, medium-, and long-term risks to the shorelines of Tuckerton Borough and Little Egg Harbor Township. Several general recommendations and strategies are included in this report to help minimize future risk to natural and community resources within the study area.

Community Profile

The Borough of Tuckerton sits on the western shore of Little Egg Harbor, and is entirely within the Barnegat Bay Watershed (Figure 1). The Borough encompasses 3.8 square miles, with 36 miles of shoreline along tidal waterways. The Borough was incorporated from portions of Little Egg Harbor Township in 1901, though it was first settled in 1868. According to the US Census Bureau, in 1930 the Borough of Tuckerton had a population of 1,429 in 407 households. In 2010 the census estimated the year-round population in the town had grown to 3,347 persons. In addition to the year-round population, the 2010 census estimated there are 382 seasonal properties within the town.

The Township of Little Egg Harbor, which covers approximately 73 square miles, with 258 miles of shoreline, surrounds Tuckerton on non-bayfront boundaries (Figure 1). Just over 35 percent of this area is covered by water, leaving over 47 square miles of land. Township stormwater drains to Little Egg Harbor and Great Bay, which are part of the Mullica River watershed. The 2010 census estimated that 20,065 people called Little Egg Harbor their year-round residence. Also, approximately 1,701 seasonal dwellings are located within township boundaries. In 1930, the census registered just 547 residents within the township. The largest percent growth within a single decade occurred between 1960 and 1970, during the development of the lagoon communities of Mystic Island and Osborn Island. The population was estimated at 847 in 1960 and 2,972 in 1970. By 1990 the population had grown to 13,333.

Shoreline History

As the population has changed, so has the landscape. Aerial imagery from 1930 reveals that the study area was predominately wetlands, with a few homesteads. Major roads in the area, including Green Street and Great Bay Boulevard, are visible in the photos. Around the 1950s developers started to connect existing islands in Great Bay and Barnegat Bay and create lagoon communities to increase home ownership and accessibility along the shoreline. This was

Figure 2. 1930s aerial imagery of the study area.

accomplished by removing vegetation and sediment from rectangular stretches of marsh to create navigable channels and then filling the adjacent marsh to create buildable land.

Several communities within the study area were built in this fashion (Figure 3). In Tuckerton, lagoons were created to establish Tuckerton Beach, as well as lagoons off of Tuckerton Creek and Thompson Creek. In Little Egg Harbor, the communities of Mystic Island and Osborn Island, as well as neighborhoods off of Great Bay Boulevard, were created using this approach. Construction for Mystic Island began before 1956. The property tax data for these neighborhoods indicates that a number of the roads and homes were built between 1962 and the early 1970s.

The practice of developing the lagoon communities stopped with the passage of the State of New Jersey's Wetlands Act of 1970. There is still evidence of lagoons that were started, but not finished within both towns. This can be seen in the aerial imagery of lagoons that were never built upon, as well as the tax maps where paper streets cut through existing marshland. Within the study area, this process created approximately 61 additional miles of shoreline along the coast, allowing approximately 3,689 homes to be built adjacent to lagoons.

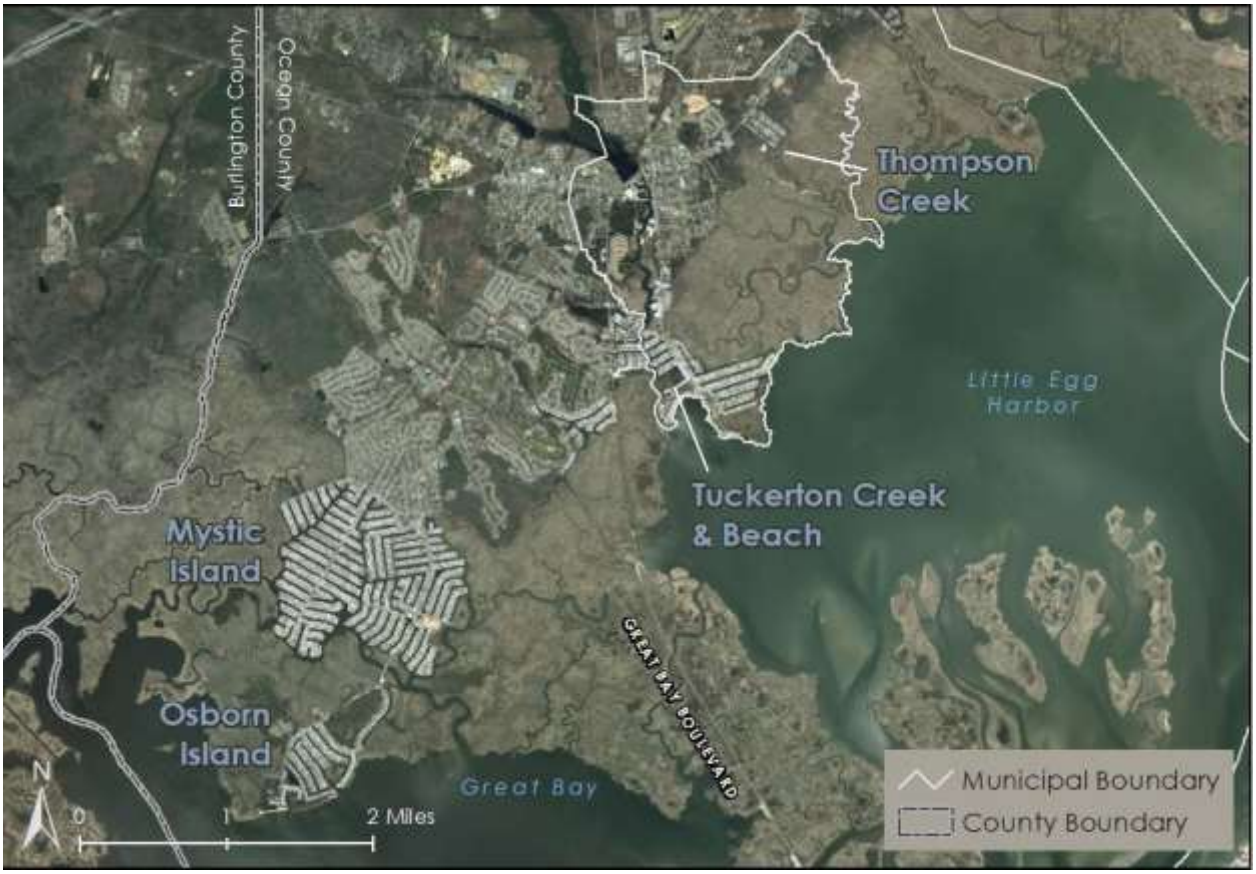

Figure 3. The creation of lagoon communities depicted above created an additional 61 miles of shoreline and developable land for approximately 3,689 homes.

Marsh conversion resulted in the loss of 1,200 acres of wetlands. Wetlands provide numerous ecosystem services that benefit the adjacent and regional communities, both ecological as well as human. These benefits include: protection from wave energy and storm surges; habitat for birds and aquatic life; and the storage of nutrients and pollutants, including carbon. Nationally, salt marshes are estimated to

provide $780- $15,000 per acre in water purification benefits each year.[1] Because the value of ecosystem services is difficult to quantify, this estimate does not include the cost of damages avoided from wave dissipation, or the benefits that marshes provide to national fisheries and food supply systems.

In addition to wetland loss due to marsh conversion, hundreds of acres of marshes were ditched for mosquito control and salt hay harvesting. In the 1930s the Ocean County Mosquito Extermination Commission leveraged the assistance of various relief labor including the Works Progress Association and Civilian Conservation Corps to produce over 1,600 miles of drainage ditches by 1936. It is not clear how much of that ditching occurred within the study area by 1936, but a 1930 aerial photograph indicates that ditching was already a well-established practice in this area. The 1950 aerial indicates that ditching had occurred in areas adjacent to existing or anticipated development. Over time scientists came to understand that this practice was ineffective as a mosquito control measure because it eliminates or degrades the habitat for species that eat mosquitos. Furthermore, it is understood now that the practice of ditching changes the hydrology of the wetland, which compromises its capacity to self-sustain. Ditching can compromise the health of a marsh and cause it to degrade. For these reasons, wetland ditching has since been discouraged through regulation and the development of alternative management practices.

Shoreline Assessment

Background and Methodology

The purpose of a shoreline assessment is to detail and evaluate the integrity of shoreline features in terms of potential for erosion, and vulnerability to rising seas and coastal storm events. The specific objectives of this assessment are to evaluate change in the shoreline between 1930 and 2015, estimate the change in wetlands during that timeframe, evaluate the current elevation and health of tidal wetlands within the study area, identify the location and integrity of shoreline features along the coastline, and evaluate the vulnerability of these features to future conditions. This assessment combines GIS data in a desktop analysis with survey and observational data collected from field visits. This assessment informs the recommended risk management strategies included in this report.

One of the key aspects of this shoreline assessment is determining what natural and engineered features comprise the shoreline within the study area, and evaluating their condition and capacity to withstand predicted future changes.

The first step in creating an inventory of the shoreline was to assess historic conditions over time. This was accomplished by digitizing the shoreline using aerial imagery from 1930, 1956, 1972, and 2012. Once the shorelines were digitized, shoreline change over time was analyzed using the United States Geologic Survey's (USGS) Digital Shoreline Analysis System (DSAS). DSAS computed the distance and rate of shoreline change.

[1] http://www.nbep.org/journals/2014-nov/Special%20Edition_Salt%20Marshes%20and%20Sea%20Level%20Rise.pdf

In addition to shoreline change, this assessment examined tidal wetland loss within the two bays. Wetland loss was characterized by change in wetland extent between 1930 and 2015, using the Land Use/Land Cover dataset and 2015 aerial imagery. The final steps in the shoreline assessment were evaluating the typology of the shoreline, the condition of each shoreline type, and its vulnerability to erosion. This assessment was based on existing National Oceanic and Atmospheric Administration's (NOAA) data and refined using 2012 Land Use/Land Cover data created by NJDEP and aerial imagery from 2015.

Shoreline Movement and Change

In addition to the changes in characterization, shorelines shift in alignment and geographic position. Waves wash over the land and deposit sediment, and pull sand or sediment as they retreat. This occurs during normal tide cycles, as well as storm events, and results in shifting coastal landmasses, such as barrier islands and marshes, over time. The rate of these changes varies dramatically by site due to a variety of factors including wave heights, wind exposure, watershed size and geomorphology, and the ecology of the surrounding area. This change can also be accelerated or altered through land management practices and human influences. In areas that have been developed, efforts are made frequently to minimize changes in the shoreline by "armoring" the land to withstand wave effects. In addition to the changes that occur from naturally erosive processes, change along the shoreline can also be attributed to draining and filling tidal marshes.

This assessment uses digital imagery to evaluate migration and changes attributed to accretion, erosion, and subsidence, including changes within the tidal wetlands. This assessment also estimates changes to the location and position of the shoreline due to development. Imagery from the 1930, 1956, 1972, and 2012 were digitized to estimate the approximate distance that the shoreline has moved between 1930 and 2012. It is important to note that these images are not time-stamped, therefore, some of the calculation may incorporate fluctuations in tide, as well as migration. For the purposes of this assessment, DSAS was used to analyze the distance and rate of shoreline change between 1930 and 2012.

Shoreline Migration

As seen in Figures 4 and 5, shoreline changes have occurred within the study area since 1930. Each line represents a digitized shoreline from 1930, 1956, 1972 and 2012. In areas that experienced erosion or development, the shoreline migrated westward, or landward, between 1930 and 2012. In areas that experienced accretion, the shoreline moved east, or seaward. Between 1930 and 2012 the greatest landward migration of the shoreline occurred at the southern tip of the peninsula that separates Great Bay from Little Egg Harbor, shifting over 400 meters landward in some locations (Figure 4).

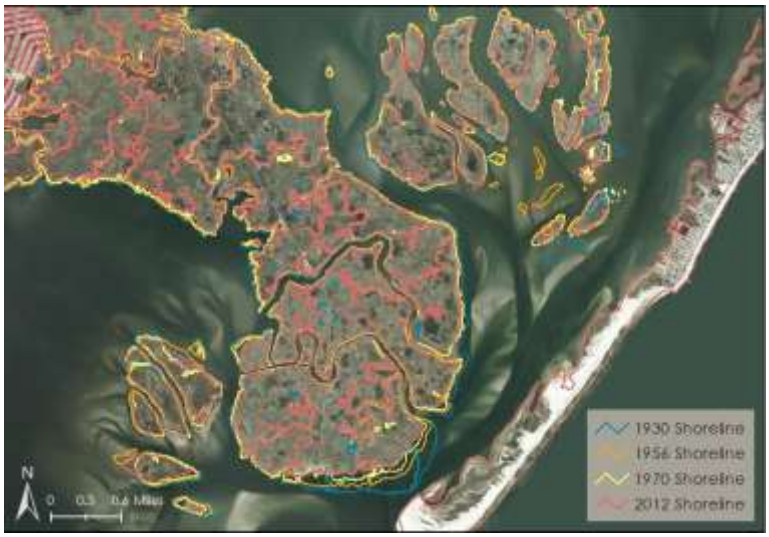

Figure 4. Shoreline migration was measured from 1930 through 2012. The southern tip of the peninsula experienced the greatest landward migration in the study area.

On average, shorelines within the study area migrated approximately 43 meters (approximately 141 feet) landward between 1930 and 2012, a rate of 0.5 meters per year. This rate was calculated on areas where the shoreline was unarmored in both 1930 and 2012. Though the rate is an average, some areas of the shoreline retreated more quickly than others.

Figure 5. Shoreline migration depicted around Tuckerton Beach and vicinity. Since 1930 there is a general trend of landward movement of the shoreline and expansion of creeks.

Shoreline Characterization

This analysis was performed by refining the NOAA Environmental Sensitivity Index (ESI) dataset for the entire study area. ESI data were created by NOAA to identify coastal habitats that may be vulnerable to off-shore and near-shore chemical spills. The ESI classifies features, including man-made and natural features, along the shoreline into categories based on feature/habitat type and vegetation. These data provided an initial characterization of the shoreline within the study area. For the purposes of this study these classifications were modified to fit the categories listed below.

In addition to refining the categories, this assessment refined the shoreline created by the ESI. The ESI was created using data that are coarser than what are available within the study area. For this reason, the ESI dataset was refined using the 2012 shoreline digitized for this project. This allows the assessment to reflect the most accurate data available throughout the study area, as seen in Figure 6.

Landward Classes	*Total Miles within Study Area*
Emergent Wetlands; Not Ditch Influenced	135.5
Emergent Wetlands; Ditch Influenced	94.3
Bulkhead	55.1
Beach	3.8
Scrub/Shrub Upland	3.0
Disturbed/Roadside Vegetation	1.0
Unarmored Lawn	0.7
Boat Ramp	0.1
Rip-Rap; Exposed	0.1
Rip-Rap; Sheltered	0.1

Table 1: Miles of Shoreline by Landward Type

Figure 6. Shoreline characterization categories depicted around Tuckerton Beach and vicinity.

Beach/Unarmored Shoreline

The first type of shoreline classified includes beach, unarmored lawn, disturbed/roadside vegetation, and scrub/shrub upland. These types of shoreline are vulnerable to change and erosion, from both storms and daily wave action. A small percentage of the study area shoreline is comprised of these categories; however, field observations noted signs of erosion in the areas visited.

Areas classified as beach, a collection of shoreline segments throughout the study area, encompass 3.8 miles of sandy shoreline that may, or may not, have some vegetation. These areas are not necessarily bathing or public access beaches, which are limited to small areas within both municipalities. About 40 parcels have been classified as having an "unarmored lawn" along part or the entire parcel boundary. All of these properties are within the developed area, though not all of the parcels at the time of this assessment, have a structure. Although there are only 40 parcels, it is difficult to determine the risk to surrounding parcels.

Disturbed/roadside vegetation frequently refers to what separates the road from the watercourse and does not have an existing bulkhead. Though this classification occurs in both municipalities, it is common along Twin Lakes Boulevard on Mystic Island. Land adjacent to roadways that is vulnerable to erosion should be a particular concern to governments responsible for long-term maintenance and the implications of evacuations or emergency access if the roadway were to fail. The remaining unarmored shoreline, not classified as wetlands, is considered to be "scrub/shrub upland". These are vegetated areas that are not tidal marsh, but may experience degradation and erosion along banks similar to wetland areas. There is approximately three miles of this shoreline type within the study area, and it is concentrated along undeveloped parcels within the developed area of both municipalities.

Armored Areas

Another type of shoreline that was classified for this assessment is hardened structures including bulkheads and revetments. Approximately 19 percent of the shoreline has been armored on the landward side. The majority of parcels adjacent to the shoreline that have a structure have been engineered with a bulkhead or revetment. Of the parcels adjacent to the shore with a building, 99 percent have a bulkhead. An additional 0.07 percent of parcels have riprap revetments.

Bulkheads provide protection against erosion due to tidal conditions and storm surge. Bulkheads that are built at-grade do not provide any protection for the property against wave action that overtops them. They also cannot protect the property from subsidence.

As part of the assessment, a field visit was conducted to evaluate the condition, elevations, and integrity of bulkheads within the study area. However, the majority of bulkheads within the study area is located on private property, is privately owned, and was not directly inspected for this assessment. Given the layout of the communities within the study area, many of the bulkheads could be observed from the rights-of-way throughout the study area. In general, the bulkheads in this area are constructed of wood, metal, or vinyl. Numerous bulkheads appeared to have been replaced within the last 10 years, though it was not possible to determine the reason for their replacement. There was some evidence of failing bulkheads and potentially vulnerable bulkheads that may result in the transference of risk.

There are also bulkheads that protect main thoroughfares through both municipalities including the neighborhoods on Mystic Island and Osborn Island. Some bulkheads have failed and have not yet been replaced, leaving these stretches of road vulnerable to future erosion.

Wetlands

There are an estimated 8,785 acres of tidal wetlands within the study area, based on the 2012 land use/land cover data and 2015 aerial image interpretation. The wetland complexes in this area offer protection against coastal storms, wave action, and erosion. They provide additional habitat and water quality benefits. Approximately 78 percent of the shoreline has wetlands on the landward side.

For this assessment, wetlands were further characterized as either "ditch-influenced" or "not ditch-influenced" based on proximity to mosquito ditches. Wetlands sharing a landmass with, and within 100 meters to a ditching feature were classified as ditch-influenced. Approximately 32 percent of the wetland shoreline was classified as ditch influenced.

Wetland Loss

In addition to visualizing shoreline migration, digitizing aerial imagery allows for quantification of the change to the extent of tidal wetlands within the study area. It is estimated that, since 1930, a total 2,948 acres of marsh were lost and 376 acres that were "gained" for a total net loss of 2,572 acres within the study area (Figure 7). This increase of wetland area may be attributed to marsh migration, or to errors in geo-referencing or imagery resolution.

Approximately 45 percent of the 2,572 acres of wetlands that were lost can be attributed to development of the lagoon communities within both towns. The remaining 1,414 acres reverted to open water, which can likely be attributed to erosion.

Figure 7. Wetland change from 1930 to 2015. 45% of wetland loss is attributed to creation of the lagoon communities; the balance reverted to open water.

Erosion Vulnerability

One of the primary objectives of this shoreline assessment was to evaluate the vulnerability of the shoreline within the study area to erosion. The Ocean County Hazard Mitigation Plan (HMP) listed coastal

erosion as a Hazard of Concern for Ocean County. Erosion potential in coastal areas varies by shoreline type, slope and topography, and exposure to wave, wind, and tides. The HMP used the NJDEP shoreline type dataset to evaluate erosion potential for Little Egg Harbor and Tuckerton and estimated that there no property value was at risk due to coastal erosion. This assessment expands that evaluation to include erosion potential along the lagoons and the marshes. For this assessment, the shoreline type was analyzed and exposure to wind and waves were modeled using InVEST. The topography and slope of the coastal area was also evaluated, confirming that there is very little elevation change along the shoreline within the study area.

Approximately 81 percent of the shoreline within the study is comprised of land that is vulnerable to erosion. This estimate includes shoreline classified as wetlands, beach, scrub/shrub, disturbed vegetation, and unarmored lawn. Some of these parcels, such as wetlands and beach, cannot be armored but there are a small number of properties within the developed areas that either had shoreline structures removed and not replaced, or they were never constructed. Most of the properties identified as unarmored are private lands, so it was not feasible to evaluate the condition of the shoreline at these locations.

Lands classified as bulkheads or riprap were not considered to be highly vulnerable to erosion. However, these structures can sustain damage from storms and tides and may be vulnerable to overtopping, scouring, and undermining. Where permitted, shoreline stabilizing structures should be inspected periodically to ensure their structural integrity is maintained. It is also important to note that the juxtaposition of shoreline structures and unarmored land may result in accelerated erosion.

In addition to evaluating the types of erodible shorelines this assessment used the InVEST model to examine the risk of erosion based on wind and wave energy exposure. InVEST provides a relative assessment of exposure, which is depicted in Figure 9. This illustrates that shoreline within the least sheltered areas, such as the northeastern shore of Tuckerton Beach, faces the greatest risk from erosion. This is reaffirmed by the areas that have experienced the greatest land migration since 1930, which includes the above- mentioned shoreline of Tuckerton. The shorelines around the islands, along the lagoons, and near the mouth of Tuckerton Creek and the Mullica River experience the most shelter within the study area.

Figure 8, shows channels through the marsh have minimal risk for wind and wave exposure, but during field observations through the marsh complex it was noted that several of the channels were experiencing erosion on one side of the channel and sediment deposition on the opposite bank. A more detailed study of the channels would be required to determine the cause of this discrepancy. One possible explanation is boat wakes through the channels, which are not accounted for by the InVEST model. If boats are traveling through the channels close to one side, the wakes could be causing greater erosion on one side of the channel.

Without a more detailed study to determine if the boat wakes are generating greater wave energy within the navigation channels, however, it is difficult to definitively assert that they are the source of tidal marsh channel erosion. The variation between the data included in the InVEST model and what was observed in the field suggests that human impacts may be the cause of erosion observed in the channels, which may be managed through policy changes, to reduce the impacts to the marsh. A detailed study of wave energy and vessel navigation should be performed to determine if such policies would help protect the vitality of the shoreline under future conditions.

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Figure 8: Relative wave exposure within the study area. Protected areas such as shoreline within creeks have a relatively lower risk of erosion versus areas adjacent to open water where fetch and wind energy are greater.

Marsh Assessment

Through the completion of the desktop analysis, it became clear that the existing marsh along the shoreline is vital to the resilience and ecological integrity of the study area. There is concern about the stress rising sea levels place on salt marshes. Salt marshes depend on deposition of sediment in order to maintain certain elevation ranges above mean sea level. Scientific studies are being performed to evaluate the factors that influence a marsh system's capacity to maintain these elevations as sea levels continue to rise, but each marsh system has unique hydrology and environmental factors. Therefore, it is critical to evaluate the existing conditions of the hydrology, elevations, and tidal forces within the marsh system before determining the health and forecasting the future of the marsh.

As part of this assessment, elevations and visual observations were taken throughout the marsh complexes on April 25th, June 16 th, and June 17 th, 2016. The goal of this component of the assessment was to establish a baseline of the elevation, vegetation communities, and drainage conditions on the marsh plain. Unfortunately, the scope and timeline of the project did not allow for a detailed marsh assessment for this report element. The steps needed for an appropriate marsh monitoring program are outlined in the recommendation section of this report. The marsh assessment undertaken for this project was designed to capture a snapshot, ground-truth some of the trends that are visible through the desktop analysis, and create a baseline upon which to build future monitoring assessments. For this project, 15 sites were selected at locations throughout the marsh plain. These sites were selected to

provide a representative sample of the marsh within the study area, with a bias of the areas closer to developed land. The sites are shown on Figure 9.

Figure 9. Marsh assessment site locations within the study area.

At each site, several elevations were taken and plant species were observed and catalogued. The table below details these observations of the field assessment. These data can be used as a comparison for future evaluations to allow for trend analysis over time. The current day Mean High Water (MHW) and Mean Higher High Water (MHHW) elevations as derived from NOAA VDatum are shown for reference. Plant species growth form, such as short, intermediate or tall, was also noted as a general indicator of plant vigor and health.

The vegetation species are noted as indicators of the plant communities presently existing on the marsh plain. Typically, high marsh species, such as *Spartina patens,* perform best within the MHW and MHHW tide range; while low marsh species, such as *Spartina alterniflora,* perform best within the mean tide level and MHW tide range. When vegetation communities are observed outside of their respective ranges, it could indicate a transition or stress to the plant community. This was the case in a few sites within the marsh expanse. More evaluation is necessary to determine the implications of the results. Note that MHW and MHHW elevations listed are based on modeling from local tide stations; water elevations should be collected at each site location in order to assess accurate tide levels.

In addition to the vegetation and elevations, drainage conditions as well as the prevalence of pannes and pools were observed. These observations are detailed in Table 2. All elevations are in feet and reference NAVD 1988. MHW and MHHW elevations were determined using VDatum, though it should be noted that conclusions about the drainage conditions of each site should not be drawn from the observations below.

The relationship between tidal flow and marsh drainage requires more data points than could be acquired through this preliminary assessment. Details regarding the specifications for such a monitoring program are included in the recommendation section.

Table 2: Marsh Field Assessment Observations

Site 1 Date visited: 04/25/2016 Spartina alterniflora is short form and extensive, limited other vegetation species. Site appeared saturated. Presence of small pannes and numerous pools, particularly adjacent to the bay.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina alterniflora - short	1.57	1.49	1.92
Site 2 Date visited: 04/25/2016 Site dominated by Spartina alterniflora, short form. Limited extent of Spartina patens. No presence of saturation on marsh plain.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina patens	1.82	1.56	1.97
Spartina alterniflora - intermediate	1.94		
Spartina alterniflora - short	1.94		
Spartina alterniflora - tall	1.20		
Site 3 Date visited: 04/25/2016 Spartina alterniflora is extensive and saturated. Presence of small pannes.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina patens	1.76	1.57	1.98
Spartina alterniflora - intermediate	1.31		
Spartina alterniflora - short	1.59		
Site 4 Date visited: 04/25/2016 Spartina alterniflora primarily in short form, limited patches of intermediate form. Numerous pools distributed and evidence of expanding significantly very close to channel.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina alterniflora - intermediate	1.16	0.91	1.25
Spartina alterniflora - short	1.48		

Site 5

Date visited: 06/17/2016

Site is well drained, no pools present. Small patches of Spartina patens distributed throughout site. Some Phragmites australis interspersed with Iva frutescens.

Vegetation Species	Average Elevation	MHW	MHHW
Iva frutescens	2.09	0.92	1.24
Spartina patens	2.07		
Spartina alterniflora - intermediate	1.78		
Spartina alterniflora - intermediate; Limonium carolinianum	1.65		
Spartina patens; Spartina alterniflora; Limonium carolinianum	1.74		
Rack Line	1.54		

Site 6

Date visited: 06/16/2016

Site dominated by Spartina alterniflora short form. Marsh plain was very wet at high tide, approximately 1-3 inches of water sitting on the surface.

Vegetation Species	Average Elevation	MHW	MHHW
Spartina patens	1.06	0.91	1.26
Spartina alterniflora - intermediate	0.75		
Spartina alterniflora - short	0.70		
Spartina alterniflora - tall	0.77		

Site 7

Date visited: 06/17/2016

Site dominated by Spartina alterniflora short form. Sparse Limonium carolinianum and Salicornia europaea in pannes. Site appears adjacent to undeveloped upland with presence of Phragmites australis.

Vegetation Species	Average Elevation	MHW	MHHW
Spartina patens	1.04	0.99	1.24
Spartina alterniflora - intermediate	1.09		
Spartina alterniflora - short	1.25		
Spartina alterniflora - tall	0.65		

Site 8

Date visited: 06/17/2016

Diversity of low marsh species. Small, limited patches of Spartina patens. Pools on site.

Vegetation Species	Average Elevation	MHW	MHHW
Spartina patens	1.55	0.98	1.24
Spartina alterniflora - short; Limonium carolinianum; Salicornia europaea	1.25		

Site 9 Date visited: 06/17/2016 Diversity of low marsh species. All growth forms of Spartina alterniflora observed. Healthy patches of Spartina Patens. Presence of small pannes.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina patens	1.69	0.96	1.24
Spartina alterniflora - intermediate	1.28		
Spartina alterniflora - short; Limonium carolinianum; Salicornia europaea	1.46		
Spartina alterniflora - tall	0.84		
Site 10 Date visited: 06/17/2016 A diverse plant community and possible identification of an aster. Prevalence of numerous dry pannes.			
Vegetation Species	Average Elevation	MHW	MHHW
Iva frutescens; Spartina patens	1.85	0.94	1.24
Spartina patens	1.91		
Spartina alterniflora - intermediate	2.06		
Spartina alterniflora - short; Limonium carolinianum	1.47		
Rack Line 1	1.90		
Rack Line 2	1.62		
Site 11 Date visited: 06/16/2016 Observed erosion around marina and throughout channel. Pools show signs of erosion and contain submerged aquatic vegetation. Vegetation limited to Spartina alterniflora.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina alterniflora - intermediate	1.45	1.46	1.92
Spartina alterniflora - short	1.56		
Spartina alterniflora - tall	0.81		
Site 12 Date visited: 06/16/2016 Erosion along banks; abundance of pools with submerged aquatic vegetation. Vegetation community classes include high marsh grasses and scrub/shrub and low marsh Spartina alterniflora short form.			
Vegetation Species	Average Elevation	MHW	MHHW
Iva frutescens	2.11	0.89	1.25
Spartina patens; Distichlis spicata	1.95		
Spartina alterniflora - short	1.81		
Rack Line	2.05		

Site 13 Date visited: 06/16/2016 Abundance of pools, particularly adjacent to the road. No obvious signs of erosion along the primary channel.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina alterniflora - short	1.52	1.38	1.89
Spartina alterniflora - tall	1.01		
Limonium carolinianum	1.42		
Site 14 Date visited: 06/16/2016 Abundance of pools that appear to be expanding. Submerged aquatic vegetation in pools.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina Patens - stunted	1.47	1.40	1.90
Spartina alterniflora - intermediate; Limonium carolinianum	1.00		
Spartina alterniflora - short; Limonium carolinianum	1.62		
Spartina alterniflora - tall	-0.46		
Salicornia europaea	1.84		
Site 15 Date visited: 06/16/2016 Large pools with submerged aquatic vegetation.			
Vegetation Species	Average Elevation	MHW	MHHW
Spartina alterniflora - short	1.05	0.90	1.29

Critical Issues

Coastal Storm Risk

One of the most important issues facing Little Egg Harbor Township and Tuckerton Borough is the risk of damage associated with hurricanes, nor'easters, and extratropical storms. Hurricane Sandy damaged thousands of structures within the study area and caused millions of dollars in damage. A number of smaller coastal storms have occurred since Sandy that have caused flooding and storm surge damage to the area, including Hurricanes Jonas (January 2016) and Joaquin (October 2015). 13,171 acres of the land within the study area is within the FEMA 1% flood zone. This accounts for 38 percent of land within Little Egg Harbor and 65 percent of the land within Tuckerton. These percentages are likely to increase as storm intensities shift and sea levels rise.

This assessment estimates that 87 percent of the developed shoreline is armored against erosion from daily tides. However, armoring does not necessarily prevent damage from coastal storms. Bulkheads, the primary type of armoring in the study area, are not usually designed to prevent flooding associated with storm tides and may experience undermining or scouring when the water overtops them. Bulkheads and revetments are designed to prevent soil from moving from the shore under the pressure of tidal forces at lower elevations. When waves associated with storm events are larger than the design elevation, the structure is overtopped. A bulkhead or revetment that is forcibly or frequently overtopped, either in a single storm event or over time, can become structurally unsound. Waves that overtop bulkheads may erode the land behind the structure, creating a pocket for water to fill during the next wave. Over time the pocket will continue to deepen until the pressure of the water that fills the void pushes the bulkhead away from the land. It is also important to note that all engineered structures have a life expectancy, meaning that they are designed to be replaced over time. Over time, aging bulkheads may be more likely to fail under the pressure of a storm surge than a properly designed system of appropriate age.

During a field assessment of the study area, bulkheads were observed in the lagoon communities that had been built to various elevations. Inconsistencies in the heights or design of bulkheads may result in increased flooding of adjacent properties. Though it was impossible to access and assess all of the bulkheads within the study area, it was observed that a number of original wooden bulkheads have been replaced in recent years with synthetic structures. The synthetic bulkheads that were observed appeared to be in good condition. Several failing bulkheads adjacent to roads throughout the study area were also observed. These were constructed of wood, and as noted above, appeared to have been older and, as a result, may have been more susceptible to failure. Though many of these failing structures were found along public right-a-ways, the town is not necessarily responsible for their maintenance. Property owners in coastal areas may inherit infrastructure such as bulkheads when buying a house. Many of these structures were deeded to an adjacent property at the time of construction.

The undetermined protection value provided by the existing marsh expanse is another challenge in identifying and planning for coastal storm risk in the project area. Tidal marsh lies along approximately 230 miles of shoreline, between the land and open water. It is recognized that near-shore marshes dissipate wave energy and attenuate flooding. If the marshes become shallow open water, these benefits decline by an unknown margin. No existing study evaluates the change in risk for flooding or storm surge under future conditions without the presence of the marsh.

Unprotected Areas

Although 87 percent of the developed shoreline is armored, the remaining 13 percent is vulnerable to erosion from daily tides as well as storm events. Deflected tides from neighboring structures can increase erosion along unarmored areas of this shoreline. Bulkheads and other armoring do not absorb the energy of storm tides. These structures prevent a wave from following its intended path, which deflects that energy in another direction and has been shown to increase the scouring impact in front of and adjacent to the structure. When an unarmored parcel is adjacent or across the channel from a structure, the scouring that occurs from the deflected wave may exacerbate an erosion event.

Sea Level Rise

In addition to the risk of damage from coastal storms mentioned above, rising sea levels will increase the risk of damage from daily tides within tidal marsh and developed parts of the study area. MHHW in 2050 is estimated to cover an additional 1,684 acres of land within Little Egg Harbor and Tuckerton as compared to the existing MHHW water line.

Many of the bulkheads surveyed in the shoreline assessment do not have sufficient freeboard above existing mean high water levels to protect the shoreline under future conditions. These bulkheads will be overtopped frequently. Repetitive or forceful overtopping can undermine bulkhead structure and compromise its effectiveness and integrity. In addition to bulkheads, other critical infrastructure such as roadways, sewers, and communication infrastructure is vulnerable to saltwater intrusion and inundation, which can corrode infrastructure and require frequent maintenance and repair.

Marsh Health and Vitality

Erosion

Erosion is a natural process within a wetland complex. Marshes erode and accrete over time to maintain vitality under dynamic marine conditions. Within the study area there are visible signs of erosion along the shoreline and along the navigable channels. During a field visit to the marsh, large pieces of the marsh bank calved into shallow water; in other areas the jagged edges of recently eroded banks were prominent. Throughout the study area, it is estimated that 1,414 acres of the marsh have been lost to open water since 1930. It is likely that these changes have been caused by erosion, though there is an undetermined margin of error attributable to the digitization process. Although erosion does occur naturally from normal tidal conditions, it can be accelerated by human influences, including boat wakes.

The marsh edge near the end of Great Bay Blvd shows steep banks indicative of an eroding shoreline.

Subsidence

Another process that naturally occurs within tidal marshes is subsidence, or the sinking of the land. Over time the sediment in marshes compacts and new sediment is added to the top of the marsh to maintain an elevation appropriate for the vegetation community. When new sediment is not being deposited on the marsh, the only process evident is the sinking of land and the decreasing elevation of the marsh plain. A GPS field survey revealed that the elevation of the marsh plain is inconsistent and certain internal areas of the marsh are lower than the fringe, which suggests that sediment is not being deposited through over wash across the entire marsh plain.

Subsidence can result in the frequent inundation and extended saturation of the internal areas of the marsh during high or moderate tides. This will stress the vegetation of the marsh community and create die-off. When marsh vegetation dies, its root structure no longer holds the soil in place and the marsh will erode. Thus, subsidence is considered to be an accelerator of marsh erosion and wetland loss. Subsidence can cause pools to form through the marsh plain, which can channelize and create headcuts through the existing wetland areas, accelerating loss.

Marsh Migration Limits

In addition to subsidence and erosion, marshes face another threat due to future climate conditions. As sea levels and tidal elevations rise over time, the vegetation in the marshes will receive more frequent and deeper inundation of salt water, which will change the composition of the marshes. Tidal wetlands exist in two zones, high marsh and low marsh. High marsh prefers less frequent inundation and is usually located between mean high water and the highest predicted water level for any given year. Low marsh will thrive between mean high water and mean tide level. Low marsh vegetation is very salt tolerant and can withstand greater frequency of inundation. However, as sea levels rise, low marsh vegetation will not survive where inundation is constant.

Marshes can migrate inland to higher elevations, as one natural adaptation approach for rising sea levels. Over time high marsh communities convert to low marsh communities and areas of upland become high marsh. This process can only occur where slope and land use allow. High marsh cannot expand to steep sloped areas or developed uplands. Under these conditions, the existing high marsh will convert to low marsh, the existing low marsh will convert to open water and the size of the overall wetland complex will shrink.

Given the existing land use patterns within the study area, there is little opportunity for these marshes to migrate landward. If land use patterns change in the future, and the hydrology supports it, there may be opportunity for the marshes to migrate. However, under current conditions there is limited opportunity for migration and it will be not be possible for the marshes to sustain the same expanse overtime.

Shoreline Risk-Reduction Strategy

Overview

The shoreline of Little Egg Harbor and Tuckerton contains numerous community and ecological assets. The lagoons, marinas, and beaches provide abundant access for residents and visitors, while the marsh systems provide rich habitat for birds and aquatic life, recreation opportunities, as well as important nurseries for regional fisheries. This access to the rich resources of Barnegat and Great Bay has supported much of the growth both towns have experienced since the early 1900s. Although the estimated 61 additional miles of shoreline along navigable channels created through the development of the lagoon communities has promoted growth and has provided opportunities for residents and visitors, it presents a challenge to address increasing coastal risk. Strategies to address coastal risk along the shoreline depend on the particular shoreline type, the level of risk tolerance within the community, and the overall goals the community has for its coastal management. Per the Request for Proposals, this report does not outline site-specific strategies to address risk, but instead responds to the critical issues identified throughout the study area as a result of the desktop and field assessments.

This report outlines several potential strategies to address risk along both the developed and undeveloped reaches of the shoreline. The broad goal of "risk-reduction" encompasses more specific goals of stabilizing the shoreline, minimizing risk of rising sea levels, and minimizing risk of coastal storm damage, without compromising ecological integrity or public access. The strategies have been derived based on these goals to reduce future risk to the natural and community assets along the shoreline, enhance and conserve the existing or pre-existing natural resources, and maintain, or improve, public access to the shoreline. The report details several approaches that can be used throughout the study area to address specific vulnerabilities to erosion, rising seas, and wave action. While this report does not identify specific sites where these strategies should be implemented, it balances protection options for both the developed and non-developed areas of the shoreline.

This strategic plan also balances the use of "hard" and "soft" approaches. Traditional shoreline protection strategies have largely depended on what is referred to as "grey" or "hard" engineering, usually denoting a concrete, stone, or wooden structure designed to prevent flooding or erosion. These strategies include the installation of bulkheads, sea walls, levees, and revetments to minimize natural erosive forces and, depending on design, reduce flood risk. In the past several years there has been increased research and support for "softer" engineering techniques that offer similar benefits, but are designed to adapt to the natural dynamic coastal systems. The US Army Corps of Engineers refers to these approaches as "natural and nature-based features" (NNBF), these measures can also be referred to as "coastal green infrastructure." Generally, "soft" or "green" coastal protection measures mimic or enhance native protection systems such as vegetated dunes, salt marshes, submerged aquatic vegetation, oyster reefs, or woody debris. Some protection strategies include creating or enhancing these natural systems, while other approaches replicate the benefits these systems provide along the coast.

In any shoreline protection strategy, a combination of "grey" and "green" techniques allow the most comprehensive protection of infrastructure, natural resources, and flexibility for dynamic conditions. Using both approaches within the study area will enhance the ecological benefits and natural resilience of shoreline features such as marshes, while still allowing the marina-based culture that defines both towns. Additionally, it is recommended that Little Egg Harbor and Tuckerton work with NJDEP and landowners to ensure the shoreline protection strategy provides protection while adhering to state and

local regulations. It is imperative that shoreline structures and restoration projects are designed to current standards and do not increase future risk to adjacent properties.

Data Limitations

This study is an initial assessment. Before recommending site-specific engineering and restoration solutions for the shoreline, a more detailed study needs to be performed at the anticipated sites to understand how rising sea levels, coastal storms, and other forces are affecting the site. This is particularly true within the marsh expanse. The scope of this project was to assess the shoreline, which while inclusive of the marsh, did not allow for a thorough assessment of the marsh expanse. A detailed assessment of sections of the marsh should be completed as part of an ongoing monitoring program.

A marsh management and monitoring program has two critical functions. Foremost, it establishes monitoring protocol. This monitoring will establish the data necessary to prioritize shoreline protection and adaptation strategies in the future. Secondly, as sea levels and storm conditions change in the future, a monitoring program would allow an understanding of the marsh's capacity to adapt. Without these data, singular data points may be erroneously extrapolated as trends and protection efforts may be ineffective or detrimental to the ecosystem.

A cooperating partnership with all owners within the study area would be ideal to leverage all resources within the marsh complex. Additionally, any restoration or enhancement proposal should include a detailed assessment that follows the protocol below. It is critical to develop a greater understanding of the vulnerable areas of the marsh expanse before designing or prioritizing enhancement measures.

In 2015, the Partnership for Delaware Estuary (PDE) produced a report[1] on assessing and preparing for the future of marshes within the region. The report bridges the gap between landscape level planning and local implementation and design through the identification of vulnerable marsh systems and the most appropriate method to restore the marsh complex. The report outlines a methodology to establish a detailed assessment to further understand the relative vulnerability of marshes of interest within the study area.

These data will inform where, when, and how the recommended strategies in this report are implemented. These data are necessary not only to prioritize protection efforts, but also to design projects that accommodate future conditions. For the purposes of this document, these measures are referred to as "enhancement" strategies. Traditionally, marsh restoration is a broad term used to describe efforts to return an ecosystem to its condition prior to disturbance. It is becoming increasingly recognized that restoring these ecosystems to previous states will not aid in the capacity to adapt to future conditions, such as rising seas. Effective enhancement strategies are designed to support the ecosystem's natural capacity to adapt and minimize the stress placed on the ecosystem from identified environmental sources such as sea level rise.

Assessment Protocol

While there are a few resources for marsh assessment protocols, it is recommended that the PDE approach is used within the study area. The PDE study identified marshes of interest to assess within the region. This was accomplished through a stakeholder process. However, for the purposes of a detailed assessment or a long-term monitoring program it is recommended that sites are selected that are

[1] Marsh Futures: use of scientific survey tools to assess local salt marsh vulnerability and chart best management practices and interventions. Accessible at: http://delawareestuary.s3.amazonaws.com/pdf/Summit15/PDE-Report-15-03_Marsh%20Futures.pdf.

representative of the entire marsh expanse within the study area. Basing the assessment on marshes that are currently under consideration for restoration or candidates for dredged material application may skew the assessment to ignore possible degradation or vulnerabilities in marshes farther away from the developed shoreline. The sites used in this initial assessment can be used as an initial cross section of the entire marsh area. Additional assessment sites should be chosen based specific characteristics such as those with potential vulnerability; or those that appear to have expanding pools; pannes, or channels, or those with potential enhancement value; or those known to be eroding adjacent to residential areas.

To create a vulnerability assessment, the PDE approach collects elevation and topography data, vegetation health, and marsh edge loss. The elevation data should be obtained using a survey-grade GPS in order to minimize error. Within the salt marsh, very small changes in elevation (2-5 cm) can result in drastic variations in vulnerability, so it is important to use highly-accurate survey equipment. The PDE report recommends collecting approximately 400 elevation points for every 1.5 acres of salt marsh, though this may vary based on the topography of the marsh plain. A site with uniform high marsh and minimal elevation change may require fewer data points than a site with variations in vegetation communities and topography.

The points do not need to be uniformly distributed throughout the site. Instead they should be collected along transects across the site, and clustered based on variability in elevations. In areas with slopes at the marsh edge, points should be clustered. This will provide the best representative sample in order to make a surface elevation model of the marsh plain. This approach was used for this shoreline assessment, however, due to time constraints the number of points taken are insufficient for development of a surface elevation model. The surface elevation model will also take into account vegetation communities and inform the vulnerability assessment. It will also provide the baseline to which future assessments should be compared in order to understand changes to the marsh plains surface elevations. This would inform an understanding of accretion and subsidence trends within the site.

In addition to detailed elevation data, metrics to assess vegetative health should be collected. PDE recommends blade height, canopy cover, bearing capacity, and horizontal view obstruction as indicator measures of vegetative health. Vegetation should be evaluated in 1 meter plots throughout the site. These indicators were selected because they can be measured quickly, and collectively they provide a comprehensive depiction of vegetative health. Such an assessment should be performed in late summer or early fall when most salt marsh species have reached maximum growth, but before they go to seed. PDE provides rationale and details on the methodology for collecting each of these indicators in the report. The assessment of vegetative health coupled with the surface elevation model provides a robust understanding of areas of the marsh that are less resilient to changing climate and inundation conditions. It also allows an understanding of how and whether or not the marsh may be evolving to adapt to rising seas.

A long-term marsh management program would periodically repeat this assessment protocol over several years in order to continually monitor the health and adaptation of the marsh. As mentioned above, any enhancement project or restoration project should also initiate a detailed assessment that mirrors this approach. For proposed projects, data should also be collected on tide and inundation cycles to verify flushing and drainage at the proposed site. These data should be collected over the period of several months in order to foster understanding about the current and projected hydrology on the marsh plain. This understanding is critical to effective restoration or enhancement design.

Minimize Risk of Erosion

The marsh edge shows erosion at a site within the study area.

Erosion is a naturally occurring process that helps reshape land formations and ecosystems to respond to dynamic forces. Erosion is responsible for the formation of the Grand Canyon, partly responsible for the formation of the barrier islands, and has shaped much of the landscape across the US. However, much of that erosion and change occurred before modern development patterns. In areas where there is development, erosional forces present a significant risk to property and life. It is important to minimize this risk, where possible, through land use policies and appropriate engineering techniques. Land use policies minimize the number of structures and infrastructure vulnerable to erosive forces, while both "soft" and "hard" engineering techniques protect existing structures and property. In addition to efforts to stabilize the shoreline, where possible, communities can implement actions to reduce stressors that accelerate erosion, such as invasive species management, managing boat wakes, and stormwater management.

Within the study area, erosion was visible along the shoreline in both the desktop assessment and the field visits. The desktop assessment indicated that erosion was occurring in all unarmored areas of the shoreline, including shoreline reaches in the salt marshes and along the developed lagoon communities. In most of the developed areas, however, the shoreline has been stabilized with bulkheads or riprap. These traditional armoring methods can have deleterious effects on the shoreline and regional ecology by disrupting natural sediment transfers and deflecting wave action. There are alternatives, which are highlighted in the table below and explained in this report, that reduce the risk to property and resources from erosion while allowing erosion to occur in some places along the shoreline.

Under current NJDEP rules, a lawfully existing bulkhead can be replaced in-kind with a permit-by-rule. For many lots along the shoreline, this will continue to be the most effective approach of shoreline stabilization to reduce risk of erosion on property and structures. However, in some cases, where bulkheads are not permitted, where overtopping increases the vulnerability of the structure and property, or where the structure is actively degrading the natural protective capabilities of the existing salt marsh, it may be best to use an alternative approach to reduce erosion risk. As sea levels rise, more properties and shoreline structures will become increasingly vulnerable to frequent overtopping and may need to use these alternatives.

This report describes ways to reduce erosion risk through set-backs, living shorelines, sea grass restoration, maintaining armoring, and minimizing stressors that exacerbate erosion. The table identifies whether each of these strategies is best suited for developed or undeveloped areas.

Summary of Erosion Risk-Reduction Strategies

Developed Areas	Undeveloped Areas
• Use setbacks and zoning to reduce property at risk	• Enhance ecological function to boost natural resiliency
• Stabilize shoreline using living shoreline techniques or armoring, where necessary.	• Stabilize shoreline using living shoreline techniques
	• Minimize stressors that accelerate erosion

Reduce Property At-Risk

The most costs-effective long-term method of reducing risk to property is to minimize the exposure by reducing proximity to the identified hazard. Setbacks can be used to achieve this to minimize risk along a dynamic shoreline. Setbacks on coastal properties serve two primary functions. Foremost, they reduce the risk to property by guaranteeing a distance between the structure and the erodible shoreline. This distance can minimize the damage caused by daily tidal erosion, as well as erosion caused by storm events. The second purpose of setbacks is to minimize the stress on an unarmored shoreline. Runoff, soil compaction, and landscaping from developed properties can accelerate erosion along natural bluffs and shoreline features. Setbacks reduce the impact of these activities on the shoreline edge.

North Carolina, Texas, Florida, and Maine are among the states that use setbacks and estimated coastal erosion rates to reduce vulnerable property and protect the shoreline. Although they are frequently implemented on oceanfront properties that are unarmored, setbacks can be used on both armored and unarmored parcels in developed areas. Traditionally, coastal setbacks designed for erosion are equivalent to the distance the land is projected to erode during the duration of a 30-year mortgage. This is largely true of oceanfront properties or on large lots adjacent to coastal bluffs. Requiring distance between the water's edge, with positive drainage towards the water, can still protect structures from erosion in lagoon communities.

Zoning can also be used to ensure that additional properties are not placed at-risk within the study area. Although the developed area within both communities is largely built-out, it is important to ensure regulations limit future densities. Zoning within the communities could be used to limit future redevelopment or in-fill development opportunities to in-kind replacement, structures with smaller footprints, or lot consolidation, where feasible. The zoning for Tuckerton and Little Egg Harbor was not reviewed as part of this assessment, but a review of existing zoning to ensure that local ordinances are consistent with future shoreline goals and visioning should be performed.

Implementation

As an erosion risk reduction measure, setbacks will largely help protect property with unarmored shorelines. Within the study area, a small fraction of the lots do not have bulkheads or other armoring. Additionally, many of the lots are small and a setback based on erosion rates may render the lot too small to build on. Without just compensation, this regulation could be deemed as a taking. However, particularly on lots that are not permitted to armor the shoreline, set-backs that require structures are built as far back from the water's edge as feasible, with positive drainage towards the water, could extend the useful life of the property.

In order to address small lots, ordinances could be modified to reduce the allowable building footprint, while increasing height limits in order to maintain the same floor area ratio on the property. This would allow a property owner to locate a structure at the greatest distance from the water as possible while maintaining the development value of the lot.

Living shorelines

In areas with environments deemed critical for protection, either along the developed or undeveloped shoreline, it is important to stabilize the shoreline against future erosion. Historically within the study area, stabilization has been accomplished using revetments or bulkheads. Living shorelines, which refer to engineered shoreline management practices that use vegetation or other organic material to minimize habitat loss and erosion in the littoral zone, offer an alternative to "hard" engineering techniques. Living shorelines can be used along both developed and undeveloped shorelines and are considered to be more resilient than other engineered shoreline stabilization methods, such as bulkheads, because they will not be undermined during a storm event.

Living shorelines is a broad term which includes several different types of engineering techniques. According to NJDEP there are three living shoreline types: natural, hybrid, or structural. Natural living shorelines include features with natural vegetation, submerged aquatic vegetation, fill, and biodegradable organic materials. Structural living shorelines include, but are not limited to, breakwaters, groins, and revetments. These self-sustaining engineered systems rely on organic material and may allow for future habitat. Hybrid systems include many of the features considered to be natural living shorelines, but also incorporate low-profile rock formations. These features can be combined to meet the specific project goals.

Implementation

To minimize the impact of erosion within the study area, living shorelines can be used to secure the banks of salt marsh, reduce wave energy along sandy beaches, or replace bulkheads within developed areas. These techniques should be considered for all future shoreline stabilization projects within the study area.

Given the extent of navigation channels within the study area, design for living shorelines within the study area should consider the permitting requirements for shoreline stabilization projects within these channels. Both the US Army Corps of Engineers and the State of New Jersey have recently updated their permits for shoreline projects. Additionally, there is growing guidance from state and federal agencies on best management practices, funding resources, and permitting feasibility for various living shoreline approaches. In February 2016, the Stevens Institute of Technology finalized *Engineering Guidelines for Living Shorelines*[2], prepared for the NJDEP to help communities and organizations design permissible and viable living shoreline projects in New Jersey.

At the time this study was published, a living shoreline project is proposed within the study area in conjunction with the Marsh Restoration and Resiliency Project for Little Egg Harbor Township and the Borough of Tuckerton, funded through a grant from the National Fish and Wildlife Foundation (NFWF). This project seeks to stabilize the eroding, unarmored stretch of shoreline adjacent to Iowa Court on Osborn Island.

[2] Living Shorelines Engineering Guidelines. Accessible at: http://www.nj.gov/dep/cmp/docs/living-shorelines-engineering-guidelines-final.pdf

Seagrass Restoration

Seagrasses are underwater vegetation communities that can form dense meadows along the ocean floor. Submerged Aquatic Vegetation (SAV), such as seagrasses, serve critical ecosystem functions in the estuary. They also serve the critical function of reducing erosion, and can be a valuable addition to living shoreline designs. The dense root system of these communities helps reduce erosion, and seagrasses have been shown to provide wave attenuation. Additionally, these vegetation communities provide critical habitat for spawning and juvenile fish, feeding areas for larger fish and wading birds. SAV communities also store carbon and nutrients, which helps water clarity and water quality. There are limited seagrass communities within the study area. A report by the Center for Remote Sensing and Spatial Analysis at Rutgers produced in 2011 showed the presence of seagrass communities near Barrel Island and adjacent islands in the Bay.

Seagrasses provide natural wave attenuation, which can extend the life of living shoreline structures and reduce risk of erosion. Restoration of the seagrass communities of Great Bay and Barnegat Bay will contribute to coastal resiliency by reducing the energy of waves that roll across their beds. Further study is necessary to determine where within the bays would be suitable for seagrass restoration opportunities. Seagrasses are vulnerable to excessive nutrient loading, boat scouring, and sea level rise. Restoration potential is dependent on effective management, within the estuary and the entire drainage area, as well as the ability for the bed to migrate landward over time to adapt to rising sea levels.

Implementation

Establishing a sea grass community as its own shoreline protection project within the study area may not be a priority for shoreline protection at this time. However, seagrass communities should be considered as part of design concepts for future living shoreline projects within the study area to reduce wave energy.

Maintain Armoring and Existing Shoreline Protection

While living shoreline projects help improve the ecological and habitat value of the shoreline and should be considered as a possibility in all shoreline stabilization projects, they may not be feasible in every location. Within the developed area, where there are inhabited structures and critical infrastructure, it is important for health and safety to maintain the shoreline stability. Where living shorelines are not an option, this may be achieved through maintenance and replacement of bulkheads and riprap revetments. Bulkheads, which make up 99 percent of the shoreline parcels with buildings within the study area, are engineered to resist tidal forces and hold the shoreline bank in place. They are a very effective measure to reduce the risk of erosion, though in doing so they can increase erosional forces on adjacent properties and disrupt sediment flows within the bay.

Implementation

On lots with existing bulkheads, that will not be frequently overtopped by daily tides, are not suitable for living shorelines, and have existing residential, industrial, or commercial structures, NJDEP's permit-by-rule for bulkhead replacement is an appropriate approach to minimizing risk of erosion.

However, bulkheads are not typically designed to accommodate rising sea levels or to prevent flooding from wave action. Properties that should be permitted and encouraged to replace existing bulkheads, may not be appropriate for such measures as sea levels rise and vulnerabilities within the study area change. For many lots along the shoreline, armoring should be considered a short- or medium-term solution. Where bulkheads are permitted, they should remain regulated. Bulkheads achieve the best results when there is consistency in height and design along the shoreline.

As mentioned in the report, there are inconsistencies with the height and use of bulkheads along the lagoons within the study area. Although bulkheads can be modified to add movable flood panels or capped to keep pace with rising levels, these techniques can undermine structural integrity. Adding height to an existing structure can change the distribution of pressure on which the original design was based. Property owners should be encouraged to use one of the strategies outlined in this report to reduce coastal storm risk in-lieu of retrofitting a bulkhead to serve a purpose it was not initially designed to achieve.

Minimize Stress on Shorelines

Although erosion is the hazard, there may be additional stressors on the shoreline that increase erosion. Some of these factors, such as landscaping and soil compaction can be minimized through the use of setbacks and zoning within developed areas. In undeveloped areas, specifically the salt marsh areas, erosion may be accelerated by ecological degradation, subsidence within the marsh plain, and the repetitive wave action created by boat wakes. Wakes create forcible wave action along the banks of the marsh. These waves may inundate the vegetation too frequently, which results in die-off.

As the vegetation dies, the root system becomes unstable and the bank can collapse, causing erosion. When these plants become stressed by poor sedimentation or dysfunctional hydrology, or they are replaced with invasive species, their root systems fail and the bank becomes more likely to collapse from the force of wave action. There may be some strategies that NJDEP, Little Egg Harbor, and Tuckerton can implement to reduce the stress on the salt marshes and support their natural resistance to erosion.

Implementation

One approach the communities and NJDEP can take is to prioritize ecological restoration of the marsh. The PDE produced a report that outlines strategies to stem loss of salt marsh within the estuary. The report identifies several stressors that accelerate degradation including pollutant loading, sediment supply, over-visitation, boat wakes, or dredging practices that alter sediment transfers. Policies to address these potential stressors, and enforcement of existing protection policies are a cost-effective approach to minimizing the impact of environmental factors on the vulnerability of salt marshes. Many of the policies mentioned are not within the purview of municipal authority. Little Egg Harbor and Tuckerton should work with NJDEP and appropriate federal agencies on implementing policies that affect the ecological integrity of the marsh plain.

Further study on theses stressors, such as impact of boat wakes, is warranted prior to developing any policy. Given the federal regulations pertaining to navigation channels, any policy affecting boat traffic, wakes, visitation, or dredging may require cooperation with US Coast Guard, the USACE, New Jersey State Police Marine Services Bureau, and NJDEP. For example, these agencies may be required to approve the wake regulations or the buoys required to notify boaters of the change in zones.

Minimize risk of rising sea levels

The existing MHHW elevation added to 1.48 feet of sea level rise anticipated by 2050 is estimated to inundate 1,684 acres of land within the study area. While the elevations of some of this land may increase through natural accretion, to keep pace with rising sea levels, it is unlikely that 100 percent of the anticipated inundation area will be filled either naturally or through human efforts. Rising sea levels will also increase flood risk from extreme tide cycles, including "lunar tides", "king tides", and "spring tides" which can elevate tide levels beyond the MHHW line. High sea levels also increase flood risk from coastal storm events and rainfall events. Part of the reason Sandy was such a devastating storm was because of the high-tide water elevations when the storm surge occurred. As sea levels rise, water elevation will consistently meet or exceed those experienced during Sandy.

The other potential source of flooding that will be exacerbated by rising sea levels is the back-flooding that occurs through the stormwater drains. The outfall pipes, which allow the stormwater to drain into the sea, may routinely be underwater as mean sea levels continue to rise. On a sunny day, this can allow sea water to flow backwards into the pipes and flood streets within the towns. On a rainy day, this will limit the storm system's ability to funnel stormwater away from properties and streets. In both instances, nuisance flooding will increase in low-lying areas where the stormwater system cannot properly function.

Rising sea levels will increase both nuisance flooding and damage from storm events across the study area. The Community Vulnerability Assessments, which were completed by New Jersey Future for both Little Egg Harbor and Tuckerton, detail the estimated property at-risk within this area and the potential impacts to the community. Within the developed areas, these impacts may include repetitive flooding, decreased access, and infrastructure damage. Within the undeveloped areas, rising sea levels may cause accelerated degradation of salt marsh, and increased erosion, and loss of public access along beach areas.

Minimizing the impact of rising sea levels along the shoreline will require multiple strategies within the developed and undeveloped areas. There are already signs of the increased risk within both areas. Signs of degradation and changes in vegetation suggest some parts of the marsh may be stressed from prolonged inundation. In the developed areas, such as Tuckerton Beach, the town reports nuisance sunny day flooding from the storm system. Despite these early indicators, the timing and extent of the risk posed by rising sea levels is uncertain. To enhance the resiliency of the shoreline it is recommended that monitoring and mitigation measures should be put in place as soon as possible. Specific strategies that should be employed along the shoreline are outlined below.

Summary of Sea Level Rise Risk-Reduction Strategies

Developed Areas	Undeveloped Areas
• Elevation of structures and infrastructure	• Elevate salt marsh plains
• Reduce development in flood-prone areas	• Enhance marsh hydrology and function to withstand future stressors
	• Allow for marsh migration inland

Elevation of Structures and Infrastructure

One option being considered along the entire United State coastline to adapt to rising sea levels is elevation of structures and infrastructure. This costly short-term solution may be appropriate in some areas of the shoreline, based on specific municipal goals and objectives. But elevating all of the infrastructure that needs to be raised is probably not a suitable long-term adaptation strategy because it would be cost prohibitive and may not be technically feasible or permittable.

Adaptation through elevation involves placing additional layers of asphalt on roadways to raise the surface above projected water levels. This allows for vehicle use during high tides. It is important to note that increasing road height will not protect underground infrastructure such as water mains, gas lines, sewers, and stormwater pipes. These facilities may be vulnerable to corrosion, increased buoyancy due to instability in the subsurface soils, and reduced access for maintenance and emergency repairs.

Implementation

The Borough is currently elevating road heights in Tuckerton Beach to maintain emergency access to residential areas during extreme high tide events. A detailed engineering study would be required to determine if this strategy would be effective to reduce sea level rise risks to underground transmission systems over the medium- and long-term. A benefit cost analysis should be part of such a study to evaluate the cost-effectiveness of this approach over these timeframes.

Reduce Development in Areas Impacted by Tidal Flooding

Local zoning regulation is one of the most effective tools a community has to redirect future development away from riskier areas. Creating zones that limit density or land uses in certain areas to allow for marsh migration and accommodate rising seas will concentrate development within areas that can be protected. This approach will reduce exposure to future flooding. There are a number of options municipalities can use to address existing structures. In areas that will be frequently inundated with tidal flooding from high tides, municipalities can help homeowners plan for the time when they will no longer be able to remain in their homes, transfer those homes to future generations, or resell those properties for what has traditionally been fairly high market values.

Of course, the simplest approach is for the municipality to not intervene in the property owner's right to develop their property as they see fit. While this approach has political appeal, because it theoretically allows the market to determine when the land is inhabitable or not, it may prove to be a very costly tactic for both homeowners and municipalities. The municipalities right to create zoning and existing regulations that govern land development have been upheld as part of the government's responsibility to protect the health, safety, and welfare of the public. Regulating lands that will be frequently flooded is an extension of this established mandate.

If municipalities choose not to regulate future land uses in areas subject to inundation, they should be aware of the potential economic risks. Freddie Mac released a report in 2016 that highlighted the potential for homeowners to choose to default on their mortgage, regardless of their capacity to pay. The data collected from the 2008 housing crisis suggests that homeowners will walk away from a property if

the value of the home is less than the remaining mortgage value. [2] Homeowners also may walk away from homes that do not carry a mortgage in areas that cannot be protected and face increasing flooding.

Implementation

To reduce risk sea level rise poses to properties along the shoreline within the study area, it is recommended that both municipalities consider options to acquire structures or development rights on properties that currently experience flooding from high tides. Both the State and Federal government have programs that help fund property acquisition. The federal programs are administered by FEMA and are managed by NJOEM in New Jersey. In addition to the FEMA mitigation programs, the state administers the Blue Acres program to which homeowners can apply to have their homes purchased. Although the acquisition process is often lengthy and complex, and may require local political support, and a municipal funding match, the program is effective in reducing the number of properties currently experiencing nuisance flooding.

Marsh Elevation

As sea levels rise, marshes will experience longer periods of inundation if the marsh plain surface elevations do not keep pace. Marshes accrete sediment naturally, through deposition from wave action. It is uncertain whether the salt marshes within the study area will be able to accrete at the same pace as rising sea levels. There was a study published by PDE on Monitoring and Assessment of Representative Tidal Wetlands of the Delaware Estuary that suggests that tidal wetlands in Barnegat Bay are not accreting at a rate to keep pace with sea level rise. [3]

One strategy to ensure that marsh elevations keep pace with rising sea levels is to manually add sediment to the marsh plain. This approach is intended to address the concern that the marsh surface is experiencing extended inundation periods, stressing the vegetation, because accretion is not keeping pace with the rate of sea level rise and/or subsidence. As noted above, accretion is a natural process of sediment deposition onto the marsh plain and subsidence occurs as marsh soils sink and compact. Although both processes result in marsh elevations that cannot support appropriate vegetation, reasons why these two processes occur are different and should be understood before designing a restoration approach.

One approach to artificially raising a marsh surface in marsh systems where accretion is not keeping pace with rising sea levels is through thin layer deposition (TLD) of dredged materials. This option is currently being considered by NJDEP in a series of TLD pilot projects funded through a NFWF grant. Dredged material, which is sediment deposits that have settled on the bottom of watercourses, often carry contaminants and may not match the sediment on any adjacent marsh plain. Consequently, NJDEP is carefully considering the ecological implications of these projects and requiring extensive soils testing and monitoring.

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[2] Freddie Mac. April 2016. Insight. http://www.freddiemac.com/finance/report/20160426_lifes_a_beach.html

[3] Partnership for Delaware Estuary. 2013. Monitoring and Assessment of Representative Tidal Wetlands of the Delaware Estuary. https://s3.amazonaws.com/delawareestuary/pdf/PDE-Report-13-03_MACWA%20RAM%202013.pdf

Though thin-layer placement, which is also being considered as part of the ongoing NFWF project within the study area, is a potentially beneficial use of dredged material in marsh restoration efforts, a singular application may not provide long-term marsh protection against rising sea levels. Additionally, there are significant gaps in the research regarding the future ecological implications of this approach on the hydrology, vegetation, and quality of habitat. More research on TLD, which is underway, is needed before its role in a shoreline protection strategy can be fully determined.

Implementation

Enhancement of the marsh plain elevations is a strategy that should be considered throughout the study area. However, in order to determine if a marsh necessitates sediment deposition, it is important to follow the assessment protocol identified by PDE. Marsh areas that are characterized by sparse vegetation that appears stressed, with expanding open water areas in the interior, and low surface elevations compared to mean high water are good candidates for marsh elevation enhancement projects.[4]

Enhance Marsh Hydrology

Although elevation is a critical piece to ensuring that a marsh is protected from the risks of rising sea levels, it is not the only potential risk factor for the marsh plain. The marsh's capacity to maintain proper hydrology and drainage as sea levels rise is a critical issue that may result in subsidence, die-off, and erosion. All saline tidal marshes need some saturation from salt water to sustain their vegetation communities. However, when a marsh experiences tidal inundation too frequently, or the salt water sits on the marsh plain for too long, it can impair the vegetation's capacity to grow. This leads to stunted vegetation heights and root systems, which limits the vegetation's strength to hold the soil in place; erosion is accelerated when vegetation is compromised in this way. Hydrologic enhancement can be designed to combat this source of degradation. The focus of this approach is to remove or reduce stressors that impair the necessary flushing of the tidal marsh.

One of the prominent hydrologic stressors within the study area is the remnant ditching from salt hay harvesting and mosquito control measures. This is particularly prominent within marshes adjacent to developed areas. Ditching inherently manipulated the natural hydrology of the marsh system, inhibiting natural processes that maintain marsh surface elevation, such as accretion. Ditching has also been shown to exacerbate marsh subsidence. Hydrologic enhancement focuses on restoring the marsh system's natural hydrology by eliminating the ditches and restoring drainage channels so the system can once again sustain itself.

Implementation

In order to effectively alter the hydrology of the marsh, it is imperative to collect temporal data demonstrating the relationship between the marsh plain and the tide cycle. This can be obtained through the use of data loggers that will automatically collect tide data at the site. The collected data will help determine how frequently the marsh is being inundated by tides, how long the period of inundation lasts, and be used to set the proper design elevation. Efforts to repair the hydrology of the marsh plain may include filling ditches, changing dredging patterns, or removing other structures that limit sediment transport or constrict flow.

[4] Partnership for Delaware Estuary. 2015. Marsh Futures. http://delawareestuary.s3.amazonaws.com/pdf/Summit15/PDE-Report-15-03_Marsh%20Futures.pdf

Allow for Marsh Migration

Coastal adaptation plans frequently include a recommendation "conserve undeveloped areas to allow for marsh migration." As tide levels rise, marshes will naturally try to maintain the same differential by accreting, if sediment deposits allow, or migrate to higher elevations.

However, marshes cannot always migrate inland. The elevations, pollutant loading, salinity, hydrology, and soil conditions must allow for this adaptation over time. Marsh vegetation may also have to compete against sturdy invasive species such as *Phragmites australis* for this upland space.

Implementation

Marsh migration should be considered a long-term strategy for the study areas. At this time, it is recommended that as part of the shoreline protection strategy, both Little Egg Harbor and Tuckerton conserve and manage undeveloped upland areas adjacent to existing marshes to allow for marsh migration where possible. Before any development is permitted in existing undeveloped upland adjacent to marsh areas within the study area, it is highly recommended that a study be performed to determine if that area would be suitable for marsh migration in the future. This study would need to evaluate the factors that affect migration that are outlined above.

Minimize risk of coastal storm damage

Coastal storms present a significant risk to the shoreline within the study area. The Little Egg Harbor Township Vulnerability and Exposure Analysis[3] performed for the Township of Little Egg Harbor, which is available online, and the CVA for the Borough of Tuckerton both detail the estimated current and future risk to the communities from coastal storms. Storm surge, wind, debris, and rain that can be associated with a coastal storm event can cause damage to roads, power lines, homes, pipelines, bulkheads, beaches, and salt marshes. Recovering after a storm, as both communities are acutely aware, is a resource-intensive and exhausting exercise. With predictions of intensifying coastal storm events, it is important to consider strategies to reduce the risk of coastal storm damage.

This general goal applies across the entire shoreline because all shoreline types are vulnerable to damage from coastal storm events, although the type and degree of damage varies. Within developed areas of the shoreline it may be appropriate to maintain or replace armoring, remove at-risk properties, or reduce wave energy. Efforts to reduce wave energy may include installation of offshore breakwaters or armoring the shoreline. Marsh expanse is a considerable contributor to wave energy reduction. Maintaining or restoring the extent of the marsh plain will be critical to the effort to protect the shoreline within the study area. If the marsh experiences significant degradation or is unable to maintain consistent elevation with respect to sea levels, the area of open water will increase. Increasing the area of open water adjacent to the developed shorelines of Little Egg Harbor and Tuckerton will allow greater wave energy generation during coastal storm events, which could increase storm surge intensity and extent in future storm events. Maintaining the marsh, to the greatest extent possible, must be a key component of the shoreline protection strategy for the study area.

[3] Little Egg Harbor Township Vulnerability and Exposure Analysis. February 2015. Accessible at http://www.leht.com/admin/data/img/uploads/LEHT_VE_Assessment_Final_Report_3-15.pdf

Remove At-Risk Property

The best approach to reducing risk from coastal storms is minimizing exposure to property by reducing the total value of structures within the hazard area. Acquisitions or buy-outs would remove a building from a property and allow it to be converted to open space. This is the only strategy that will eliminate personal property risk from coastal storms. All other strategies outlined in this report, or elsewhere, are risk-reduction approaches.

Funding for acquisitions has traditionally come from a combination of the New Jersey Blue Acres program or FEMA's Federal Mitigation Assistance Grant Program (FMA), as well as public funds for open-space and conservation programs. The acquisition of high-risk property from willing owners is an effective mechanism to reduce future damage associated with coastal storm events. This approach reduces the dollar value of exposure within a community. Homes that have been identified as repetitive loss or severe repetitive loss properties are frequently good candidates for this mitigation option.

Repetitive loss or severe repetitive loss properties are homes and businesses that have experienced frequent and moderate to severe flood events in the past ten years. Because of their expense on the National Flood Insurance Program, FEMA assigns high priority to acquiring these properties. Given the projections of risk within the study area, it is reasonable to assume that many of the homes that have experienced repetitive flooding in the past 10 years will continue to experience flooding from future storm events. Although there are other mitigation options to address repetitive flooding, such as elevation or floodproofing (where appropriate), removal of the structure is the surest approach to eliminating the risk of damage.

Depending on the source of funding, there are limitations associated with the use of a property after acquisition. Blue Acres has strict regulations governing the management and activities on properties purchased with these funds. FEMA's rules focus on deed restrictions that limit construction of insurable structures on the properties. It is important to understand the implications of all funding mechanisms before pursuing acquisition, however the entire shoreline would benefit from this strategy. It is recommended that properties that will experience frequent tidal flooding as sea levels rise, as well as those that are identified by FEMA as repetitive loss and severe repetitive loss properties, be targeted for volunteer acquisitions as funding permits.

Implementation

Both municipalities should consider acquisitions of severe and repetitive loss properties along the coast. A repetitive loss property is a structure that has been heavily damaged in multiple events within a short time period. Being classified as repetitive loss does not necessitate acquisition, but these at-risk properties are the most vulnerable structures within the study area. A home that has been substantially damaged in a smaller coastal event, as well as Sandy, is at high-risk for experiencing future damage. Historically, in New Jersey, these are the homes that are most likely to be selected for competitive funding programs because of their high risk of flood damage. However, municipalities should establish education and outreach programs to help homeowners understand their options. These programs should be opened to all property-owners in high-risk areas. Any flood-prone home that can be purchased is a reduction in coastal storm risk.

Zoning and Flood Protection Ordinance

Local zoning regulation is one of the most effective tools a community has to redirect future development away from riskier areas. Overlay zones can be added to underlying regulations to manage risk in designated areas of the community. Overlay zones can specify design standards and/or permissible uses in areas that may experience significant storm surge and flooding in order to reduce or avoid damage and improve resilience. Both Little Egg Harbor and Tuckerton should consider overlay zones as an approach to reduce risk from coastal storms and sea level rise.

Implementation

The Sustainable and Resilient Coastal Communities Final Report, created for the NJ Department of Environmental Protection, provides specific guidance on creating overlay zones within the study area.

Armor/Protect Against Surge

One approach to withstand the impact of waves along shorelines that face risk from storm surge is to build a large wall, revetment, or dune. This approach is widely used in the US and is known to be effective at reducing property damage from coastal flooding. At this time within the study area, there is no feasible location to engineer dunes, or construct a traditional seawall or levee to protect against large storm events. Dense development adjacent to the shoreline, coupled with the desire and need for access to lagoons and marinas, would make siting a large-scale structural protection measure very difficult. This may be an option for consideration in the future, with different land use and development patterns.

If this option was pursued in future planning, there are several siting and design considerations the communities should take into account. Structural protection measures are designed to withstand waves of a certain height and hydrodynamic forces, when these heights or forces are exceeded, the structure can be overtopped or undermined. This occurred in Sea Bright, NJ during Hurricane Sandy causing substantial damage in the community. Structures such as bulkheads and sea walls can also have unintended consequences on adjacent properties. When a wave hits a hardened wall, the energy from the wave is not dissipated, instead it is reflected. It can cause scouring around the structure, or it may be deflected to an adjacent property. The impacts of redirected risk should be thoroughly considered in the design of any structural project. Additionally, structural protection measures can cause habitat loss, change sediment transport, and alter ecosystems.[5] There is growing research on the impacts of hardened shorelines to salt marshes, fisheries, and beach ecosystems.

Implementation

While a large-scale protection project is unlikely at this time, some property owners may choose this tactic to protect their home. Structural protection measures such as seawalls, bulkheads, and revetments are regulated activities. Engineers and property owners may also consider designing elevated bulkheads to provide flood protection, though this is not generally the function of a bulkhead. The design considerations outlined above apply to individual property protection efforts. A poorly-designed structural protection measure may be illegal and/or cause more damage during a storm event.

[5] Dugan, J; Hubbard, D. Ecological Effects of Coastal Armoring: A Summary of Recent Results for Exposed Sandy Beaches in Southern California http://pubs.usgs.gov/sir/2010/5254/pdf/sir20105254_chap19.pdf

Breakwaters

Offshore Breakwater Systems use large stone structures strategically designed to intercept waves prior to reaching the shore. Breakwater systems are best suited in areas that have long stretches of shoreline with moderate to high wave energy. Similar to other hardening approaches, breakwater systems deflect wave energy. It is important that any project design models the potential impact to adjacent areas to ensure there are no unintended adverse impacts to the surrounding shoreline.

Implementation

Within the study area, breakwaters could be considered for installation near-shore of eroding shorelines. They can be used in conjunction with other living shoreline and shoreline stabilization efforts in both the developed and undeveloped areas of the shoreline. To be designed effectively, near the shore there should be a hardy sandy bottom, with shallow water depths and no significant submerged vegetation. However, because of their potential conflict with navigation channels, it may not be appropriate to site breakwater projects in narrow channels or canals with anticipated boat traffic.

Marsh Restoration and Enhancement

In addition to the marsh enhancement efforts outlined in the above sections, where it is feasible within the study area, the marsh can be restored to the extent it was mapped by the NJDEP 1977 Tidelands Base Photo Map. The State of New Jersey and the United States Army Corps of Engineers grant permits to create wetlands in existing open water, as long as there were historically wetlands mapped by the NJDEP 1977 Tidelands Base Photo Map. Although this study shows the expanse of marsh since 1930, the 1977 Tidelands Base Photo Map is the regulatory authority on where marsh can be created. Reverting open water to marsh will extend the marsh farther into the water increasing its overall footprint. This is currently being recommended as part of the ongoing National Fish and Wildlife Foundation (NFWF) marsh restoration project within the study area. Converting open water to marsh can be a costly and involved undertaking, that should be based on thorough baseline ecological data and assessments to ensure the elevations, vegetation communities, and appropriate stabilization features are designed.

In addition to reestablishing marsh area, vegetation enhancement of the marsh plain could strengthen the ecosystem's natural adaptation capacity. Revegetating areas of marsh land that have become sparse or stressed will strengthen the root system that prevents erosion. This effort is most cost-effective when the stressors that have caused the site's degradation are understood and resolved.

Implementation

This technique is being implemented within the study area under a NFWF grant. Future project locations include marsh areas that have experienced high rates of retreat since 1977. Any restoration project that reestablishes marsh should also consider a breakwater element, living shoreline, or another design component to reduce the erosional force that caused the retreat prior to restoration.

Additional Resources/Guidance

As this shoreline protection strategy evolves to encompass specific stabilization or enhancement projects, there are a number of valuable resources that may be helpful to their design, including:

Partnership for Delaware Estuary

The Partnership for Delaware Estuary is the leading organization in the region for studying the impacts of climate changes on local marsh systems. They have established protocols for evaluating impacts and potential enhancement efforts at degraded sites. Their reports on Monitoring and Assessment of Representative Tidal Wetlands of the Delaware Estuary and Marsh Futures can provide detailed guidance on how to establish appropriate monitoring and assessment efforts to ensure that marsh enhancement design addresses degradation and stressors without compromising the system's ability to adapt.

Virginia Institute of Marine Sciences Center for Coastal Resources Management

The website for this research institute at William & Mary College contains a wealth of information on living shorelines, wetland management, shoreline protection strategies, and the shoreline inventories for dozens of communities in Virginia, Maryland, and Delaware. The Institute has also designed decision support tools that can be used to determine which shoreline protection strategy is best suited for a specific project site.

Other Relevant Publications/Websites

Northeast Regional Ocean Council. *Make Way for Marshes: Guidance on Using Models of Tidal Marsh Migration to Support Community Resilience to Sea Level Rise*

Hudson River National Estuarine Research Reserve. Sentinel Site for Climate Change Research in Tivoli Bays.

Narayan, S., Beck, M.W., Wilson, P., Thomas, C., Guerrero, A., Shepard, C., Reguero, B.G., Franco, G., Ingram, C.J., Trespalacios, D. 2016. *Coastal Wetlands and Flood Damage Reduction: Using Risk Industry-based Models to Assess Natural Defenses in the Northeastern USA.* Lloyd's Tercentenary Research Foundation, London.

National Park Service. 2016. *Coastal Adaptation Strategies Handbook.*

Conclusion

The shoreline of Little Egg Harbor and Tuckerton faces several potential threats as a result of the changing climate. The strategy options outlined in this report are designed to reduce the risk of damage in future coastal storms to property, ecosystems, and the shoreline. There are other shoreline protection strategies, such as sea walls and tide gates, not included in the strategy options as they are not appropriate for the geography. The strategies outlined in the preceding sections focus on approaches that enhance the ecological value of the region, while addressing the particular critical issues affecting Tuckerton and Little Egg Harbor.

According to the data collected and analyzed in the course of preparing this assessment, the shoreline of Little Egg Harbor Township and Tuckerton Borough is highly vulnerable to short-term coastal storm risk, and long-term geomorphology changes as sea levels rise. In the absence of remedial action, both communities face a high likelihood of marsh loss, severe flooding and associated damage, increased wind and wave energy potential, and worsening erosion. Given the complex network of lagoon communities and marsh complexes, the strategy for protecting the human and natural resources within this area is not unilateral. Planning and prioritization of projects is necessary to ensure effective short-, medium-, and long-term adaptation to changing conditions in the bays.

This report provides a baseline assessment of current conditions and includes several strategies to help provide resilience to the shoreline as these conditions change over time. This assessment was not developed to provide site-specific detail regarding the best approaches for short- and long-term protection. Instead this report offers a suite of options that would be suitable for future projects and outlines the need for additional assessments and data in this area. The strategies included in this report promote ecological enhancement and allow for the shoreline to remain dynamic and naturally adapt to changing conditions over time.

In areas that have already been armored or developed, this report discusses the concerns with inconsistencies and gaps in that armoring, and the limited protection that armoring can afford. It is an appropriate strategy in areas where investment in development continues to be significant and retreat is not immediately feasible or appropriate. However, it is important to note that all engineered protection strategies have a lifespan and are built to only withstand the maximum storm event for which it was designed. Engineered protection strategies can be overtopped, undermined, or transfer risk to adjacent properties. Future armoring projects should be undertaken with consideration for design limitations.

There is a growing wealth of data and research on shoreline protection, climate change, and adaptation. Specific data gaps identified through this project include the impacts of boat traffic through the marsh plain, the feasibility of establishing sea grass communities, the implications of the beneficial reuse of thin-layer dredged material application, and hydrology monitoring data to assess current tide cycles. A more thorough study of the marsh plain could also help identify rates of subsidence and pool expansion, and additional stressors on vegetation communities. These types of studies would help inform appropriate future policies and restoration projects that would increase the resilience and ecological function of the shoreline area.

Figures to Appendix 3

Provided as separate attachment download

Shoreline Assessment Memorandum

Township of Toms River

Ocean County, NJ

Prepared for:
Township of Toms River

New Jersey Department of Environmental Protection
Coastal Management Program
Office of Coastal and Land Use Planning

Prepared by:
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March 2017

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Prepared for:

New Jersey Department of Environmental Protection
Coastal Management Program
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Contents

Introduction

The Township of Toms River is located in Ocean County, New Jersey. The Township sits on the northern end of Barnegat Bay, and is entirely within the Barnegat Bay Watershed (HUC8: 02043001) (Figure 1). The Township encompasses 52.7 square miles. The community has a rich maritime history and culture that depends on the 111 miles of shoreline within their jurisdictional boundaries. In 2012, when Sandy descended on New Jersey, the community experienced record flooding and damage. Marinas were destroyed, houses were knocked off their foundations, and millions of dollars of infrastructure was damaged. Since Sandy, Toms River has been working to identify and understand their risk and vulnerability to future storm events and rising sea levels. As part of this effort, the township and New Jersey Future were awarded a grant by the New Jersey Department of Environmental Protection (NJDEP) to develop a shoreline inventory. This grant is part of a larger project, the Sustainable and Resilient Coastal Communities grant program administered by the NJDEP through funding provided by the United States Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA), to evaluate strategies to enhance the resiliency and sustainability of coastal communities within the state.

This shoreline assessment uses Geospatial Information System (GIS) data to detail the existing shoreline types and conditions along the tidal waters, and document shoreline migration and changes in tidal wetland cover over time within the township. The study area for this assessment includes 111 miles of shoreline within the jurisdictional boundaries of the municipality, as shown in Figure 1. It includes the mainland, the banks of all creeks up to the head of tide, the bay islands, the barrier island, and the salt marsh complexes within the bays.

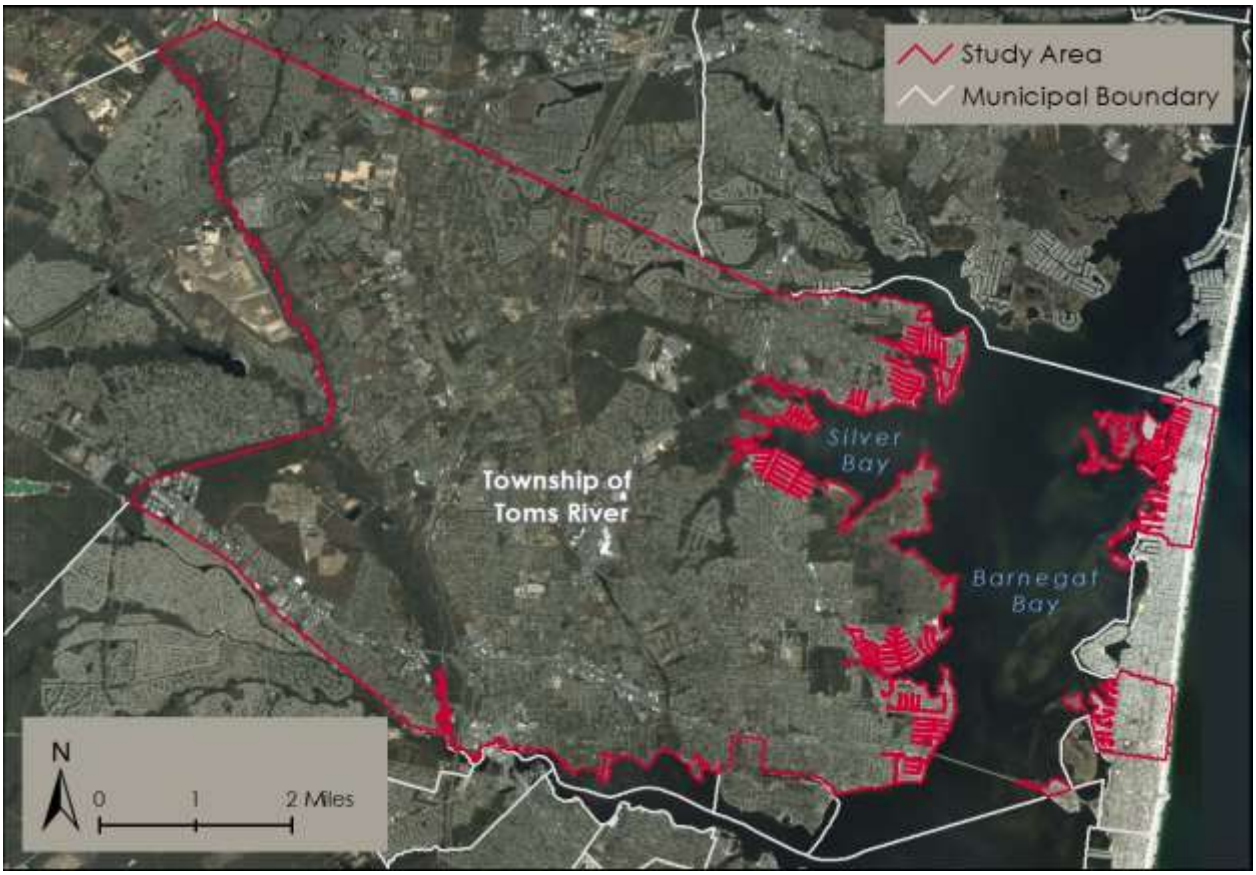


Figure 1. The Study Area in the Township of Toms River includes 111 miles of shoreline.

Understanding the existing conditions and historic changes that have occurred along the shoreline is an important step to addressing critical issues facing the township. This memo and the data created through this analysis will inform strategies to stabilize and restore vital defenses against short-, medium-, and long-term risks to the shoreline of Toms River Township.

Shoreline Assessment

Background and Methodology

The purpose of a shoreline assessment is to detail and evaluate the integrity of shoreline features in terms of potential for erosion, and vulnerability to rising seas and coastal storm events. The specific objectives of this assessment are to develop an inventory and typology of the shoreline, evaluate change in the shoreline between 1930 and 2015, and estimate the change in wetlands during that timeframe.

The first step in creating an inventory of the shoreline was to assess historic conditions over time. This was accomplished by digitizing the shoreline using aerial imagery from 1930, 1963, and 2012. In addition to shoreline change, this assessment examined tidal wetland loss within the township. Wetland loss was characterized by change in wetland extent between 1930 and 2015, using the Land Use/Land Cover dataset and 2015 aerial imagery. The final step in the shoreline assessment was evaluating the typology of the shoreline. This assessment was based on existing National Oceanic and Atmospheric Administration's (NOAA) data and refined using 2012 Land Use/Land Cover data created by NJDEP and aerial imagery from 2015.

Shoreline Movement and Change

In addition to the changes in characterization, shorelines shift in alignment and geographic position. Waves wash over the land and deposit sediment, and pull sand or sediment as they retreat. This occurs during normal tide cycles, as well as storm events, and results in shifting coastal landmasses, such as barrier islands and marshes, over time. The rate of these changes varies dramatically by site due to a variety of factors including wave heights, wind exposure, watershed size and geomorphology, and the ecology of the surrounding area. This change can also be accelerated or altered through land management practices and human influences. In areas that have been developed, efforts are made frequently to minimize changes in the shoreline by "armoring" the land to withstand wave effects. In addition to the changes that occur from naturally erosive processes, change along the shoreline can also be attributed to draining and filling tidal marshes.

This assessment uses digital imagery to evaluate migration and changes attributed to accretion, erosion, and subsidence, including changes within the tidal wetlands. This assessment also estimates changes to the location and position of the shoreline due to development. Imagery from the 1930, 1963, and 2012 were digitized (Figure 2) to evaluate the shoreline movement between 1930 and 2012.

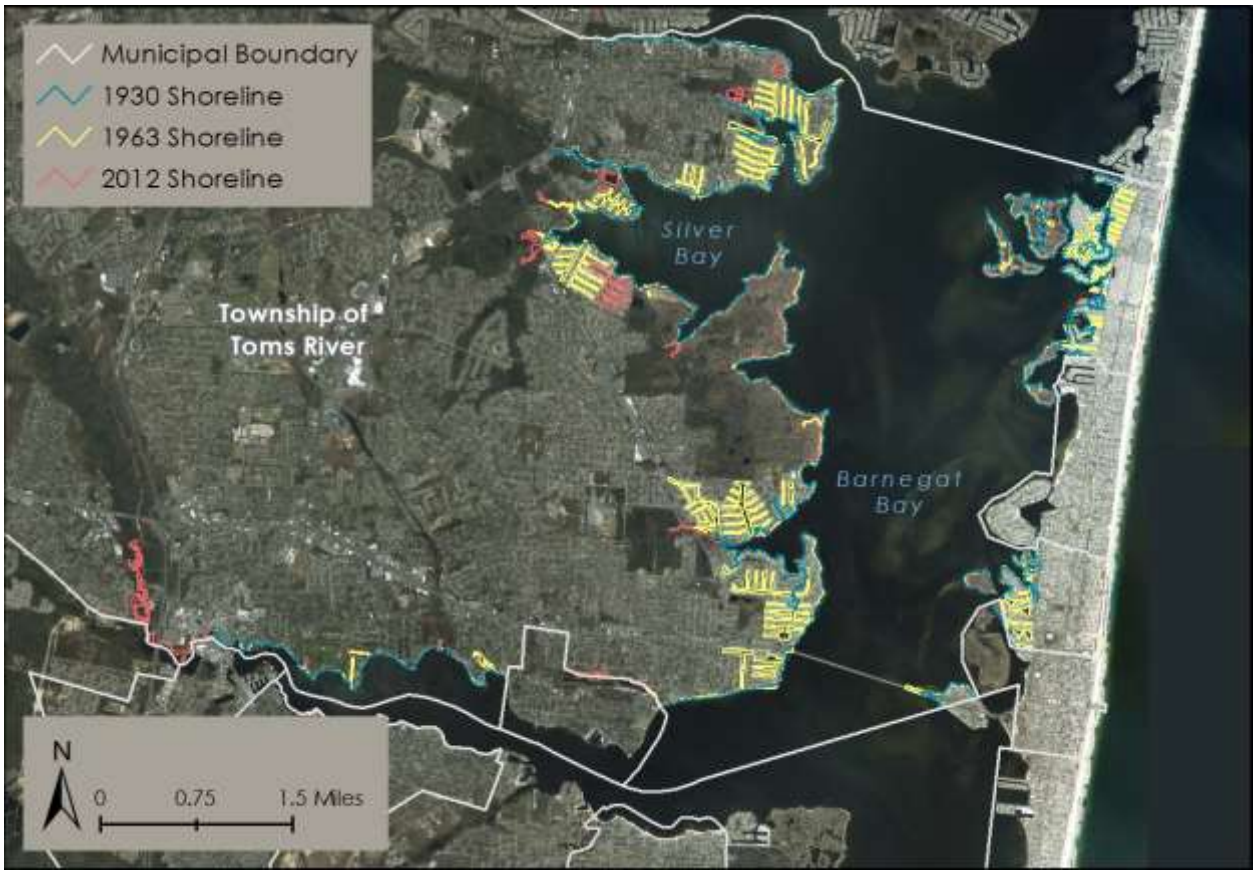


Figure 2. Shoreline migration was measured from 1930 through 2012.

Shoreline Migration

On undeveloped segments of the shoreline, the general movement trend was landward. However, the starkest changes in the shoreline are a result of development (Figure 3). The development of lagoon communities has pushed the shoreline landward and increased the overall length of shoreline in the township. Between 1930 and 2012 the shoreline increased from a length of approximately 53 miles to approximately 111 miles.

Figure 3. Shoreline migration depicted around Silver Bay and vicinity. Since 1930, the development of lagoon communities has shifted the shoreline landward and expanded the total length of shoreline.

Shoreline Characterization

This analysis was performed by refining the NOAA Environmental Sensitivity Index (ESI) dataset for the entire study area. ESI data were created by NOAA to identify coastal habitats that may be vulnerable to off-shore and near-shore chemical spills. The ESI classifies features, including man-made and natural features, along the shoreline into categories based on feature/habitat type and vegetation. These data provided an initial characterization of the shoreline within the study area. For the purposes of this study these classifications were modified to fit the categories listed below.

In addition to refining the categories, this assessment refined the shoreline created by the ESI. The ESI was created using data that are coarser than what are available within the study area. For this reason, the ESI dataset was refined using the 2012 shoreline digitized for this project. This allows the assessment to reflect the most accurate data available throughout the study area, as seen in Figure 4.

Landward Classes	*Total Miles within Study Area*
Bulkhead	72.8
Emergent Wetlands; Ditch Influenced	15.3
Upland	8.4
Emergent Wetlands; Not Ditch Influenced	7.2
Beach	6.2
Rip-Rap; Exposed	0.6
Unarmored Lawn	0.2
Scarps and Steep Slopes in Clay or Mud	0.2
Rip-Rap; Sheltered	0.1

Table 1: Miles of Shoreline by Landward Type

Figure 4. Shoreline characterization categories depicted around Silver Bay and vicinity.

Beach/Unarmored Shoreline

The first type of shoreline classified includes upland, beach, unarmored lawn, and scarps and steep slopes in clay or mud. These types of shoreline are vulnerable to change and erosion, from both storms and daily wave action. A small percentage of the study area shoreline is comprised of these categories; however, field observations noted signs of erosion in the areas visited.

Areas classified as beach, a collection of shoreline segments throughout the study area, encompass 6.2 miles of sandy shoreline that may, or may not, have some vegetation. These areas are not necessarily bathing or public access beaches.

About 15 parcels have been classified as having an "unarmored lawn" along part or the entire parcel boundary. All of these properties are within the developed area, though not all of the parcels at the time of this assessment, have a structure. Although there are only 15 parcels, it is difficult to determine the risk to surrounding parcels.

Scarps and steep slopes in clay or mud refer to the sheer faces found on the edges of tidal wetlands. These are often exposed at low tides but can also occur in areas where marshland is undergoing erosion.

Areas classified as upland refers to segments of shoreline where there is a sudden transition from open water to upland vegetation such as trees and shrubs. The typology of the shoreline was assessed up to the head of tide on Toms River. Riverine uplands associated with Toms River account for approximately 4.6 miles of shoreline classified as upland. Other shorelines classified as uplands include areas of fill such as remnants of berms from artificial bogs.

Armored Areas

Another type of shoreline that was classified for this assessment is hardened structures including bulkheads and revetments. Approximately 66 percent of the shoreline has been armored on the landward side. The majority of parcels adjacent to the shoreline that have a structure have been engineered with a bulkhead or revetment. Bulkheads provide protection against erosion due to tidal conditions and storm surge. Bulkheads that are built at-grade do not provide any protection for the property against wave action that overtops them.

Wetlands

There are an estimated 597 acres of tidal wetlands within the study area, based on the 2012 land use/land cover data and 2015 aerial image interpretation. The wetland complexes in this area offer protection against coastal storms, wave action, and erosion. They provide additional habitat and water quality benefits. Approximately 20 percent of the shoreline has wetlands on the landward side.

Wetland Loss

In addition to visualizing shoreline migration, digitizing aerial imagery allows for quantification of the change to the extent of tidal wetlands within the study area. It is estimated that, since 1930, a total 1,423 acres of marsh were lost and 94 acres that were "gained" for a total net loss of 1,329 acres within the study area (Figure 5). This increase of wetland area may be attributed to marsh migration, or to errors in geo-referencing or imagery resolution.

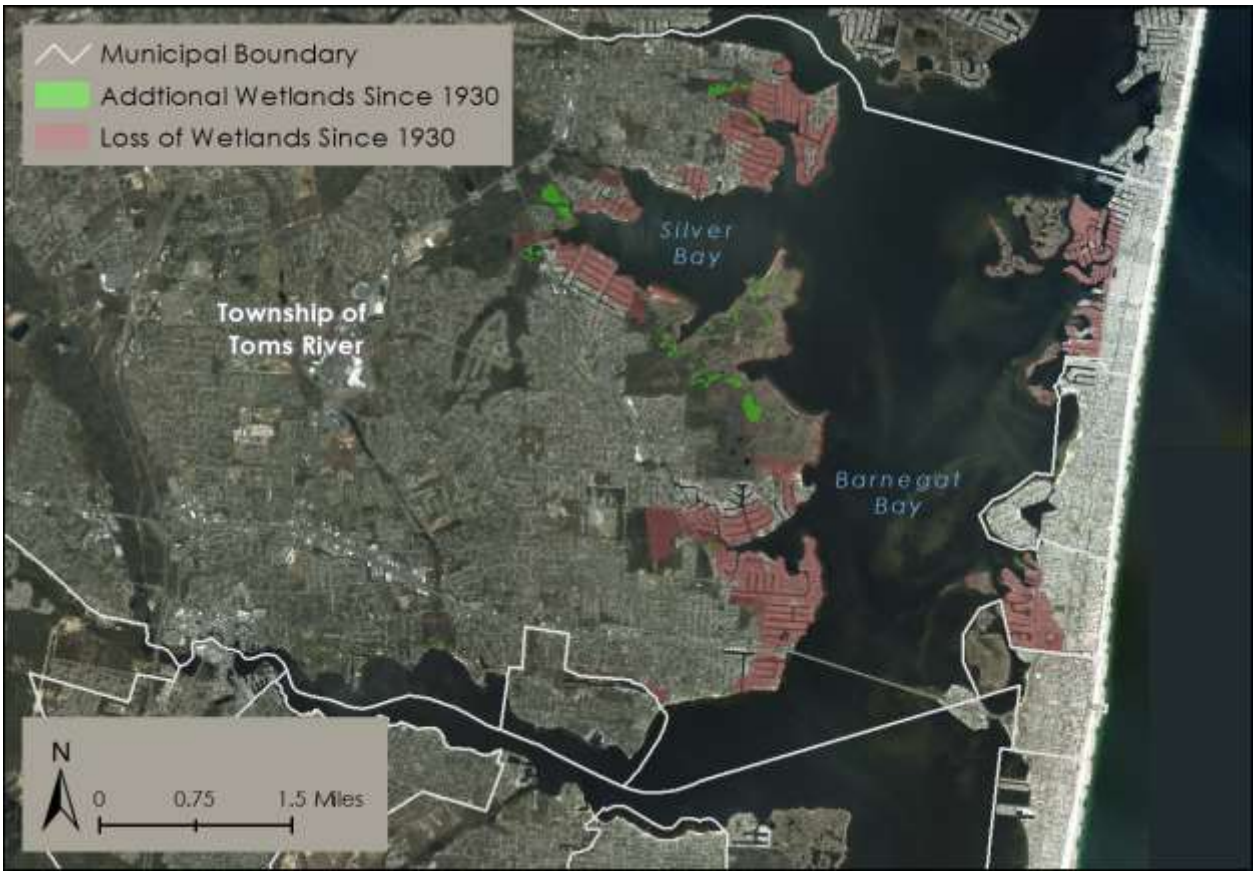


Figure 5. Wetland change from 1930 to 2015. Wetland loss is especially concentrated in areas of lagoon community development.

CUMULATIVE AND SECONDARY IMPACTS ASSESSMENT

AVAILABLE ONLINE AS A SEPARATE DOWNLOAD

Appendix 5

S&RCC Buildout Analysis

Transmittal

16 West Lafayette Street
Trenton, NJ 08608-2002
(609) 393-0008 *Tel.*
(609) 393-1189 *Fax*
www.njfuture.org

To: David Dumont, Elizabeth Semple, Nick Angarone, Kelly Pflike

From: David Kutner, Jessica Jahre, Christiana Pollack

Subject: S&RCC Buildout Analysis

Date: 9 May 2016

Good morning :
It's our understanding that a build-out analysis would be used in Task 1B, Cumulative and Secondary Impacts Assessment, to establish a baseline assessment of existing conditions and municipal expectations for future development. The secondary impacts assessment would be performed based on the build-out scenario and the preferred scenario to evaluate potential consequences that would result from changes in policy based on the future conditions.

To conduct the assessment, we anticipated that the build-out analysis performed by the Water Quality Management Plans would forecast the distribution of the future population and land use across the participating communities according to existing regulations and that this information would be provided in a geospatial format. We assumed that this analysis was created using population projections, maximum zoning allowances, or a standard density ratio, and CAFRA development limitation. With this information we'd be able to visualize how impervious surfaces (and population) would be distributed over the entire community when it reached build-out. In turn, this information would enable us to understand how many people and structures may be at risk if the communities continue to develop under their current land use regulatory scheme. It would also allow an understanding of the anticipated secondary ecological impacts associated with such a build-out scenario. This information would form a baseline for comparison of each future-conditions scenario.

Given that the above-described analysis was evidently not performed, we've started to rethink how a build-out analysis would be used to meet our project objectives. In our view, the principal objective of the build-out analysis was to determine the maximum allowable impervious surface that could be achieved based on coverage, and the associated land use that is either existing, or permitted under zoning, if there is no existing development on the parcel. This would enable us to evaluate secondary ecological impacts. The Vacant Lands data that has been provided is helpful but we believe it's only a first step in this important, broader analysis.

As we understand it, the definition of the *Vacant land* includes real property within sewer service areas in agricultural, forest, urban, and barren LULC categories, that has not been fully improved, isn't owned by a public or non-profit entity, does not have a development approval and is not a utility or public right-of-way. We believe it is necessary to identify buildable vacant lots outside the sewer service area, because these areas still have development potential even if the unit yield would be low.

Once determined, vacant land should then be compared to existing zoning to determine what potential land use may be developed on those vacant parcels. These data would be integrated into the existing LULC dataset, which would be modified to reflect the maximum impervious coverage prescribed under CAFRA or Pinelands zones. Development potential on any parcel not included in CAFRA or Pinelands areas would be based on the maximum intensity permissible under existing zoning. The final step to this build-out analysis would be to revise the LULC classifications (LU Code and Label) to reflect the maximum achievable impervious surface coverages so that the water quality model would use the integrated LULC data that reflects the maximum development allowed under existing regulations.

Since our budget and project scope did not anticipate that we would conduct the buildout analysis we're hoping that you can do it and provide the results so that we can assess secondary impacts and the relationship of inundation extents and "anticipated" development based on current zoning.

It's important to note that while this analysis would allow us to evaluate the secondary ecological impacts of build-out under current regulations, it wouldn't yield an estimate of potential future population and its distribution across the community. We believe this will have to be an understood caveat when we compare the anticipated distribution of population under the current land use scheme to projected build-out under future growth scenarios. Projecting population associated with build-out requires a far more detailed evaluation, calculating maximum achievable density under zoning of vacant lots, lots not currently built to full potential and lots with redevelopment potential. However, we don't believe that this added detail would necessarily further the objective of this project.

Please let us know how you want to proceed.

PROPOSED RISK ZONE MAPS

AVAILABLE ONLINE AS A SEPARATE DOWNLOAD

MEETING SUMMARIES

STRATEGIC AND RESILIENT COASTAL COMMUNITIES

Toms River Township Steering Committee Meeting

Friday, May 20, 2016
8:30 – 10:00

Sunshine Meeting Room
33 Washington Street, Toms River Township

AGENDA

1. Introductions
2. Project objectives
3. Project scope/schedule
4. Committee's role
5. How this project fits with other ongoing projects
6. Shoreline assessment
7. Critical issues
8. Next steps (Steering Committee meetings schedule)

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT
PROJECT DESCRIPTION

The New Jersey Department of Environmental Protection is reviewing its CAFRA regulations to ensure the future viability of resources within coastal areas. The study to be undertaken in conjunction with this grant will include: a desktop assessment of Toms River's shoreline to identify areas of change from 1930 to 2012; evaluation of potential for erosion associated with shoreline types and structures (such as bulkheads); review of existing and draft planning documents (e.g. master plan, land use and zoning regulations, hazard mitigation plan), applicable CAFRA regulations, coastal development patterns, areas of projected flood risk; and recommendations of alternative planning scenarios designed to minimize or avoid future coastal hazard risk for the Township's consideration. The project consulting team is responsible for recommending changes to the NJDEP CAFRA regulations that will address future coastal hazard risk. This grant provides funding for the work of the project consultant and Township staff.

STRATEGIC AND RESILIENT COASTAL COMMUNITIES

Little Egg Harbor/Tuckerton Steering Committee Meeting

Monday, May 23, 2016
1:30 - 3:30

Police Department Training Room
665 Radio Road, Little Egg Harbor Township

AGENDA

1. Introductions
2. Project Objectives
3. Project Scope/Schedule
4. Committee's role
5. How this project fits with other Little Egg/Tuckerton initiatives (Status of other initiatives)
   a) SRPR – Tuckerton
   b) Vulnerability Analysis – Little Egg
   c) Tuckerton ongoing planning activities
   d) Community Assets Vulnerability Analysis
   e) Getting to Resilience
   f) CRS
   g) Health Impact Assessment
   h) NFWF grant
   i) Public education and outreach
6. Shoreline assessment
7. Critical issues
8. Set Steering Committee/public meetings schedule
9. Next Steps

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT
PROJECT DESCRIPTION

The New Jersey Department of Environmental Protection is reviewing its CAFRA regulations to ensure the future viability of resources within coastal areas. The study to be undertaken in conjunction with this grant will include: a detailed assessment of Little Egg Harbor Township's and Tuckerton Borough's shoreline to identify areas of change from 1930 to 2012; evaluate potential for erosion associated with shoreline structures (such as bulk heads); review of existing and draft planning documents (e.g. master plan, land use and zoning regulations, hazard mitigation plan), applicable CAFRA regulations, coastal development patterns, areas of projected flood risk; and recommendations of alternative planning scenarios designed to minimize or avoid future hazard risk for the Township's and Borough's consideration. The project consulting team is responsible for recommending changes to the NJDEP CAFRA regulations that will address future coastal hazard risk. This grant provides funding for the work of the consultant team, Township and Borough staff.

STRATEGIC AND RESILIENT COASTAL COMMUNITIES

Little Egg Harbor/Tuckerton Steering Committee Meeting

Monday, May 23, 2016

1:30 - 3:30 pm

MEETING NOTES

Introductions

Gene Kobryn, Mayor of Little Egg Harbor
Sue Marshall, Mayor of Tuckerton
Donna Dougherty, Little Egg Harbor
David Fuller, Little Egg Harbor
Lisa Stevens, Little Egg Harbor
Sam Colangelo, Tuckerton
Joe Schwartz, Tuckerton
Christiana Pollack, Princeton Hydro
David Kutner, NJ Future
Katie-Rose Imbriano, BRS
Kelly Pflicke, DEP
Leah Yasenchak, BRS/NJ Future

Project Scope: New Jersey Future and Consultant Team are examining the designation of CAFRA (Coastal Area Facilities Review Act) Centers based on likelihood of inundation from flooding and sea-level rise (SLR). By 2050 with SLR and/or hurricane impact, the three (3) CAFRA centers in Little Egg Harbor and Tuckerton (Mystic Island, Tuckerton, Parkertown) are projected to experience significant flooding/inundation.

Project Objectives:

- Risk based assessment of CAFRA
- Shoreline assessment
- Evaluate erosion potential
- Revise existing draft plans and coastal development patterns
- Recommend alternative development scenarios
- Propose CAFRA changes

Committee's role: Provide general project oversight and continuing feedback as project products are drafted, assist the consultant team to communicate project findings residents and interested parties from throughout both municipalities.

Project Fit: This project builds on several other planning initiatives already underway or completed in Little Egg Harbor and Tuckerton, including:

- **SRPR (Tuckerton)**
- **Vulnerability Analysis (Little Egg)**
- **Tuckerton planning activities** (beginning summer 2016)
    - Master Plan Re-Examination Report
    - Sustainable Neighborhood Plan
    - Zoning and Land Use Regulations Amendments
    - Capital Improvement Plan
- **Community Assets Vulnerability Analysis**
- **Getting to Resilience (GTR) and Community Rating System (CRS)** – There is an opportunity to revisit the work that has been undertaken towards increasing resiliency in the two years since GTR survey was taken. If the community puts into practice initiatives that increase community resilience, both communities could improve their ranking under FEMA's Community Rating System which could result in individual property owners receiving a reduction in their FEMA flood insurance.
- **Health Impact Assessment** – The Mystic Island Buyout HIA has been completed and the final report has recently been released.

- **NFWF grant** – There is a follow-up meeting scheduled for mid-June. The projected schedule calls for submitting the permit application in July, receiving permit authorization in September, and starting construction May 2017. The target completion date is the end of 2017. New Jersey Future submitted an application for additional funds for the living shoreline project to DEP under a section 319H non-point pollution control grant.
- **Public education and outreach** – New Jersey Future anticipates that the SRCC project will expand work undertaken through the Local Recovery Planning Manager program, with each successive project building a more detailed basis for decisions that will guide future development with consideration for the towns' future flood and inundation risks.

Shoreline assessment: By 2050 with SLR and/or hurricane impact, CAFRA centers are projected to experience significant flooding/inundation. New Jersey Future and Princeton Hydro are conducting a detailed examination of shoreline characteristics of both municipalities and compiling a Shoreline Assessment report. The goal of the Shoreline Assessment report is to identify critical issues that will serve as the basis for consideration of various future development scenarios.

Shoreline Assessment Objectives

1. Characterize shoreline.
2. Assess shoreline movement (shoreline migration between 1930 and 2012).
3. Identify areas of wetland loss (1930-2012).
4. Analyze erosion potential.

Process

- Explanation of how shoreline and infrastructure was inventoried and classified
- Evaluated shoreline change and calculated net shoreline migration (mostly loss, but some gains)
- Wetland loss: approximately 18% of wetlands have been lost due to a combination of development and erosion in the past ~80 years.
- Evaluated erosion potential to determine what areas will need protection (infrastructure to protect against future inundation)

Preliminary results and observations

- Much of the developed areas of the towns are bulkheaded.
- Unarmored areas that could be accessed (private lands were inaccessible) are showing signs of erosion
- Marsh is showing evidence of erosion and subsidence – Princeton Hydro is conducting a preliminary in-field marsh survey, taking elevation measurements.
- Critical infrastructure is at elevations close to Mean Higher Water – Princeton Hydro used survey-grade GPS to analyze elevation

Comments

- The cul-de-sac at Iowa Court on Osbourne Island has degraded and the road is cracked. The road has been undermined 3 ft. and the asphalt curls in warm water.
- Citizens expressed concerned about seeming lack of implementation of protections to prevent shoreline erosion; conservation approach taken by DEP; length of time taken to undertake protection measures.

Critical issues

New Jersey Future provided a preliminary list of critical issues and asked Steering Committee members to review and provide comments directly to David or at next Steering Committee hearing.

Steering Committee/public meetings schedule

- **Steering Committee Meeting #2**: Wednesday, July 20, 2016 at 10 am, location TBD.
- **Public meeting #1**: Tuesday, August 2, 2016 at 7:30 pm, at the Little Egg Harbor Community Center.
- S**teering Committee Meeting #3:** Wednesday, Sept 7, 2016 at 10 am, location TBD.
- **Public meeting #2**: Tuesday, October 4, 2016 at 7:30 pm, at the Little Egg Harbor Community Center.

Sea Level Rise/Flood Inundation

1. **Sea Level Rise:** The most densely developed areas In Little Egg Harbor Township (Mystic Island and Parkertown) and Tuckerton Borough (Tuckerton Beach) lie along the immediate coast. These areas, that sustained the majority of property damage during Hurricane Sandy, are extremely vulnerable to storm events and sea level rise. Just one foot of sea level rise will cause partial inundation of most streets in Mystic Island and every street in Tuckerton Beach. Little Egg Harbor Township is among the municipalities in Ocean County with the most repetitive loss events and amount of paid losses through the National Flood Insurance Program (NFIP). If no action is taken to minimize future inundation risk, by 2050, 34% of the area of Township, or over 9,000 acres, would be exposed to inundation from sea level rise. In Tuckerton 55%, or 1,100 acres, of the Borough would be at risk of inundation by 2050 from rising sea levels.

Marsh Health and Viability Over Time

1. **Erosion**: There is evidence of erosion along the edge of the existing marshes, mudflats, and stretches of unarmored shoreline. Expansion of streams within the area in both width and depth is another indicator of erosion. Streams are also extending farther into marshes and new smaller stream threads are cutting through the marsh. Erosion is a natural process, but it is accelerated by subsidence of the marsh systems, which is occurring concurrently. Erosion is also exacerbated by the frequency and intensity of wind, waves and boat wakes. Expanding stream and creek channels increase risk of flood exposure as stream beds gradually extend into developed areas

2. **Subsidence:** Subsidence is evident in the marshes, which is indicated by the presence of standing water on the marsh plain during receding tides and changes in the hydrology of the marsh. Natural pannes and pools on the marsh surface are expanding and tidal flushing of the marsh has been reduced. This results in stunted vegetation growth and loss of vegetation in areas where standing water does not drain. Subsidence in a marsh can compromise its capacity to accrete properly and maintain healthy vegetative communities. This deterioration in the health of the marsh may accelerate the erosion of the marsh.

3. **Slow Accretion:** Over time sediment deposits on the marsh plain. This process, called accretion, allows the marsh to remain elevated above sea level and enables vegetation to continue growing. However, a series of studies suggest that the marshes in this region will not accrete as quickly as sea levels rise. Slow accretion of the marsh will result in more frequent inundation of the marsh plain, which will stunt the growth of the vegetation communities and accelerate the erosion of the marsh.

4. **Marsh Migration Limitations:** As tides and coastal conditions change, marshes have a tendency to migrate inland. Areas of the existing marsh erode and new marsh areas expand landward. However, existing land use patterns in this area create a barrier to the marsh's landward migration limiting its capability to sustain the same expanse over time.

5. **Natural resource constraints:** Future development is limited or prohibited in certain environmentally-sensitive areas of the Borough, including wetlands, floodplains and critical wildlife habitats.

Shoreline Protection

1. **Overtopping:** Many of the bulkheads surveyed in the shoreline assessment do not have sufficient freeboard above existing mean high water levels to protect the shoreline under future conditions and will be frequently overtopped. Repetitive or forceful overtopping can undermine the structure and compromise its effectiveness and integrity.

2. **Inconsistent Protection:** Bulkheads and revetments help reduce risk of erosion and nuisance flooding, but such measures can also shift risk to adjacent property owners. Throughout both communities there are drastic inconsistencies in the elevation and application of armoring along the shoreline. There are several parcels that do not have armored shorelines and are therefore more susceptible to erosion, which may affect the existing armored shoreline stability on adjacent properties.
3. **Marsh vitality:** The current expanse of marsh offers considerable coastal protection. As the marsh erodes and shrinks over time, this level of protection will diminish and may increase the vulnerability of the community to future storm surges and wind, wake, and wave action.

Natural Resource Constraints

1. **Natural Hazards:** The County All-Hazard Master Plan determined that both towns are at risk for coastal erosion, ice jams, hurricanes, tropical storms, Nor'easters, climate change, wildfires and nuclear incidents.
2. **Soil limitations**: Much of the soil in the remaining developable areas along the towns' coast is too sandy or flood-prone to support additional development.
3. **Water Quality:** Development has caused significant environmental impacts including loss of natural lands and vegetation that absorb stormwater. Parts of Little Egg Harbor and Tuckerton are also experiencing noticeable negative effects from excessive water withdrawals which induce saltwater intrusion, threatening plant and animal habitat and potable water supplies and infrastructure.

Infrastructure Vulnerability

1. **Age of Infrastructure:** The Ocean County Multi-Jurisdictional All Hazard Mitigation Plan (2014) has identified critical infrastructure improvements needs to protect the towns from coastal erosion and flood related hazards. These include the repair and installation of bulkheads, seawalls, riprap, and bay-front energy dissipation structures.
2. **Road access:** There are only two major roads in Tuckerton Borough (South Green Street and Route 9) and three in Little Egg Harbor Township (Radio Road, Route 9 and Great Bay Boulevard). None of these roads adequately accommodate current or projected traffic volumes during seasonal and peak travel periods. These roadways also serve as evacuation routes but this function is compromised since portions of the roadways currently experience flooding during lunar tides, a condition that will become more frequent and extensive as sea level continue to rise.
3. **Salt water intrusion**: storm water system maintenance and management must include installation of backflow preventers on storm drain outlets to reduce potentially damaging saltwater backup. In Tuckerton this problem is particularly pronounced in the Tuckerton Beach area.
4. **Sewer system**: Power disruption caused by flood inundation during major storm events renders vulnerable sewer system pump stations inoperable causing sewer service back-ups.
5. **Utilities:** There is no uniform direction to guide the development of utilities systems to ensure that they are resilient. Both towns are susceptible to flooding from coastal storms along the bay which can lead to power outages and damage to utility infrastructure. In addition, during storms power loss contributes to problems with emergency communication and service. Little Egg Harbor's MUA does not currently have generators to operate during and after a storm event.

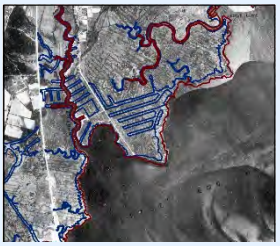
Planning/Zoning/Land Use Controls

1. **Land Use**: 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 of at risk areas, retain community character and preserve the Township's economic stability?

2. **Zoning regulations**: Developable land is limited and only available in certain zoning districts. In some cases land currently zoned to permit development is located in areas subject to increasingly frequent inundation. The Township's current zoning regulations and master plan do not reflect known risks from various hazards. It is important to consider the financial implications of maintaining and encouraging future residential development in areas subject to sea level rise and flood inundation. The vast majority of repetitive losses through the National Flood Insurance Program have been single-family residential dwellings within these areas.
3. **Capital Improvement Plans:** Capital Improvement plans should be regularly developed and are particularly critical to guide municipal investments in coastal areas at risk. The Strategic Recovery Plan recommends that the Township construct storm resistant infrastructure including equipment, pumps and buildings elevated above the flood hazard elevation and berms or levees to protect capital facilities. These investments should be based on a practical capital budgeting process to enable the township to ensure a balance between costs and tax revenues.
4. **Community Character:** Adaptation strategies that are being deployed in an uncoordinated fashion, largely without local, state or federal government involvement. This is having a significant adverse effect on community character, particularly where elevated structures are interspersed among at-grade dwellings. In addition, structures that are elevated are often considerably enlarged and are out of character and far more costly than pre-existing structures. Local decision makers should evaluate whether elevation is the appropriate response in the long-term.

Tuckerton and Little Egg Harbor Shoreline Assessment

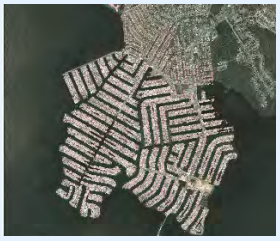


Shoreline Change

Since 1930 this area has seen significant changes including the development of lagoons and other neighborhoods, erosion and stream expansion in the marshes, and migration of the coastline. The shoreline has moved landward an average of 140 feet.

Erosion and Subsidence

There is evidence of erosion in marshes and along the shoreline. Erosion is a natural process, but is accelerated by subsidence, which occurs throughout the marsh and coastal area. It is also accelerated by frequency and intensity of waves and boat wakes.



Sea Level Rise

Many areas of both towns already experience periodic flooding from high tides. One foot of sea level rise will result in regular tidal inundation of every street in Tuckerton Beach and 55 percent of Little Egg Harbor Township.

Coastal Storm Risk

Tidal surges currently endanger approximately 1500 homes along the bay in Little Egg Harbor Township. This is projected to expand as storms increase in intensity, sea levels rise, and water temperatures warm.

Bulkheads and Shoreline Protection

93 percent of the parcels along the shoreline that have buildings have structures in place to minimize erosion and migration.

Bulkheads, if designed and maintained properly, help prevent erosion due to normal tides. Some bulkheads may provide limited protection to wave action during storms, depending on the height of the structure and the adjacent land.

Bulkheads do not prevent flooding by default and may be at risk for undermining or scouring as storms increase in frequency and intensity. Furthermore, inconsistencies in the heights or design of bulkheads may result in increased flooding of adjacent properties.

Marsh Health

There are 9,070 acres of saltwater marshes within Tuckerton Bay and Great Bay. This is approximately 82% of the area the marshes covered in 1930.

The marshes offer several benefits such as habitat, improvements to water quality and air quality. They also provide critical protection from coastal storms by slowing down waves, absorbing impact from tidal surges, and minimizing erosion.

Saltwater marshes are dynamic habitats that naturally migrate and evolve, but they can be vulnerable to erosion, subsidence, as well as degradation.

Activity such as ditching, dredging, and boat traffic can reduce marsh viability. Marshes may also be vulnerable to sea level rise.

Marsh migration within Tuckerton and Great Bay is constrained by developed land. As sea levels rise or land disturbances increase the marshes may not survive and the benefits they provide may be lost.

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES
Little Egg Harbor/Tuckerton Steering Committee Meeting

Wednesday, July 20, 2016
10:00 - 11:30

Police Department Training Room
665 Radio Road, Little Egg Harbor Township

AGENDA

1. Introductions
2. Review project objectives
3. Overview: current shoreline conditions/sea-level rise projections
4. Review existing Little Egg Harbor Township/Tuckerton Borough CAFRA center boundaries
5. Review vacant developable parcels map
6. Proposed future development scenarios
7. Implementation options
8. Next Steps/public meeting

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT
PROJECT DESCRIPTION

The New Jersey Department of Environmental Protection is reviewing its CAFRA regulations to ensure the future viability of resources within coastal areas. The study to be undertaken in conjunction with this grant will include: a detailed assessment of Little Egg Harbor Township's and Tuckerton Borough's shoreline to identify areas of change from 1930 to 2012; evaluate potential for erosion associated with shoreline structures (such as bulk heads); review of existing and draft planning documents (e.g. master plan, land use and zoning regulations, hazard mitigation plan), applicable CAFRA regulations, coastal development patterns, areas of projected flood risk; and recommendations of alternative planning scenarios designed to minimize or avoid future hazard risk for the Township's and Borough's consideration. The project consulting team is responsible for recommending changes to the NJDEP CAFRA regulations that will address future coastal hazard risk. This grant provides funding for the work of the consultant team, Township and Borough staff.

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES
Little Egg Harbor/Tuckerton Steering Committee Meeting

July 20, 2016

MEETING SUMMARY

Attendees:
John Schwartz .....Tuckerton Borough Council
Sam Colangelo.....Tuckerton Borough Council
Gene Kobryn .....Little Egg Harbor Township Council
Linda Stevens .....Little Egg Harbor Township Council
Robert Burr .....Little Egg Harbor Environmental Comm
Liz Semple .....NJDEP, Coastal Management Program, Office of Coastal & Land Use Planning
Rick Brown .....NJDEP, Coastal Management Program, Office of Coastal & Land Use Planning
Kelly Pflicke .....NJDEP, Coastal Management Program, Office of Coastal & Land Use Planning
Katie-Rose Imbriano.....BRS, Inc.
David Kutner .....New Jersey Future

1. **Review of Project Objectives**
   Principal objectives are to evaluate developed areas based on future flood inundation risk, identify risk mitigation strategies, propose changes to CAFRA rules that respond to coastal hazards, protect natural resources and can be replicated throughout the coast

2. **Review of Past Discussions**
   a. ***Three CAFRA Centers in Little Egg Harbor and Tuckerton***
      1) Parkertown (CAFRA Village – 60% impervious cover)
      2) Mystic Island (CAFRA Town Center – 70% impervious cover)
      3) Tuckerton (CAFRA Town Center – 70% impervious cover)

   b. ***Shoreline Assessment***
      1) Identified shoreline structures and habitat, shoreline movement, wetlands loss, erosion potential
      2) Reviewed results – unarmored areas showing signs of erosion; 18% of marsh area lost since 1930; marsh is showing evidence of erosion and subsidence
      3) NFIP payed out $187 million to Little Egg harbor Township – more than 25 other states; New Jersey ranks 3rd in the U.S. in terms of amount of NFIP payouts. NFIP program currently $28 billion in debt. Not likely to be able to receive these levels of federal assistance into the future.

3. **Development scenarios**
   a. ***Introduction***
      1) What degree of risk for future damage from storms is tolerable; at what point does the impact from storms become so severe that the community begins to change development patterns.
      2) Does the community want to consider land use regulations that would provide the greatest level of protection or do the communities want to continue follow a status quo approach with the understanding that there is some level of future exposure?
      3) One of the most effective tools that municipalities have to shape development patterns is zoning. But it is slow to achieve changes and existing uses are typically “grand-fathered” in.
         a) Discussion about including in Zoning, such as setbacks and design standards

b. ***Questions considered***

1) Where should land use change occur to avoid/minimize risk?
2) When should new regulations be put into effect?
3) What are the options to implement changes

c. ***Review Maps of Risk Areas***

1) How does the group feel about using the 500, 100 or 10 year floodplain boundaries to delineate the areas of risk?
2) What should development outside the areas of risk look like? How do you shift or re-locate growth?
3) In the areas that already completely built-out, municipalities need to consider planning and zoning strategies that would achieve adaptation.
4) The committee reviewed a map showing developable lands to evaluate future development potential. It was noted that Tuckerton does not have substantial amounts of remaining developable lands, much of the area of the Borough that can be developed has been.

d. ***Feedback***

1) Regulations: Any new development needs to consider accommodating areas that have to be re-located within the municipality. Concerns that remaining developable land has growth restrictions or is subject to state regulations like COAH and Pinelands. It was noted that it will be necessary to reconsider development potential in currently environmentally sensitive, vacant lands, particularly if development within high risk areas is shifted out of these areas creating new opportunities for habitat expansion and marsh migration.
2) Revenue: Commercial and property taxes are a major driver for local land use decisions. Using economic considerations, you want to encourage growth anywhere in the town.
3) LEHT feels like State Planning Commission is opposed to growth on SR-9 and CR-539 corridors, which have a PA-4 designation.
    a) Community supports the idea that NJ Future should advocate for more density and development in environmentally-sensitive areas and current areas that have development regulations in order to re-locate development away from the coast.
    b) Community generally supports the idea of not encouraging future development in the designated flood areas.
4) It was noted that much of the developable vacant lands shown on maps for Tuckerton are mostly currently being developed for single-family residential subdivisions, so there is basically no capacity to re-direct growth; adaptation or use of lots that have not been developed to full potential may be a better option.
5) It's important to take a holistic/region-wide approach.

e. ***When to implement a scenario***

Towns could define a variety of points in time when regulations would be put into effect:

1) Wait for the next major storm/hurricane
2) Ten-Year intervals as master plan is reviewed and updated according to state planning legislation.
3) Wait until a pre-established increment of sea-level rise occurs
4) Wait until a pre-determined change in property valuation occurs
5) A combination of the above perhaps

a) How many times should the town be exposed to or experience damage before making a decision to move out of high-risk areas? Condition is analogous to domestic violence, people put up with inordinate abuse until a point is reached when the abuse become intolerable. What does the government offer to help us get out or become more resilient?

b) The issue is so big and the problems so pervasive that community resilience cannot be addressed on a municipal level, but should be addressed on a county/regional/state level.

c) The current political may not be right for engaging in this conversation.

4. Implementation options

a. ***Reviewed list of 8 different implementation option***

1) Rolling easements/increased setbacks
2) Transfer development rights
3) Sea-level rise overlay zone
4) Targeted buyouts
5) Limit building size/density
6) Increase freeboard requirements
7) Gradually reduce services
8) Special flood hazard zone tax district
9) Combination of the above

b. ***Feedback***

1) Blue Acres program payments were based on pre-Sandy fair market values, which were low due to the recession conditions that preceded the storm. Consequently, payment offers were often not sufficient to secure replacement housing.
2) Need to include community resilience as an element in the municipality's Master Plan.
3) The idea of a special flood hazard zone tax district would probably not be viewed as a favorable option
4) Property owners who don't invest in armoring their properties (maintaining bulkheads) must be encouraged to do so that residents who do maintain them won't experience flood damage
5) Important to consider implementation of a variety of options and gain a full understanding of the negative or unintended consequences that may be associated with pursuing any of them.
6) It is easier to discuss changes that future populations would have to make than identify actions current residents need to consider because it is hard dispassionately evaluate economic impacts, changes to your own behavior, or leaving your current locations to avoid risk.

5. Next steps

a. Scenarios can be tailored to each of the triggers; preferred scenarios for various "when's"

b. Public meeting scheduled for August 2nd **PLEASE NOTE**: ***this meeting date has been changed to August 25th at 7:00 and will be held at JCNERR, 130 Great Bay Boulevard***

Sustainable and Resilient Coastal Communities

Little Egg Harbor/Tuckerton Public Meeting

August 25, 2016
7:00pm-8:30pm

Jacques Cousteau Coastal Center
130 Great Bay Blvd., Tuckerton Borough

AGENDA

1. **Introductions**
2. **Risk analysis recap**
3. **Project objectives**
   - Why is the analysis needed?
   - How should strategies be implemented?
   - When should action be taken?
4. **Breakout group discussions**
5. **Reconvene/group presentations**
6. **Next Steps - Where do we go from here?**

A BRIEF INTRODUCTION TO THE
SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT PROJECT

The New Jersey Department of Environmental Protection (NJDEP) is reviewing its coastal regulations (Coastal Area Facilities Review Act, CAFRA) to ensure the future viability of resources within coastal areas that are subject to future flood inundation risks. To accomplish this objective NJDEP has contracted with New Jersey Future, a non-profit organization, which has assembled a professional planning team to evaluate coastal development patterns and areas of projected flood inundation in three pilot communities - Little Egg Harbor Township, Tuckerton Borough and Toms River Township. Based on its assessment of development patterns and risk projections, New Jersey Future will recommend alternative planning scenarios, adaptation and/or mitigation options intended to minimize or avoid future hazard risk. The planning scenarios and implementation strategies will form the basis for recommending changes that will ensure that NJDEP's coastal regulations address coastal hazard risks municipalities throughout the state are likely to face in the future.

Poll: menti.com Code 13 47 20

OPEN MEETING

STRATEGIES TO REDUCE RISKS ASSOCIATED WITH FLOODING

All are invited

Date: **Thursday, Aug. 25, 2016**

Time: **7:00 to 8:30 pm**

Location: **Jacques Cousteau Coastal Center**
130 Great Bay Blvd., Tuckerton

The non-profit advocacy group New Jersey Future is hosting an open meeting for residents of Little Egg Harbor Township and Tuckerton Borough to discuss strategies to reduce risk associated with future storms and chronic flooding.

How - Implementation Options

1. **Rolling easements/increased setbacks**: ensure that wetlands, beaches, barrier islands, or access along the shore moves inland as shores erode and/or sea levels rise, no shoreline armoring

2. **Transfer development rights**: redirects development that would otherwise occur in areas of risk to areas that are designated to accommodate growth

3. **Sea-level rise overlay zone**: extends boundaries of the regulated floodplain and provides for relocation of development in highly vulnerable areas

4. **Targeted buyouts**: prioritize buyout activity based on risk

5. **Limit building size/density**: permit only smaller or more mobile structures that will be easily relocated

6. **Downzone**: limit development and redevelopment to low-density/low-intensity uses

7. **Restrict rebuilding**: prohibit redevelopment of storm-damaged structures in highly vulnerable areas or prohibit redevelopment of repetitive loss/severe repetitive loss structures

8. **Increase freeboard requirements**: increase freeboard consistent with projected SLR estimates. Require site surveys to confirm pre-construction elevations.

9. **Reduce services**: gradually limit or stop public infrastructure investments in areas at risk

10. **Special flood hazard zone tax district**: Tax residents who continue to live in areas at risk, tax amount based on the incremental difference in the costs to provide services (roads, stormwater, storm cleanup, sewer, water, gas, electric, bulkheads, communications, ER process)

11. **Disclosure requirements** in agreements of sale: notify all prospective owners of potential flood risk in addition to floodplain boundaries

12. Require **cumulative substantial damage accounting:** establishing a maximum payout based on the total of all claims filed beyond which no further assistance will be provided.

13. **Life rights** – grant current owner the right to live in a home for the duration of the owner's life but once that current owner no longer inhabits the property it cannot be resold or reused. In exchange the owner is paid a fair market value for the property at the time the life rights agreement is executed

14. **Municipal consolidation**- dissolve municipal boundaries to enable regional response to regional risks

15. **Combination of the above**

Breakout Group Questions #2

1. Should local officials from coastal communities consider future risk of flooding when they plan development? If yes, should the community plan for minimizing risk to the greatest extent or take a more moderate approach?
2. Where do you think the towns should permit residential development in the future; and where should future businesses and municipal functions such as schools, libraries, fire stations and police headquarters be located?
3. At what point do you think the tipping point might be reached when residents who live along the coast can no longer tolerate flooding and storm damage and are ready to take action to shift development patterns in order to address risks?
   a. The next major Sandy-like hurricane?
   b. When nuisance flooding occurs every day?
   c. Some pre-determined increment of sea-level rise?
   d. A pre-determined change (drop) in property values?
   e. Every ten years when the municipality is required to update its community master plan?
   f. Some combination of the above?
4. We presented several options that Little Egg and Tuckerton could consider to shift future growth to areas that have lower risk of flood inundation. Which one(s) do you think might be supported by you and other residents of the town? Can you think of others? (*Need to review options during opening presentation*)

How

1. Rolling easements/increased setbacks - ensure that wetlands, beaches, barrier islands, or access along the shore moves inland as shores erode and/or sea levels rise (buffer management plans). Shoreline armoring that would stop inland shoreline migration would be prohibited and structures seaward of the rolling design boundary would be barred
2. Transfer development rights – redirects development that would otherwise occur in areas of risk to areas that are designated to accommodate growth
3. Sea-level rise overlay zone- extends boundaries of the regulated floodplain and provides for relocation of development in highly vulnerable areas
4. Targeted buyouts- prioritizes buyout activity based on risk
5. Limit building size/density- permit only smaller or more mobile structures that will be easily relocated
6. Downzone: limit development and redevelopment to low-density/low –intensity uses
7. Restrict rebuilding- prohibit redevelopment of storm-damaged structures in highly vulnerable areas or prohibit redevelopment of repetitive loss/severe repetitive loss structures
8. Increase freeboard requirements- increase freeboard consistent with projected SLR estimates.
9. Gradually reduce services- limit or stop public infrastructure investments in areas at risk

10. Special flood hazard zone tax district (San Francisco Bay passed (on June 7, 2016 with approval of 69% of voters) a regional $12 tax on all parcel owners, proceeds to go to shoreline protection from coastal flooding and marsh restoration). Tax residents who continue to live in areas at risk based on the incremental difference in the costs to provide services (roads, stormwater, storm cleanup, sewer, water, gas, electric, bulkheads, communications, ER process)
11. Combination of the above

STRATEGIC AND RESILIENT COASTAL COMMUNITIES

Little Egg Harbor/Tuckerton Public Meeting

r **Jacques Cousteau National Estuarine Research Reserve (JC NERR)**

August 25, 2016 - 7:00 pm

MEETING NOTES

Introduction

- Introductions
- Review of NJ Future mission
- Introduction to Menti polling system and crowd questions

Risk Analysis Recap

Purpose: Evaluate vulnerability to likely hazards;

Objective: Prioritize those actions that most effectively reduce/avoid future loss. FEMA prioritized Sandy recovery by rebuilding in place, potentially putting residents at risk.

Process: Inundation Extent
Inundation Depth
Estimation of Exposure

Results: Series of maps delineating limits of flooding, present and future

Review of Project Objectives

Pilot a comprehensive planning approach that:

- responds to coastal hazards (future risk);
- protects coastal resources;
- meets local needs;
- defines a predictable NJDEP permitting process;
- is replicable throughout the coast.

Reviewed and defined implementation options.

When should action be taken? Most people responded with – "combination of potential timeframes." Most people are ready to move forward.

Showed maps of conservation and growth zones with vacant/developable lots.

Breakout group discussions

Group 1 comments:

- No matter what implementation tools are selected, existing residents should be grandfathered in.
- Intergovernmental cooperation is important.
- Residents are concerned about the municipality permitting high-density development in vulnerable areas.
- Residents are concerned about a decline in housing values and their inability to sell.
- Consider the economic impact of each implementation option
- Rolling easements would have to be phased in and the impacted owners bought out.
- It would be difficult to re-locate Tuckerton residents at risk within the Borough because there is not enough vacant, developable land.

- Buy-outs could be held up if many residents refused to sell, and programs like Blue Acres should consider buying up individual properties, not an entire block at a time.
- There was support for #7:
  7. Restrict rebuilding: prohibit redevelopment of storm-damaged structures in highly vulnerable areas or prohibit redevelopment of repetitive loss/severe repetitive loss structures.
    - Some group members thought that once a home had been substantially damaged, the owner should not be allowed to re-build or re-sell, but instead be bought out.

- There was strong opposition to #9 and #10:
  9. Reduce services: gradually limit or stop public infrastructure investments in areas at risk
  10. Special flood hazard zone tax district: Tax residents who continue to live in areas at risk, tax amount based on the incremental difference in the costs to provide services (roads, stormwater, storm cleanup, sewer, water, gas, electric, bulkheads, communications, ER process)

Group 2 comments

- There was strong opposition to #9 and 10 (see above).
- There was support for "Life rights" and "Buy-outs,"
    - Keep in mind that many people who move will re-settle near the shore because of their lifestyle preferences.
    - Buy-outs should be targeted at existing foreclosures.
- Disclosure requirements (during real estate transactions) need enforcement.
- Target high-risk areas for education on vulnerability
- Cumulative accounting damage should be assessed at the local level.
- If there is enough impact, people will leave eventually but residents should not have to wait until that point.

Reconvened/reported back

Questions

- Clarifying questions from participants about reasons for high NFIP payments; reasons for NFIP bankruptcy; whether or not Little Egg Harbor is less safe than other NJ coastal communities.
- Could marshes be built up to accommodate for Sea-Level Rise? Marshes/wetlands are part of a dynamic system and need to remain at a certain elevation, and it is hard to predict how they will be sustained in the future. Current studies will inform future knowledge of wetland protection.
- Are there examples of successful implementation options from other communities? Yes, but they are mostly in other states. There are also examples from communities impacted by riverine flooding.

Comments

- There is a weak cost-benefit discussion with the facts that we have.
- A lot of factors come into play when building community resiliency into a Master Plan and Zoning Code because of potential legal challenges.
- Lots of negative reactions to descriptions of implementation options.
- Advertise the upcoming meeting more broadly – concern about broader participation.

Next steps

- There will be a second public meeting, and an upcoming steering committee.

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES
Little Egg Harbor/Tuckerton Steering Committee Meeting

Thursday, September 15, 2016
2:00 – 3:30

Police Department Training Room
665 Radio Road, Little Egg Harbor Township

AGENDA

1. Introductions
2. Review outcome of 8-25-16 public meeting
3. Proposed future development scenarios
4. Implementation options
5. Implementation timing
6. Next Steps

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT
PROJECT DESCRIPTION

The New Jersey Department of Environmental Protection is reviewing its CAFRA regulations to ensure the future viability of resources within coastal areas. The study to be undertaken in conjunction with this grant will include: a detailed assessment of Little Egg Harbor Township's and Tuckerton Borough's shoreline to identify areas of change from 1930 to 2012; evaluate potential for erosion associated with shoreline structures (such as bulk heads); review of existing and draft planning documents (e.g. master plan, land use and zoning regulations, hazard mitigation plan), applicable CAFRA regulations, coastal development patterns, areas of projected flood risk; and recommendations of alternative planning scenarios designed to minimize or avoid future hazard risk for the Township's and Borough's consideration. The project consulting team is responsible for recommending changes to the NJDEP CAFRA regulations that will address future coastal hazard risk. This grant provides funding for the work of the consultant team, Township and Borough staff.

Sustainable and Resilient Coastal Communities

Little Egg Harbor/Tuckerton Public Meeting

October 4, 2016
7:00pm-8:30pm

Little Egg Harbor Community Center
317 West Cala Breeze Way, Little Egg Harbor Township

AGENDA

1. **Introductions**
2. **Risk analysis recap**
3. **Review 8-25-16 public meeting outcomes**
4. **Proposed development scenario**
5. **Implementation options**
6. **Implementation timing**
7. **Questions, next steps**

A BRIEF INTRODUCTION TO THE
SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT PROJECT

The New Jersey Department of Environmental Protection (NJDEP) is reviewing its coastal regulations (Coastal Area Facilities Review Act, CAFRA) to ensure the future viability of resources within coastal areas that are subject to future flood inundation risks. To accomplish this objective NJDEP has contracted with New Jersey Future, a non-profit organization, which has assembled a professional planning team to evaluate coastal development patterns and areas of projected flood inundation in three pilot communities - Little Egg Harbor Township, Tuckerton Borough and Toms River Township. Based on its assessment of development patterns and risk projections, New Jersey Future will recommend alternative planning scenarios, adaptation and/or mitigation options intended to minimize or avoid future hazard risk. The planning scenarios and implementation strategies will form the basis for recommending changes that will ensure that NJDEP's coastal regulations address coastal hazard risks municipalities throughout the state are likely to face in the future.

OPEN MEETING

STRATEGIES TO REDUCE RISKS ASSOCIATED WITH FLOODING

All are invited

Date: **Tuesday, Oct. 4, 2016**

Time: **7:00 to 8:30 pm**

Location: **Little Egg Harbor Community Center**
317 West Cala Breeze Way, Little Egg Harbor Township

The non-profit advocacy group New Jersey Future is hosting the second of two open meetings for residents of Little Egg Harbor Township and Tuckerton Borough. The objective of this meeting is to discuss strategies to reduce risk associated with future storms and chronic flooding.

Press Release

Statement:

The non-profit advocacy group New Jersey Future is hosting an open meeting for residents of Little Egg Harbor Township and Tuckerton Borough. This is the second of two public meetings being held in conjunction with the Sustainable and Resilient Coastal Communities project funded through the New Jersey Department of Environmental Protection. The objective of the upcoming meeting is to discuss a specific strategy approach for reducing risk associated with future nuisance flooding and storm events.

Date: Tuesday, Oct. 4, 2016

Time: 7:00 to 8:30 pm

Location: Little Egg Harbor Community Center, 713 W. Cala Breeze Way

Press Release:

Residents and interested parties from Little Egg Harbor Township and Tuckerton Borough are invited to a meeting to consider specific strategies the towns can implement to help minimize or avoid risks associated with future flooding and storm events.

In the almost four years since Hurricane Sandy, the New Jersey coast has experienced several storms that underscore the vulnerabilities faced by coastal and bayfront communities. Residents of Little Egg Harbor Township and Tuckerton Borough have a new opportunity to explore how to address their growing vulnerability to these increasingly frequent storms and floods. New Jersey Future will host an open meeting at the **Little Egg Harbor Community Center, 317 West Cala Breeze Way** in **Little Egg Harbor Township**, on **Tuesday, Oct. 4** from **7:00 pm to 8:30 pm**. All borough and township residents, business owners, and interested parties are invited.

Sea level rise has increased the frequency and magnitude of regular, or “nuisance,” flooding and the intensity of periodic storms, putting New Jersey’s coastline at growing risk. Thoughtful, long-range planning in coastal communities is essential if they are to avoid the devastation caused by these storms. New Jersey Future, a non-profit organization that advocates for smart planning, has been working with Little Egg Harbor Township and Tuckerton Borough for the last three and a half years to help community leaders understand their future flooding risks.

The organization has initiated a new project, the Sustainable and Resilient Coastal Communities project funded through the New Jersey Department of Environmental Protection, to identify adaptation strategies. Several of these strategies were initially presented at a public meeting on Aug. 25, 2016. At the Oct. 4 meeting, New Jersey Future, along with representatives from both municipalities, will present a coastal development scenario and strategies for its implementation.

PROPOSED DEVELOPMENT SCENARIO

Scenario Overview

Risk-Based overlay zoning recommendations designed to minimize or avoid future flood exposure/hazard risks. The planning scenario and implementation options/strategies will form the basis for recommending changes that will ensure that NJDEP's coastal regulations address coastal hazard risks municipalities throughout the state are likely to face in the future.

Zones

Zone1: Conservation Zone

Objective: Ensure minimal properties experience frequent tidal flooding in 2050; allow for marsh migration.

Method: Gradually shift/reduce existing development, limit new development or redevelopment to open space, agriculture, recreation, ecological restoration, water-dependent uses (i.e. development that cannot physically function without direct access to the body of water along which it is proposed - e.g. docks, piers marinas).

Recommended extent: All land seaward of the 2050 MHHW line

Implementation Options:

- Rolling easements
- Restrict rebuilding
- Targeted acquisitions
- Special tax district
- Transfer of Development Rights
- Life Rights
- Disclosure requirements
- Limit Building size/density Downzone
- Increase freeboard requirements
- Adopt more resilient design guidelines and codes for building
- Ensure site ingress/egress is above BFE
- Modify substantial damage threshold/calculation

Zone 2: Managed growth

Objective: Reduce the property damage sustained from coastal storms.

Recommended extent: All land within the FEMA 10% flood zone in 2050, but landward of MHHW line.

Implementation Options:

- Limit Building size/density Downzone
- Restrict rebuilding
- Target acquisitions
- Increase freeboard requirements

- Adopt more resilient design guidelines and codes for building
- Ensure site ingress/egress is above BFE
- Special tax district
- Disclosure requirements
- Modify substantial damage threshold/calculation

Zone 3: Manage growth

Objective: Reduce the property damage sustained from coastal storms.

Recommended extent: All land within the FEMA 1% flood zone in 2050, not included in zones above.

Implementation Options:

- Restrict rebuilding
- Target acquisitions
- Increase freeboard requirements
- Adopt more resilient design guidelines and codes for building
- Ensure site ingress/egress is above BFE
- Disclosure requirements
- Modify substantial damage threshold/calculation (cumulative substantial damage accounting)

Zone 4: Manage growth

Objective: Limit public investment and critical infrastructure in areas that may have increased flood risk in the future.

Recommended Extent: All land within the FEMA .02% flood zone in 2050, not included in zones above.

Implementation Options:

- Limit or exclude all uses that require substantial evacuation assistance and would not have capability to shelter in place for extended periods
- Establish freeboard requirements
- Limit installation of critical public facilities and infrastructure
- Disclosure requirements

Timing Options

- After next major coastal storm event
- 1.5’ SLR vs current MHHW
- Hazard Mitigation Plan update cycle (every five years)
- Master plan update cycle (every ten years)
- Combination

STRATEGIC AND RESILIENT COASTAL COMMUNITIES

Little Egg Harbor/Tuckerton Public Meeting

Little Egg Harbor Community Center
October 4, 2016 - 7:00 pm

MEETING NOTES

1. **Introductions**
   David Kutner introduced New Jersey Future and the objective of the project. Leah Yasenchak passed out index cards for people to jot down questions as the meeting progresses.

2. **Risk analysis recap**
   David provided background on the Local Recovery Manager program and described the process undertaken to develop the vulnerability assessment.

   Participants acknowledged by a show of hands that flooding was occurring currently. David showed on the map that the area of inundation is primarily where marshes are. These provide protection to the community; they cannot stand constant inundation – they will disappear by 2050 if nothing is done.

   With a storm in 2050; additional area will be inundated. 1% storm has a 1 in 100 chance of occurring. By 2050, it is projected that a storm with the intensity of a 1% storm today will occur more frequently (the equivalent of a 10% storm).

   David explained that the purpose of the Coastal Resiliency project is to develop a process for the coastal regulations moving forward to address the larger issue of risk. Little Egg Harbor, Tuckerton, and Toms River are pilot communities looking at what actions we could take.

3. **Review 8-25-16 Public Meeting outcomes**
   Discussed on 8/25 was: Why is the project needed (risk analysis); what we can do? (Implementation options); and when should we do it?

   Participants at that meeting were asked questions such as: How often are you seeing impacts? (Most people are seeing flooding regularly.) When do you think residents willing to acknowledge that change needs to happen? (Majority felt that people would be ready to address issues after a combination of trigger events.)

   We then looked at a few different scenarios with the public and spoke with steering committee to determine preferred path forward in terms of triggering events and implementation options.

   Participants in the October meeting were asked whether they were ready to address the problem. Most people said that they don't like it, but understand that they need to do something.

4. **Proposed development scenario**
   WHERE: David explained the concepts of a conservation zone using projected 2050 mean high-high to allow marshes to migrate; an Accommodation Zone using projected 2050 10% storm and 1% storm to limit the investment in public infrastructure and establish freeboard requirements; and a Growth Zone landward of .02 flood zone with disclosure requirements.

5. **Implementation options**

   HOW: a detailed handout was provided which defined the implementation options and illustrated which are likely to be associated with which zone. These include: special tax district; rolling easements; restrict rebuilding; targeted acquisition; transfer development rights; life rights; disclosure requirements; limiting building size and density / downzoning; adopting more resilient design codes; ensuring site access above BFE; modifying the substantial damage limits (cumulative substantial damage accounting; or reduce the amount required to meet substantial damage, for example).

6. **Implementation timing**

   WHEN: When should this be put into effect? David said that while he would like to put them in place now, the reality is that it will take time for people to be ready to accept this. People like living at the shore, there is an incredible psychological and social investment in living at the shore. We are looking at a trigger event of waiting for next major storm to trigger the implementation options or 1.5 feet of sea level rise, whichever occurs first.

   Other options:
   Master Plan (10 years), County hazard mitigation plan (5 years), predetermined valuation drop (currently the value of coastal properties continues to rise. Sooner or later property values will start to reflect the impact of sea level rise and continued flooding.) Could be a combination of many different triggers. These are the recommendations we are making to the towns and the State as they think through their decision making process for capital expenditures, planning, zoning, etc.

7. **Questions, next steps**

- In the event of another storm, would FEMA change the flood maps again?

They are still in the process of revising them. An executive order was passed in Jan that feds and states need to take into account sea level rise into investment decisions.

- In LBI, homeowners are required to raise up the bulkhead; CAFRA set up to prevent building o dunes. We are paying about 28% more in taxes, everyone is a contributing member of the community. Need to adopt more height on the bulkheads. Puts a financial burden on the residents. When do we make the decision? Townspeople need to be the ones making the decision.

We are trying to start the conversation, b/c right now the community has time to think about this issue. There is nothing occurring at the state level to compel communities to think through this issue.

Changes to the CAFRA rules will be a long, public process.

Raising the residential units and raising the bulkheads will all help. However, elevating is a short term response, because you can't elevate the roads, sewage, water, etc. You won't be able to access them as you do now. Elderly and disabled people are less able to access elevated units.

- How do you determine how it gets phased in?

We are making recommendations to the towns as to how, what, and where it gets phased in. We are defining the proposed zones based on NFIP Flood zones.

- Who is going to pay for it? People would have to move inland – they are not insured for that kind of change. After Sandy there was chaos with the contractors; people were taken advantage of.

There are some options for how to fund it, but the cost of not doing anything is greater. The State /Feds have to come forward, because the municipality won't be able to afford it.

- Iowa Court, Osborne Island – was about 300 yards out 16 years ago; water comes from wetlands, rarely goes over the bulkhead
- To pay for the mitigation – out of 30 homes 6 were raised, 6 demoed with new homes, another awaiting demo; $150k per year now in taxes – when homes get COs, taxes will be higher. People understand that in 25 years, these homes will not be livable. They need to raise the roads and the sewage – use 10% of the taxes to be put away to enable the town to raise the roads in 10-15 years when it will really be a problem. NJF can advocate for additional state money. There has to be a way to not hang the current politicians out to dry, to put money aside for future infrastructure needs. Start now in baby steps, and take bigger steps as the flooding gets worse.

We talk to the elected officials, drive state policy toward a better outcome; it is a piecemeal effort until there is a more holistic approach.

- Why isn't there a mandate in LEH for bulkheading? That is an immediate solution to a problem.

Towns are starting to look at that now; building risk analysis into the decision making process. These strategies are costing a lot of money. There is a requirement that when the property changes hands to put in a bulkhead, but the town is not enforcing it.

- This is not a municipal problem, this is a federal problem. Our representatives aren't requesting enough money back to address these problems. NJ gets a lower rate of return on income taxes paid then most other state.

Personal opinion is that we all need to contribute – NJ gets more back in NFIP payouts than 48 other states. It needs to come from all levels.

- Blue acres buyback – people started rebuilding right away, when blue acres buyout call came out, people had already started building. Blue acres only wanted entire neighborhoods, and were willing to give pre-Sandy market value (which is less than what the value was in 2008).
- I don't see how you are going to stop the flooding. Water floods, come straight across the wetlands, you can raise all the houses, but the water will still come. No alternative other than buying out properties. Water is coming up more than ever before.
- People in Louisiana have raised their houses three times; LEH has never been a rich town, can't put that cost on these people. Why do you spend that money for a home that will have a 25 year shelf life? We need to do something about it.

The work we have been doing for the last 4 years is to make sure we don't let more time go by.

- There are sections of Miami that are raising their streets – are there other examples we can learn from?

All of the options we are talking about are being employed in other communities across the country. Nowhere are they looking at employing the combination of strategies that we are.

- People that have flood insurance and pay the $ to the ICC, why not do pre-mitigation – use insurance $ to let them mitigate now? $30k was the average cost to raise the house when they developed the amounts – no longer a relevant option.
- Zoning takes a long time to become realized, so we need to think about it now.

- No one is listening. Taxes are going up, property values are going down. Why isn't the town doing something? We are losing money on our homes. Mystic island is depressed, empty homes, high taxes. LBI is in worse shape, what are people saying about LBI?

Town officials are participating in the dialogue.

- 20 houses on Iowa Ct; 8 were destroyed, the rest were fixable. 4 of the destroyed homes were rebuilt as million dollar homes. 50 years from now, there will be no lagoons or houses. Only way to get out of it, is to get blue acres buyouts.

Barnegat Bay Foundation Stanton Hales – this is a difficult discussion that needs to take place. Financial resources are at stake. We need to discuss the vision for what we want the area to look like. Some places along the coast have a future, some don't. We need to set something in motion that allows us to move away from those places with no future. We need to educate the public on what gov't can and cannot do. Get the fed government to allow insurance to take into account future risks.

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES

Toms River Steering Committee Meeting

Thursday, October 18, 2016
3:00

Sunshine Meeting Room
33 Washington Street, Toms River Township

AGENDA

1. Introductions
2. Review project objectives
3. Review future development scenarios
    a. What changes may be warranted
    b. Where should changes occur
    c. How changes can be implemented
4. Next Steps

SUSTAINABLE AND RESILIENT COASTAL COMMUNITIES GRANT
PROJECT DESCRIPTION

The New Jersey Department of Environmental Protection is reviewing its CAFRA regulations to ensure the future viability of resources within coastal areas. The study to be undertaken in conjunction with this grant will include: a detailed assessment of Little Egg Harbor Township's and Tuckerton Borough's shoreline to identify areas of change from 1930 to 2012; evaluate potential for erosion associated with shoreline structures (such as bulk heads); review of existing and draft planning documents (e.g. master plan, land use and zoning regulations, hazard mitigation plan), applicable CAFRA regulations, coastal development patterns, areas of projected flood risk; and recommendations of alternative planning scenarios designed to minimize or avoid future hazard risk for the Township's and Borough's consideration. The project consulting team is responsible for recommending changes to the NJDEP CAFRA regulations that will address future coastal hazard risk. This grant provides funding for the work of the consultant team, Township and Borough staff.