

## EXECUTIVE SUMMARY

This report summarizes the work of two NOAA-funded graduate fellows research on community-level coastal flood management and climate change adaptation best practices throughout the North Atlantic region (Virginia to Maine). Guided by a steering committee composed of government and academic personnel involved with climate adaptation throughout the North Atlantic, the fellows visited coastal communities to collect information on low-cost climate change and related coastal hazard management best practices. The purpose of the work was to identify and collate cost-effective adaptation projects implemented at the municipal level, to provide NOAA with best practice information to assist with ongoing adaptation outreach.

Best practices were defined as innovative initiatives aimed at increasing resilience to coastal flooding and storm-related hazards. These best practices range from a community's efforts to decrease flood risk with systematic infrastructure designs, local climate adaptation plans, or legal mechanisms that support resilient development. Qualifying practices had to be voluntarily adopted by a local government and either not required or more stringent than state or federal law. Practices could explicitly incorporate climate change or sea level rise concerns or not. Those that did not explicitly incorporate climate change had to include coastal flooding or hazards exacerbated by climate change.

Additionally, the research aimed to identify best practice constraints or other unique conditions that determine how transferable a best practice is from one community to another. A primary goal of this work was to encourage a peer-to-peer network among community leaders to share climate change, sea level rise and flood management best practices.

Data were gathered through a search of municipal plans and codes, as well as semi-structured interviews with municipal officials and staff, conducted from July 2012 through October 2012. Follow-up surveys were conducted to gather more specific data on costs and funding sources. Two to five municipalities in each state were chosen based on a literature review in coordination with a steering committee of experts from NOAA, Sea Grant, and NGOs. Communities varied in size, from New York City with a population over 8 million, to Greenwich Township, New Jersey, just 100 miles away, with a population of about 800. The median population of our sample was 58,520. To be included in the study, communities had to be coastal, but varied significantly in geomorphology. Coastlines could include bays, harbors, open ocean shores, and sounds. Two of our sample communities were located entirely on barrier islands. Adaptation practices were classified on a variety of dimensions – Adaptation Strategy; Adaptation Practice; Adaptation Sub-Practice; Phase; Incorporation of Climate Change; Impact; and Standard. Approximate costs were obtained as well as funding sources for those projects that were separately funded.

**Adaptation Strategy:** The Intergovernmental Panel on Climate Change (IPCC) identified three types of strategies to address sea level rise from climate change: Retreat, Accommodation, and Protection (IPCC 1990). We classified adaptations as any of those three strategies and added two others – Prevention and Procedural – for those projects that did not fall into one of the IPCC categories.

- **Retreat/restoration** is defined as allowing for existing coastal ecosystems to shift landward.

Examples include buyout of repetitive loss properties and transfer of development rights. These were the rarest type of adaptation found, representing only 3% of projects.

- **Accommodation** is defined as adaptations that strengthen the resilience of existing or new structures, such as freeboard requirements. 21% of projects were classified as accommodation.

- **Protection** is defined as actions taken to protect land from inundation by rising seas and storm surge, such as elevating sea walls or beach nourishment. Protection projects represent 6% of the strategies found. These are relatively rare, since these types of adaptations are often not low-cost.

- **Prevention**, one of the new categories, is defined as anticipatory actions taken to protect or preserve land in its natural state that prevents exacerbation of exposure to coastal hazards, such as land conservation or coastal setbacks. 19% of projects were classified as prevention.

- **Procedural** adaptations are defined as projects that aim to generate climate information, disseminate such information, or incorporate such information into other plans or policies.

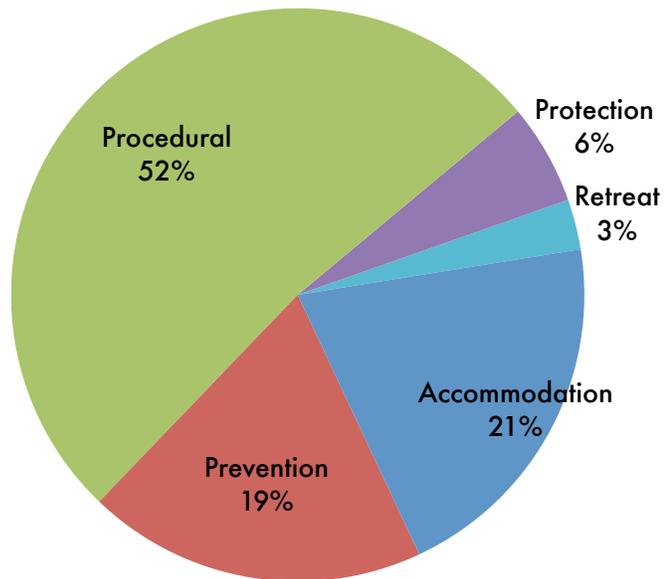


Figure 0:1 - Distribution of adaptation strategies

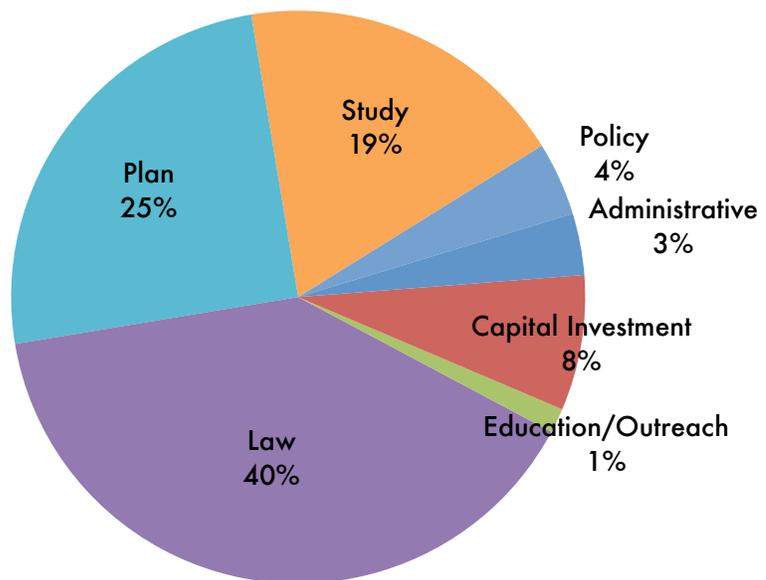


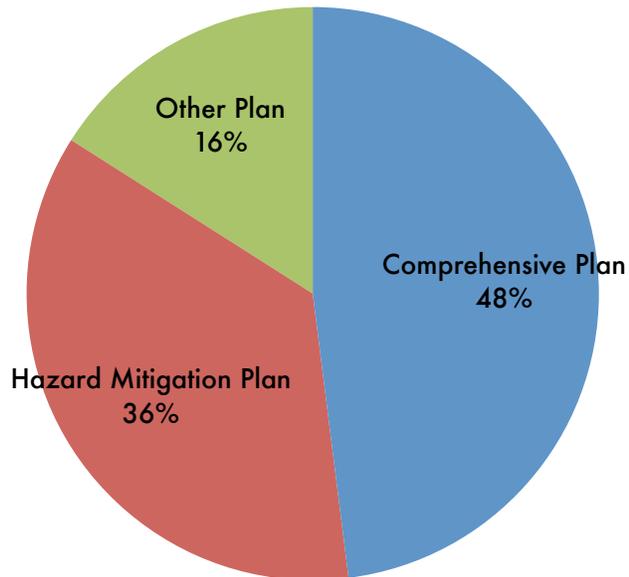
Figure 0:2 - Distribution of adaptation practices

Examples of procedural adaptations are projects such as studies, mapping exercises, administrative or educational programs, or those projects that incorporate climate change into a hazard mitigation or comprehensive plan. 52% of strategies were classified as procedural.

**Adaptation Practice:** All of the adaptations also fall into one of six “practice” categories: Plans, Studies/Pilot projects, Education/Outreach, Capital Investments, Policies, Laws and Administrative Actions.

**Plans:** Plans are process-driven documents that serve as guidance for future decision-making. The two major types of plans found in our sample were *Comprehensive Plans and Hazard Mitigation Plans*.

*Comprehensive Plans*, otherwise known as Master Plans or Land Use Plans, are statutorily defined and sometimes required in each state. They prescribe land uses and are most often implemented through the zoning and subdivision ordinance. Plans that incorporated climate change or sea level rise were referenced in our findings. The extent of such incorporation varies significantly – from mere mention to thorough incorporation in every section. In some states, plans do not have the force of law and are just recommendations. In Maine, zoning ordinances must comply with the municipality’s comprehensive plan within five years of adoption. In Rhode Island, local comprehensive plans must now incorporate sea level rise and climate change by law. *Hazard Mitigation Plans*, required by the Disaster Mitigation Act of 2000, are another venue for considering and incorporating climate change issues. Towns that have done so include



Barnstable, MA, Brewster, MA, Guilford, CT, New Haven, CT, and Poquoson, VA.

**Figure 0:3 - Types of plans that towns incorporated climate change in**

Other plans we found include a Comprehensive Waterways Management Plan in Hampton, VA; a Land Protection Plan in Hull, MA; an Open Space Plan in Little Silver, NJ; Local Waterfront Revitalization Plans, found in all our towns in New York; and PlaNYC, a comprehensive sustainability plan. Most projects that involve climate change plans are classified as studies/pilot projects if they were primarily the latter.

**Studies and pilot projects:** (19% of adaptations) often result in stand-alone documents that issue recommendations, and are sometimes woven into a climate change plan. They are often collaborative efforts with multiple partners including universities, state coastal management agencies, and NGOs. They usually employ modeling to determine risks and often include a vulnerability assessment. Examples include the Greenwich Township, N.J. Coastal Community

Vulnerability Assessment Tool as well as the Climate Change Adaptation Project in Barnstable, MA, and other New England towns led by the Consensus Building Institute, the Massachusetts Institute of Technology, and the National Estuarine Research Reserve System.

Ideally, studies should be tied into planning efforts. Some communities have incorporated climate change information generated by a study into other municipal plans. Guilford, CT, participated in a Nature Conservancy and Yale University project called the Community Coastal Resiliency Plan. It subsequently incorporated the information gathered into its Comprehensive Plan of Conservation and Development as well as its Hazard Mitigation Plan. Bowers, DE, participated in the Vulnerability Assessment and Delaware Coastal Resiliency Action Plan and is planning to comprehensively rezone the town to allow the commercial district to relocate to a less vulnerable part of town. Other towns that have incorporated climate information generated from pilot projects into their comprehensive plans include Greenwich, CT, and Marshfield, MA. Some towns—such as East Hampton and Southold, NY, and York, ME, have incorporated or referenced climate change in their plans although they have not participated in a formal study. East Hampton, NY, Southold, NY and York, ME, are examples of communities that have done this.

**Education and outreach programs** that were profiled in our sample were small in number (1% of actions) but can be big in impact. Many towns do required outreach as part of their climate, comprehensive, or flood mitigation planning processes, but the town of Greenwich, CT, and Portsmouth, VA, have exemplary outreach efforts that go far beyond required minimums.

**Capital investments** (8% of adaptations) most often involve financing the construction or maintenance of a green or gray infrastructure project. Examples include Bowers, DE, which bought out a repetitive loss property and converted it into Main Street Park with a bocce ball court; Poquoson, VA, constructed all new pump stations above the 100-year flood level; Little Silver, NJ, installed a flood gauge warning system; Scarborough, ME, established an open space fund; and Ocean City, NJ, self-funded the maintenance of its beach renourishment and protection project.

**Policy** adaptations, representing 4% of our sample, are wide-ranging in scope. They include executive orders or administrative actions, such as the adoption of engineering standards for public works that incorporate climate considerations in Groton, CT; Poquoson, VA's 4.5 ft. elevation standards for new roads; the City of New York Department of Parks and Recreation's inclusion of climate adaptation measures in their high-performance guidelines describing best practices for planning, design, construction, and maintenance of city parks; and the establishment of a coastal advisory committee in Marshfield, MA.

**Laws** are the most common type of adaptation, representing 40% of those found. Laws, which at the local level are often called ordinances or bylaws, create mandatory expectations of compliance. They are enforced by city administrative staff and the courts, and result in some type of penalty for failure to comply. In the context of climate change adaptations, they most often apply to building and zoning codes. Examples include shoreline setbacks, freeboard elevation requirements, dune and wetland conservation ordinances, cluster ordinances, and

shoreline hardening restrictions. The most stringent example of a freeboard elevation ordinance was found in Ocean City, MD, which requires up to 5.5 feet in FEMA-designated “V”<sup>1</sup> zones.

**Administrative** actions are those activities taken by a government that involve process. Examples include appointment of a waterways grants manager in Hampton, VA; establishment of a permanent mitigation planning team in Lewes, DE; a FEMA cooperative mapping project taken on by New Castle County, DE; and the establishment of coastal erosion districts in East Hampton, NY which are a mechanism for residents to self-fund beach infrastructure projects.

Projects were also classified by whether they explicitly incorporated climate change. About half of the projects were found to have explicitly incorporated climate change. The enforceable adaptations in the form of local laws and ordinances most often do not specifically incorporate climate change information, since most respond to discernible risks such as flooding. This may also be a legacy of traditional flood management model ordinances and state and federal law frameworks. Many times, however, these are tied together, in that climate change studies recommend actions to reduce flood damage expected to be worsened by projected sea level rise, for instance, by increasing required freeboard in flood hazard areas.

Adaptation projects were also grouped into four enforcement strengths, called Impact. Lastly, projects were classified by whether they were completely unique to the municipality or were implementations of a state or federal law that was more stringent than required. This category describes the Standard of the adaptation.

We found that systematic incorporation of climate change concerns into formal community planning, management, and infrastructure design is in a nascent stage. Yet we found innovative climate change and flood management practices in every state in the region, and in diverse municipalities with varying demographic and geographic characteristics. Our findings demonstrate that many communities have been acting in myriad innovative ways with unique local solutions to adapt to worsening coastal hazards, sea level rise, and climate change. The devastation wrought by Superstorm Sandy and Hurricane Irene indicate that communities are still highly vulnerable, yet the storms have also created a potential watershed moment regarding willingness to adopt innovative adaptations. We hope that raising awareness of these best practices in leading North Atlantic communities can inspire discussion and action in communities that are now considering how to better protect themselves.

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<sup>1</sup> Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves.