TOWN OF WINTHROP
OFFICE OF THE TOWN MANAGER

Town Hall, 1 Metcalf Square, Winthrop, MA 02152 Telephone: 617-846-1077

David G. Cressman
Town Manager

May 16, 2018

Matthew Beaton
Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Subject: Winthrop MVP Grant Application for Morton Street/Belle Isle Marsh

Secretary Beaton,

I am pleased to submit for your consideration this application for funding under the 2018 MVP Action Grant program. The Town of Winthrop's application in the amount of $182,525.00 will support the town's efforts to address climate change impacts that are affecting the town's Morton Street neighborhood and the nearby Belle Isle Marsh Reservation. If awarded, the town is prepared to match this request with $60,840 of town general funds to provide for the total project cost of $243,366.00.

As the largest remaining salt marsh in an urban environment, the Belle Isle Marsh is a critical conservation area that needs the town's protection as much as the neighboring residential area. The goal of the project is to increase the resiliency of the marsh complex and the shoreline along Morton Street, by studying the feasibility of incorporating nature based solutions that will make the Belle Isle Marsh more resilient to Climate Change and act as a buffer to the residential area adjacent to it.

Awarding of this grant will allow the Town to take a step forward in increasing the resiliency of the Morton Street area; assist Town residents by reducing the flood risk to their homes; and reduce costs to the Town by reducing the need to rebuild roads and repair and/or replace vital infrastructure existing in the neighborhood.

Additionally, the project offers the potential for transferability as there are many communities along the shore that have large marsh complexes that are adjacent to both private and public infrastructure. Implementation of this project will provide a guideline for those communities that have similar geomorphology, and the conceptual designs developed as part of the project will provide a road map for increasing the resiliency in similar areas around the state.

Best regards,

David G. Cressman
Town Manager

CC: Kathleen Theoharides, Assistant Secretary of Climate Change

MUNICIPAL VULNERABILITY PREPAREDNESS PROGRAM FY18

MVP ACTION GRANT

RFR ENV 18 POL 03

Applicant: **Town of Winthrop, Massachusetts**

Address: **One Metcalf Square, Winthrop, MA 02152**

Local Project Manager:

Name: Steven Calla, Director
Department: Department of Public Works
Email: scalla@town.winthrop.ma.us
Phone: 617-846-1341
Fax: 617-539-1545

Type of Climate Change Adaptation/Resilience Project:
Nature Based Water Infiltration Techniques/Redesigns & Retrofits – Feasibility Study and Permitting

Project Title: **Morton Street Feasibility Study and Permitting**

Total Project Cost: **$243,366**

Match Amount (at least 25% of TOTAL project cost): **$60,840**

Grant Amount Requested: **$182,525**

Project Summary (brief description of the proposed project in one or two short paragraphs):

The Town of Winthrop proposes to conduct a feasibility study to mitigate flooding on Morton Street. In addition, the coastal processes at the site will be evaluated to determine the water levels, tidal influence, waves and storm surge elevations at the project site for present day, as well as three future out-years (i.e., 2030, 2070, and 2100) incorporating sea level rise. These data will inform the alternatives analysis to select an appropriate nature-based or conventional infrastructure type, examining a broad range of nature-based and conventional flood mitigation techniques to determine the best solution for the Morton Street area; the selected alternative will provide the most flood control and additional environmental benefits, as well as have the longest lifetime. The Town of Winthrop will be a key partner to this process and will provide critical feedback at all stages of the project. Once a flood mitigation alternative is chosen, conceptual plans will be designed and completed, and permits will be applied for.

Morton Street Feasibility Study and Permitting

Municipal Vulnerability Preparedness Program/MVP Action Grant

Introduction

The Town of Winthrop's Morton Street Feasibility Study will analyze nature-based and conventional flood control techniques that provide coastal storm damage protection and enhance natural resources. The Morton Street Feasibility Study is consistent with the Executive Office of Energy & Environmental Affairs' goals to advance prioritized climate change adaptation actions and implementation strategies identified through community-wide vulnerability assessments. The proposed project was identified as a priority adaptation action from the Town's community-driven, comprehensive assessment of climate hazards across multiple sectors of Winthrop, including infrastructural, societal, environmental, and other sectors as chosen by the Town of Winthrop. This project will explore and research both nature-based and conventional flood mitigation techniques in the area of Morton Street, which is fronted by the Belle Isle marsh complex. Potential strategies will likely include: raising the marsh elevation, installing fiber rolls, installing a vegetated berm, and other nature-based or conventional solutions. In addition, the proposed project will include full consideration and incorporation of climate change projections and data that align with the anticipated lifespan of the project and the risk tolerance of the assets.

In 2017, Winthrop completed a climate change and vulnerability assessment (Resilient Winthrop – Designing Coastal Community Infrastructure for Climate Change). Based on priority ranking, one asset type (pump stations) and four flood areas (Belle Isle Marsh, Ingleside Park, Lewis Lake and Point Shirley) were selected for concept designs. The Belle Isle Marsh was selected due to the many residences, businesses and facilities (240 buildings) that are located near the marsh. This low-lying land is more susceptible to inundation from sea level rise and coastal storms over the next 15 years.

In April 2018, Winthrop started the Municipal Vulnerability Preparedness (MVP) program's Community Resiliency Building (CRB) Workshop. The focus of the workshop was to educate participants and increase awareness of risks facing the Town of Winthrop from natural and climate-related hazards. The process identified vulnerabilities and strengths in Winthrop from an infrastructure, societal and environmental perspective and served as the foundation for discussion. Prior to the workshop, outreach to key municipal staff, residents, businesses and organizations was conducted through the kick-off meeting.

During the CRB process, the entire Town was highlighted as being vulnerable to natural hazard events due to its location and the fact that it is surrounded by the ocean – not just a specific neighborhood. There were specific areas mentioned by attendees at the workshop as being vulnerable and those include:

- Neighborhoods:
  - Morton Street/Belle Isle Marsh – Low lying area, coastal surge and flooding.
  - Pico Avenue/Fisherman's Bend – Experiences flooding during storm events.
  - Ingleside Park – Backup and flooding due to lack of stormwater storage capacity and undersized drains. Floods during coastal storm/precipitation events.
  - Point Shirley/Shirley Street – Low-lying street and adjacent seawall experience wave overtopping and flooding during storm events.
  - Lewis Lake – Serves as a drainage area for part of the downtown area – lake overflows during storm events and causes localized flooding in adjacent areas.
  - Yirrell Beach – Coastal surge and flooding
  - Lower Nahant Avenue – Coastal surge, high tide and high precipitation events all cause backup in undersized drain lines and flooding within adjacent neighborhood.
  - Coughlin Park – Coastal erosion and flooding during coastal storms.

- Bayou Street Neighborhood – Flooding due to undersized drainage line that backs up during high precipitation events.

- Ecosystems: Belle Isle Marsh, Coughlin Park, Yirrell Beach, Ingleside Park, Lewis Lake, Beaches
- Transportation: Route 145 and Winthrop Parkway (also evacuation routes), Shore Drive, Morton Street, bridges, all roads in Town
- Infrastructure: Drainage system, Water/Sewer Infrastructure, Pump Stations, Sea Walls, Utility Power, Public Safety Building, Culverts, MWRA Deer Island Treatment Plant, Municipal Services (police, fire, emergency shelters), Existing Buildings, Proximity to MassPort/Logan International Airport

The CRB process identified six top recommendations to improve resiliency in Winthrop. The Draft Community Resiliency Building Workshop – Summary of Findings is included as Attachment C and the six recommendations are summarized below.

Rank	Action	Notes
1	Sewer & Drainage Infrastructure	Clean, maintain and upgrade (particularly in the Town Center and low-lying areas) sewer and drainage infrastructure. Seek funding for repair and replacement, design additional storage capacity and modify bylaws and incentives that would support improved conditions for projects. Work would also include flood control projects.
2	Maintain, Replace, Upgrade Seawalls	Various existing infrastructure is in place throughout Winthrop and is in need of repair and upgrade.
3	Natural and Green Infrastructure Solutions, Low Impact Development	To support or enhance the functioning of seawalls and the shoreline as a barrier and for improved stormwater management. Work would also include flood control projects.
4	Develop or redevelop a new public safety building (police, fire, ambulance)	This includes finding a site, designing the building, securing funding and completing construction of a new facility.
5	Maintain and protect Belle Isle Marsh, Coughlin Park and beaches as assets to the community for both recreation and resiliency support.	Work for areas of the community that act as natural barriers includes dune enhancement, plantings, berms, etc.
6	Identify funding for projects to increase resilience	This includes further developing the tax base to increase revenue in the community and securing the money along with leveraging local resources and representatives to seek out and secure funding for Winthrop.

Figure 1: Top Six Recommendations to Improve Resiliency. From Community Resiliency Building Workshop Summary of Findings – May 2018

a) Problem and Climate Adaption

Geographically the Town forms the northern border of the entrance to Boston Harbor. As a peninsula, the Town is physically isolated from Revere and East Boston by the Belle Isle Inlet Tidal Marsh, the last urban estuary in the Greater Boston Area and the most significant regional environmental feature found in Winthrop. Winthrop is a part of the Mystic River Watershed, which is approximately 76 square miles and extends to twenty-one municipalities north and west of the City of Boston. Because of its location, it is one of the most urban and densely populated watersheds in Massachusetts. The Town's land area is 1.6 miles and is located on a peninsula. Winthrop has 7 miles of shoreline, of which 4.4 miles lies along Boston Harbor (locally referred to as Winthrop Harbor).

The Table below from the Winthrop Hazard Mitigation Plan 2014 Update summarizes the hazard risks for Winthrop. This evaluation takes into account the frequency of the hazard, historical records, and variations in land use. This analysis is based on the vulnerability assessment in the Commonwealth of Massachusetts State Hazard Mitigation Plan, 2013.

Hazard	Frequency		Severity	
	Massachusetts	Winthrop	Massachusetts	Winthrop
Flooding	High	High	Serious	Serious
Dam failures	Very Low	N/A	Serious	N/A
Coastal Hazards	High	High	Serious	Serious
Tsunami	Very low	Extensive	Extensive	Extensive
Winter storms	High	High	Minor	Minor
Hurricanes	Medium	Medium	Serious	Serious
Tornados	Medium	Medium	Serious	Serious
Wildland fires	Medium	High	Minor	Minor
Earthquakes	Very Low	Medium	Extensive	Serious
Landslides	Low	Very Low	Minor	Minor
Drought	Low	Low	Minor	Minor
Extreme Temperature	Medium	Medium	Minor	Minor

Source, Massachusetts State Hazard Mitigation Plan, 2013, modified for Winthrop

Figure 2: Hazard Risks Summary. From Winthrop Hazard Mitigation Plan 2014 Update

In addition, the Massachusetts Office of Coastal Zone Management estimates sea level rise ranging from 0.81 feet under a low emissions scenario to 6.83 feet under a high emissions scenario by the end of this century. Such a broad range creates significant issues for Massachusetts coastal communities.

Scenario	2025		2038		2050		2063		2075		2088		2100	
	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m	ft	m
Highest	0.49	0.15	1.08	0.33	1.81	0.55	2.80	0.85	3.92	1.19	5.33	1.63	6.83	2.08
Intermediate High	0.36	0.11	0.73	0.22	1.19	0.36	1.80	0.55	2.47	0.75	3.32	1.01	4.20	1.28
Intermediate Low	0.24	0.07	0.43	0.13	0.65	0.20	0.92	0.28	1.21	0.37	1.55	0.47	1.91	0.58
Lowest (Historic Trend)	0.18	0.06	0.29	0.09	0.39	0.12	0.50	0.15	0.60	0.18	0.71	0.22	0.81	0.25
Range	0.31	0.09	0.79	0.24	1.42	0.43	2.30	0.70	3.32	1.01	4.62	1.41	6.02	1.83

Figure 3: Relative sea level rise estimates for Boston, MA. Global scenarios were adjusted to account for local, vertical land movement with 2003 as the beginning year of analysis. From Sea Level Rise: Understanding and Applying Trends and Future Scenarios for Analysis and Planning – Massachusetts Office of Coastal Zone Management.

Since 1991, Winthrop has experienced seventeen natural hazards that triggered federal or state disaster declarations, the vast majority of which involved heavy flooding. According to the Winthrop Hazard Mitigation Plan 2014 Update, both flooding and other coastal hazards have both a high frequency and serious severity, even before the impacts of sea level rise are considered. In this particular case, high frequency means events that occur more frequently than 10% a year, while serious severity means scattered major property damage (more than 50% destroyed), some minor infrastructure damage, wider geographic area (several communities), essential service interruption, and some injuries and/or fatalities. In particular, flooding was the most prevalent serious natural hazard identified by local officials.

Winthrop is subject to three kinds of flooding: 1) coastal flooding, where wind and tide leads to flooding along tidal waterways; 2) inland/riverine flooding, where the rate of precipitation and/or amount of stormwater runoff overwhelms the capacity of natural or structured drainage systems causing overflows; and 3) urban flooding, where precipitation causes the water table to rise and leads to flooding of low-lying areas such as streets and underpasses (Winthrop Hazard Mitigation Plan 2014 Update). Often these three types of flooding combine under storm events, as large amounts of draining stormwater becomes blocked by the inland push of wind and tide driven water, leading to flooding on a massive scale. Sea level rise contributes greatly to this type of stormwater flooding, as higher sea levels mean flooding of types 1 and 3 is more likely to occur. In addition, one overall impact of climate change is to make the frequency of such storms more likely and their severity much worse, leading to increased flood events for the town moving forward.

Figure E-2 Map of 2030 Flood Areas and Adaptation Locations

Figure 4: Map of 2030 Flood Areas and Adaption Locations – Resilient Winthrop July 12017

The Belle Isle Marsh Reservation, under the jurisdiction of DCR, preserves 152 acres of the 241-acre Belle Isle Marsh, Boston's last remaining salt marsh. Belle Isle Marsh is included within the Rumney Marshes Area of Critical Environmental Concern. The Belle Isle Marsh is located at the northern end of Winthrop and is also bordered by East Boston and Revere. This natural resource is owned and managed by the Department of Conservation and Recreation, as well as the towns of Winthrop and Revere. This nearly 300-acre salt marsh is one of the largest remaining in the Metropolitan Boston area. Habitats within the area include salt marsh, a tidal creek, salt pans, and upland park land. The area is home to a large list of bird species, including State-listed species of Endangered, Threatened, or Special Concern status.

Morton Street (fronted by the Belle Isle Marsh) and adjacent properties were identified in the Winthrop MVP Study/Plan as the Belle Isle Marsh flood area. During the recent 2017-2018 storms the marsh and adjacent upland flooded. Pictures of the storm surge and flooding are included in Attachment D. This allowed the storm surge to flood several houses along the Morten Street area. Flooding in this area will only get worse as sea level rises, storms become more frequent, and storm surge increases. Therefore, it is important to the Town to determine how sea level rise will affect this area and to develop alternatives to mitigate this flooding potential in this area. The MVP plan identified the following infrastructure threatened in the Belle Isle marsh area:

- Pleasant Court Sewer pump station,
- Revere Street sewer pump station,
- Pressure reducing valve station at Revere Street,
- 240 houses,
- Main Street, Pleasant Street, Morton Street & other local roadways, and
- Other infrastructure in this area.

The proposed project will not be able to address all of these problems however, it will focus on alleviating the flooding of the houses that are landward of Morton Street.

Future impacts of sea level rise present an additional natural hazard risk to the Belle Isle Marsh flood area. Long-term tide gage data collected at the National Ocean Service (NOS) station in Boston, MA provide the closest measurements to Coughlin Park. Tide gage data from the Boston station for the period of 1921 to 2014 indicate a rise in sea level of 2.81 mm/yr., or 11.1 inches total over the past century. Future changes in the rate of sea level rise could increase water levels another 1.8 feet by the year 2063 (intermediate high scenario), placing Belle Isle Marsh flood area at further risk of storm damage and flooding. In addition, Resilient Winthrop – Designing Coastal Community Infrastructure for Climate Change, states that the current flood area in the Belle Isle Marsh is 95 acres (9% of Winthrop) and will be 106 acres in 2030 (10% of Winthrop) and 135 acres (13% of Winthrop) in 2070.

It is important to utilize a range of sea level rise scenarios to understand the uncertainty in the projections for planning purposes. A number of ongoing climate change vulnerability studies (being conducted by others) will provide a sound basis for these estimates. Ranges and rates of sea level rise will be evaluated and incorporated into the coastal processes analysis to ensure an appropriate design alternative is selected.

b) Need for Assistance

The Town requires assistance to complete this project. The Town has not been able to raise the funds to address the entire problem at this time. However, the awarding of this grant will allow the Town to take a step forward in increasing the resiliency of the Morton Street area.

c) Project Description

This project will assist the Town residents in this area be reducing the flood risk to their homes. This will not only help the Town residents but will also reduce costs to the Town by reducing the need to rebuild roads and repair and/or replace the infrastructure identified above.

The Town proposes to assess which nature-based or conventional flood mitigation techniques are applicable to this location by developing an understanding of the existing environmental conditions and coastal processes at the site. A comprehensive evaluation will be used to assess the existing environmental conditions in the Belle Isle Marsh area and provide information that will be used to evaluate and select potential alternatives for mitigating the flooding in the Morton Street area. The existing conditions assessment will develop a complete picture of the ongoing processes that shape the Belle Isle Marsh Area, by utilizing an already developed and tested highly resolved, numerical processes model developed for Massachusetts Department of Transportation (MassDOT) and the Federal Highway Administration (FHWA) to assess the combined impact of sea level rise, storm events (tropical and extra-tropical), winds, tides, and waves. With a full understanding of the present-day processes at the site, as well as an examination of potential sea level rise scenarios, an alternatives analysis will be developed that evaluates the performance and longevity of various living shoreline alternatives based on a criteria matrix, which will include but is not limited to design life, level of protection, permit ability, cost, environmental benefits, and avoidance of adverse impacts.

Scope of Work

Technical Approach

The technical approach includes the following seven (7) tasks intended to assess the feasibility of implementing a nature-based shoreline project at the site and to advance the project through the conceptual design phase, including the development of conceptual engineering plans.

Task 1. Identify and review existing information

This task will compile existing information related to topography and bathymetry, wetland resources, including eelgrass and shellfish beds, historical shoreline change rates and current FEMA flood zones. Data gaps will be identified as the basis for supplemental data collection if required. A meeting with the Town will be scheduled as part of this task to discuss the project and to solicit data and input for this effort.

Task 2. Assess, map, and flag wetland resources
There is a large marsh complex that exists at the site. Additionally, the marsh system directly abuts a housing development along Morton Street. Recently the marsh flooded from the harbor and encroached on the Morton Street houses flooding several of the houses. In order to assess potential alternatives, it is necessary to flag the landward boundary of the wetland. Wetland resources at the site will be identified and evaluated for stability, ecological health and signs of stress. The landward wetland resource boundary will be delineated and flagged in preparation for the site survey that will be conducted in Task 3.

Task 3. Site topographic survey
A site topographic survey will be completed to determine the site boundaries, present location of the shoreline, the locations of the wetland resources flagged in Task 2, and the elevations of the upland adjacent to the landward edge of the marsh. These data will provide needed input directly for the alternatives analysis described in Task 4.

Task 4. Analysis of coastal processes
An existing coastal model, the Boston Harbor Flood Risk (BH-FR) Model developed by Woods Hole Group for MassDOT and FHWA, will be utilized to evaluate the coastal processes at the site. The BH-FR model is a highly resolved, numerical process model developed for the greater Boston Harbor area, which assesses the combined impact of:

- Sea level rise
- Storm events (tropical and extra-tropical)
- Winds
- Tides
- Waves

A statistical model will be applied to the data to calculate the 5-, 10-, 25-, 50- and 100-year return periods for the local wave heights and water levels at the project site. This information will be used to inform the design criteria for the nature-based alternatives.

In addition, a shoreline change analysis will be conducted to assess the rate of change of the marsh to determine if the marsh is eroding and/or if the marsh will continue to provide limited protection to the house along Morton Street. Up to 10 years of historical aerial photography, recent orthoimagery and shoreline surveys will be compiled to calculate both long- and short-term shoreline change rates.

Task 5: Drainage Analysis
Woodard & Curran will develop an existing conditions hydrologic/hydraulic model to serve as a baseline condition from which to evaluate potential mitigation measures. The modeling will consist of two components; a hydrologic model that will estimate the rate and volume of runoff generated from the watershed under various storm events and a riverine hydraulic model that will estimate the elevation and aerial extents of flooding that results from the runoff generated from the watershed. W&C is presently proposing to utilize HydroCAD and HEC-RAS computer software to conduct the hydrologic and hydraulic modeling. Following completion and review of the data collection efforts, W&C will meet with the Client to discuss to advantages, if any, of using Bentley's SewerGEMS or Wallingford's Infoworks RS/CS software to perform these analyses.

Task 6. Stormwater Management (nature-based and conventional) alternatives analysis
A meeting with CZM and the Town will be held to identify nature-based alternatives that can increase the resiliency and reduce the flooding of the area. With the improved knowledge of coastal processes, up to three (3) conceptual nature-based alternatives will be identified and evaluated. It is anticipated that various nature-based solution such as raising the marsh elevation, installing fiber rolls, installing a vegetated berm, and other nature-based solutions will be identified at this meeting. The alternatives analysis will use a criteria matrix approach, including such indicators as feasibility, design life, level of protection provided, permitability, cost, public and environmental benefits and avoidance

of adverse impacts. This task will identify profile geometry and length required, preliminarily quantify materials needed, and assess performance/maintenance requirements as the basis for recommending conceptual layout(s) for Task 6. The Town and other stakeholders will collaborate to ensure that the nature-based alternative selected is consistent with resiliency goals and feasible to implement from both a regulatory and construction standpoint.

Task 7. Preliminary engineering design
Based on the chosen alternative selected in Task 6, preliminary engineering designs will be produced detailing the design specifications for the preferred alternative.

Task 8. Final documentation and visualizations
A summary report will be completed that will summarize Tasks 1 through 6 and will provide the additional information needed for the Town to advance the selected nature-based alternative to a final design. To further advance nature-based in the state, the final report and associated graphics can also be used to transfer the input data and selection and design steps used in this project to other Towns in the region that have similar coastal management issues that might benefit from a nature-based approach. Additionally, the Massachusetts Office of Coastal Zone Management (CZM) and other agencies will be able to use this report to disseminate design steps and describe the advantages of nature-based projects over traditional hard coastal engineering alternatives.

d) Transferability

The proposed project is directly transferable to other communities along the shore that have large marsh complexes that are adjacent to both private and public infrastructure. Implementation of this project will provide a guideline for those communities that have similar geomorphology. The alternatives analysis and the conceptual designs developed as part of this project will provide a road map for the increasing the resiliency of similar area.

Experience gained from this project could benefit those sites as well, through the transfer of knowledge and experience with green infrastructure projects. Therefore, the results of this project will benefit other stakeholders and coastal communities. Finally, the summary report and final visualizations will provide an ideal method to disseminate the results of this project to the general public, as well as to other coastal communities, and to demonstrate the viability of green infrastructure techniques within the Boston area. We will also encourage and assist our contractor, the Woods Hole Group, in presenting the results of this project at relevant conferences such as the Conference on Ecological and Ecosystem Restoration (CEER).

e) Importance of Nature-based Solutions and Strategies

The goal of the project is to increase the resiliency of the marsh complex and the shoreline along Morton Street. A meeting between the Town and CZM will be held to discuss possible strategies for increasing the resiliency of the shoreline. It is anticipated that various nature-based solution such as raising the marsh elevation, installing fiber rolls, installing a vegetated berm, and other nature-based solutions will be identified at this meeting. Once identified the potential nature-based solutions will be incorporated into an alternatives analysis to determine the viability of each potential solution identified.

f) Timeline Assuming the contract award date is June 1, 2018, we anticipate that the project will be completed by May 1, 2019. The following is the schedule breakdown for the project.

g) Budget

A detailed project budget is included as Attachment A. The grant cover letter documents the 25% cash match - $60,840.

h) Project Management J

Arthur D. Leventis, P.E., Arthur is a Project Manager with 20 years of experience in planning, design and construction of water and wastewater projects. His experience includes distribution system analysis, infrastructure planning, water main design, water main construction, infiltration/inflow analysis and mitigation, collection system design, sewer main construction, pump station design and upgrades, wastewater treatment facility design and improvements, drainage design and construction, permitting, public bidding and construction management. Arthur is also familiar with the MassDEP's State Revolving Fund (SRF) requirements and the MWRA Local Pipeline Assistance and Local Financial Assistance programs, with several of the projects listed below being funded by these programs.

Michael Hansen, **P.E., C.M.F.,** is a Project Engineer with 17 years' experience in the field of civil engineering with an emphasis in floodplain and stormwater management. His experience with floodplain management includes working with FEMA regulations and requirements to help offset adverse effects to work performed within the regulated floodway and 100-year floodplain as well as compiling NO-Rise certifications and Letter of Map Revisions(LOMR). He is also experienced in hydraulic river modeling, natural channel design, stormwater system design, wetland restorations, site plan reviews and designs, field inspections and construction oversight, sidewalk feasibility studies and multi-use trail design.

Steven Calla – Steven Calla has been the Director of Public Works for the town of Winthrop since 2011. Prior to becoming the director of the department, Mr. Calla worked as the Operations Manager for Winthrop Public Works from 2007 to 2011. As Director, Mr. Calla has overseen millions of dollars of infrastructure improvements across the town, including roadway projects, water, sewer and drainage improvements, improvements to parks and improvements to other critical town facilities such as tide gates and pump stations. He has personally project managed most of those projects over the course of his tenure and is an expert in both the process for initiating and completing large scale public works projects and with the financial reporting and administration of those projects. In 2016, Mr. Calla project managed a major storm water drainage project in Winthrop's Point Shirley neighborhood, which cost a total of $835,000 and included $500,000 in federal FEMA pre-disaster Mitigation funding. Mr. Calla has previously worked as an Environmental Engineer, Electrician's apprentice and environmental and construction supervisor of his own construction and environmental services corporation. He earned a Bachelor Degree in Environmental Protection and Marine Safety from the Massachusetts Maritime Academy in 1996 and a Master in Public Administration at Suffolk University in 2017.

Dr. Lee Weishar, Ph.D, M.S., B.S., P.W.S., is a Senior Scientist/Coastal Engineer at Woods Hole Group. Dr. Weishar has more than 25 years of experience in the fields of oceanography, coastal engineering, sediment transport, and nearshore processes. For the past 10 years, he has focused on coastal engineering and wetland/marsh restoration. His coastal engineering work includes beach nourishment, coastal structures, soft solutions for shoreline protection including living shorelines, as well as dredging and sediment management. Dr. Weishar also specializes in the integration of biological, ecological, and hydraulic data to develop wetland restoration designs and to ensure that the design will meet the restoration objectives. He has been involved in the design, permitting, and construction phases of restoration projects for more than two decades. During the design phases of large-scale projects, Dr. Weishar spear-heads the preliminary hydraulic design and hydrodynamic analyses that prove to the client that a large-scale restoration is feasible. Dr. Weishar has worked to perform critical examinations of the marsh restoration performance through frequent on-site visits and analytical analyses. Dr. Weishar helped pioneer the applications of Ecological Engineering and Adaptive Management in the field of marsh restoration. Additionally, Dr. Weishar has extensive experience in evaluating the potential impacts of proposed restoration projects on existing wetlands and adjacent transitional, buffer, and upland areas. Dr. Weishar has permitted a wide variety of projects that include beach nourishment, revetments, and wetland restoration. He is familiar with environmental policy at local, state, federal and international levels.

Kirk F. Bosma, P.E., is a Senior Coastal Engineer and Team Leader of the Coastal Sciences, Engineering & Planning team at Woods Hole Group. He focuses on habitat restoration, shoreline protection, and climate change planning projects for a diverse client base. He specializes in applying numerical models to optimize engineering designs and reduce overall project life cycle costs. This includes developing and employing numerical models for marsh restoration, sediment transport, near shore spectral wave transformation, particle transport, bathymetric evolution, and two- and three-dimensional hydrodynamic processes. He also applies the latest data and numerical methods toward capturing current and future flooding risk for climate change vulnerability assessments. Mr. Bosma has a Master's from the University of Delaware's Center for Applied Coastal Research. His areas of expertise include numerical modeling of coastal and estuarine processes, coastal engineering design for shore protection, wave propagation and transformation, sediment transport and littoral processes, hydraulics for marsh restoration, climate change vulnerability assessments and engineering adaptations, and data collection and implementation of coastal engineering projects. Mr. Bosma also designed and implemented technically advanced data collection programs and analysis techniques to assess the estuarine, coastal, and oceanographic environment and help develop engineering solutions. He has also designed a number of coastal engineering structures and erosion mitigation solutions. Mr. Bosma has been the project manager for both large coastal restoration and marsh restoration projects that have included implementation of a comprehensive data collection, physical processes modeling programs, evaluation of a variety of restoration alternatives, and engineering design.

Elise Leduc, M.E.M., is a coastal scientist with experience in coastal environmental management, geospatial analysis, shoreline change analysis, wetland and resource area delineation, environmental impact analyses, ecological risk assessment, conservation prioritizations, field and water quality sampling, and Massachusetts environmental regulations at Woods Hole Group. Ms. Leduc earned a Master's in Environmental Management from Duke University's Nicholas School of the Environment where she studied coastal environmental management, geospatial analysis, wetland ecology and restoration, and coastal and environmental law and policy. She has conducted multiple shoreline change analyses in support of regional coastal development and regional sediment management planning, and has worked on interdisciplinary coastal management projects, including compiling a Beach Management Plan for public beaches in one Cape Cod town.

The key personnel who will be involved in the Morton Street Feasibility Study are listed in the table below and individual resumes are included in Attachment B.

Project Team

Name	Affiliation/Title	Role
Arthur D. Leventis, P.E.	Woodard & Curran – Project Manager	Project Manager
Michael Hansen, P.E., CFM	Woodard & Curran – Technical Manager	Technical Manager
Steven Calla	Town of Winthrop – Director of Public Works	Local Project Manager
Dr. Lee Weishar, Ph.D., M.S., B.S., P.W.S.	Woods Hole Group – Woods Hole Group Team Leader/ Coastal Engineer	Team Leader/Coastal Engineer
Kirk F. Bosma, P.E., M.C.E	Woods Hole Group – Coastal Engineer	Coastal Engineer
Elise Leduc, M.E.M.	Woods Hole Group – Coastal Scientist	Coastal Scientist

Partners – Signed support letters from all relevant local boards, departments, commissions, and other partners with a commitment for these entities to participate, as necessary, in the project.

Letters of support from all local partners are included in Attachment E.

Attachments

- Attachment A: Budget
- Attachment B: Resumes
- Attachment C: Community Resiliency Building Workshop – Summary of Findings
- Attachment D: Pictures of Morton Street During Winter 2017/2018 Flooding
- Attachment E: Letters of Support

ATTACHMENT A: BUDGET

FY18 MVP Action Grant Budget - Morton Street					
Project Task Description	**Deliverables**	**Due Date**	**Grant**	**Match**	**Total**
Task 1: Identify and Review Existing Information					
Kickoff Meeting	Memorandum of Results	7/15/2018	$2,095	$0.00	$2,095
Review Data			$4,840	$0.00	$4,840
Existing Conditions Review			$0	$0.00	$0
Total Task 1 Cost			**$6,935**	**$0.00**	**$6,935**
Task 2: Assess, map, and flag wetland resources					
Flag Upland Boundary	Memorandum of Results	8/30/2018	$0	$2,755.00	$2,755
Incorporate into GIS			$1,160	$0.00	$1,160
Memorandum of Results			$1,980	$0.00	$1,980
Total Task 2 Cost			**$3,140**	**$2,755.00**	**$5,895**
Task 3: Site topographic survey					
Survey Upload Boundary RTK	Site Topography Survey	10/15/2018	$2,755	$0.00	$2,755
Develop Plan			$3,440	$0.00	$3,440
			$500	$0.00	$500
Total Task 3 Cost			**$6,695**	**$0.00**	**$6,695**
Task Analysis of coastal processes					
Shoreline Change	Memorandum of Results	12/30/2018	$3,190	$0.00	$3,190
Storm Surge/Sea level Rise			$12,090	$0.00	$12,090
Memorandum of Results			$1,880	$0.00	$1,880
Total Task 4 Cost			**$17,160**	**$0.00**	**$17,160**
Task 5: Drainage Analysis					
Watershed Modeling	Hydrologic/Hydraulic Model	1/30/2019	$47,312	$0.00	$47,312
			$0	$0.00	$0
			$0	$0.00	$0
Total Task 5 Cost			**$47,312**	**$0.00**	**$47,312**
Task 6: Stormwater Management Alternative Analysis					
Identify Alternatives	Alternatives Analysis - Memorandum of Results	2/15/2019	$2,640	$215.63	$2,856
Evaluate Performance			$5,940	$11,000.00	$16,940
Memorandum of Results			$4,630	$0.00	$4,630
Total Task 6 Cost			**$13,210**	**$11,215.63**	**$24,426**
Task 7: Preliminary engineering design					
Preliminary Design	Preliminary Design	3/30/2019	$75,759	$1,587.00	$77,346
Permitting	Permitting		$0	$40,792.00	$40,792
			$0	$0.00	$0
Total Task 7 Cost			**$75,759**	**$42,379.00**	**$118,138**
Task 8: Final documentation and visualizations					
Prepare Draft Report	Draft Report	5/1/2019	$4,840	$2,500.00	$7,340
Prepare Final Report	Final Report		$0	$1,990.00	$1,990
Public Outreach			$7,474	$0.00	$7,474
Total Task 8 Cost			**$12,314**	**$4,490.00**	**$16,804**
TOTAL PROJECT COST			**$182,525**	**$60,840**	**$243,365**

ATTACHMENT B: RESUMES

ARTHUR LEVENTIS, PE
PROJECT MANAGER

Professional Profile

Arthur is a Project Manager with over 20 years of experience in planning, design and construction of water and wastewater projects. His experience includes distribution system analysis, infrastructure planning, water main design, water main construction, infiltration/inflow analysis and mitigation, collection system design, sewer main construction, pump station design and upgrades, wastewater treatment facility design and improvements, drainage design and construction, permitting, public bidding and construction management. Arthur is also familiar with the MassDEP's State Revolving Fund (SRF) requirements and the MWRA Local Pipeline Assistance and Local Financial Assistance programs.

Related Experience

Town of Winthrop, MA– Sewer Infrastructure Improvements. Project Manager responsible for developing and managing sewer infrastructure improvements to evaluate and mitigate inflow/infiltration in the collection system. Assisted the Town in securing MWRA funding due to expire by developing a design that would immediately utilize funds and address inflow/infiltration through video inspection, joint sealing and pipe lining. Completed MWRA funding application to assist Town in funding the project, developed design and construction documents for project and provided construction administration. Based on video inspection information, provide Town with Sanitary Sewer Evaluation Report that identified critical collection system repairs and recommended a five-year plan for improvements. Woodard & Curran has continued to work with the Town to implement recommendations from the SSES report.

Town of Winthrop, MA – Miller Field Athletic Facility Redevelopment. Project Manager for the Miller Field Athletic Field Redevelopment project. This project includes upgrades to the existing running track and athletic field, along with a new turf field, grandstand, press box, bleachers, lighting, scoreboard, concessions, restrooms, locker rooms, walkways, site utility infrastructure improvements, landscaping and site fencing. The project also included drainage improvements to an adjacent Town owned site to minimize historic flooding issues and public health and safety concerns related to recent Eastern Equine Encephalitis (EEE) identified at the site.

Lowell Regional Water Utility, Lowell, MA – Water Main Replacement Program. Project Manager responsible for the replacement design and construction of over 8 miles of water mains ranging in size from 6-inch to 36-inch. These numerous projects have included slip lining of 20-inch and 12-inch water mains across bridges with HDPE pipe, as well as thousands of feet of water main replacement. These projects were designed to minimize disruption in water service to consumers, while improving the reliability and redundancy of the distribution system by replacing older mains and pipes in areas with historically high break histories. Hydraulic analyses were performed to identify those mains critical to the reliable operation of the system. In several cases, water main and valve replacement was performed to isolate service areas, or shift service area boundaries to increase energy efficiency of the distribution system.

Education

- Bachelors, Civil Engineering, Union College

Registrations

- Professional Engineer - MA, 45470
- Professional Engineer - CT, 31327
- Professional Engineer - RI, 11436

Professional Associations

- American Society of Civil Engineers
- American Water Works Association

City of O'Fallon, MO – Main Street Water Main Improvements. Technical Lead responsible for design of over one mile of water distribution system improvements to improve water quality and fire protection in the City's main business district. The project includes water main design, permitting and design of a crossing for an active railroad, technical evaluation of on-site corrosive and contaminated soils, and construction phasing to minimize impacts of construction activities in the City's main business district.

City of Lawrence, MA – Water Main Replacement Project. Project Manager responsible for managing design, permitting, bidding, and construction oversight of 7.5 miles of 6-inch through 24-inch water main replacement and rehabilitation in a dense, urban environment funded by the Massachusetts DWSRF program. The project included working with the Department of Public Works and public safety officials to prioritize project work, coordinating work with on-going construction activities of other local utilities, and construction phasing to maintain domestic service and fire protection during construction of improvements on large diameter transmission mains.

Town of Manchester-by-the-Sea, MA – Lincoln Street Well Serpentine Loop. Project Manager responsible for design and permitting of approximately 310 linear feet of 16-inch cement lined ductile iron pipe in a serpentine pattern to increase chlorine contact time. The project included a review of available reports, record drawings, and utility information, wetland delineation, site survey, design of piping modifications to increase CT between the existing chemical injection vault and connection to the distribution system, and permitting the project with MassDEP.

Town of Manchester-by-the-Sea, MA – Pine Street Water Main Replacement. Project Manager responsible for managing design, permitting and construction oversight of approximately 5,000 linear feet of water main installation and improvements on critical infrastructure. The project involved complex phasing and construction sequencing necessary to maintain water service to the Town.

Lowell Regional Water Utility, Lowell, MA – Redundant Transmission Main Project. Project Manager responsible for design, permitting, bidding, and construction oversight of approximately 7,000 linear feet of 36-inch through 16-inch transmission main improvements. Project included site survey, wetlands permitting, MassDOT permitting, and design of complex construction phasing to maintain water service from the City's water treatment facility to its storage tanks and distribution system.

Lowell Regional Water Utility, Lowell, MA– Finished Water Main Improvements. Project Manager responsible for design, permitting and construction oversight of $1.9 million in improvements to the finished water infrastructure at the City's water treatment facility. The project included design of new redundant 30 and 36-inch ductile iron water mains, 16-inch HDPE bypass, line stops and wet taps on an existing 36-inch PCCP transmission main, and significant process piping within the treatment plant. Project challenges included design of complex construction phasing for high-risk construction activities to maintain delivery of finished water from the treatment facility to the distribution system through the City's sole transmission main during construction.

Lowell Regional Water Utility, Lowell, MA – Emergency Repairs to High Pressure Subaqueous Water Main. Project Manager responsible for design, permitting and construction administration of an emergency repair to a 12-inch subaqueous high pressure water main. A leak was discovered in a 12-inch high pressure water main (circa 1880) crossing under the Merrimack River that provides redundancy between the Stackpole Street and Beacon Street pump stations. The design included utilizing an adjacent existing reserve 24-inch subaqueous transmission main as a host pipe to slip line a new 16-inch HDPE high pressure water main to restore redundancy between the pump stations. Project challenges included identifying and locating existing valves to isolate the leak, identifying and locating the reserve transmission main for use as a host pipe, confirming integrity of the 24-inch host pipe which was the same vintage as the high pressure main and slip lining approximately 600 linear feet of HDPE pipe over an elevation change of approximately 50 feet. Identification and utilization of this unused infrastructure (24-inch transmission main) to restore redundancy allowed service to be restored quickly and saved the City an estimated $500,000 in construction costs associated with a new subaqueous main.

Town of Cumberland, RI – Asset Evaluation. Technical Lead responsible for working with the Town to provide asset valuation services and expert witness testimony related to the Town's water system assets. The project included collecting available data including length, diameter, material and age of pipes, number of service connections and hydrants, physical geometry of dams and interviewing staff regarding infrastructure condition. The work included utilizing industry-published standard construction cost indices to adjust the single year valuation to the two prior years as required by the Town. The final report to the Town included a comprehensive valuation of the RCN less depreciation of each of the studied assets and became the basis for the Town's tax determination.

MICHAEL HANSEN, PE, CFM
TECHNICAL MANAGER

Professional Profile

Michael is a Technical Manager with 17 years of experience in the field of civil engineering with an emphasis in floodplain and stormwater management. He is a Certified Floodplain Manager (CFM) and his experience with floodplain management includes working with FEMA regulations and requirements to help offset adverse effects to work performed within the regulated floodway and 100-year floodplain as well as compiling NO-Rise certifications and Letter of Map Revisions (LOMR). He is also experienced in hydraulic river modeling, natural channel design, stormwater system design, wetland restorations, site plan reviews and designs, field inspections and construction oversight, sidewalk feasibility studies and multi-use trail design.

Related Experience

University of New Hampshire, Durham, NH – Water Treatment Plant Design-Build. Technical Manager responsible for the site design and state and federal permitting of a new 2-MGD surface water treatment plant. The new water treatment plant is a conventional water treatment plant with rapid mix, flocculation, clarification utilizing plate settlers, multi-media filtration, and chlorination. Project includes three different source-waters and significant site constraints. Project is a design-build effort with Waterline Industries of Seabrook, New Hampshire.

City of Salem, MA – Canal Street Flood Mitigation Project. Project Engineer for the mitigation of flooding in the Canal Street area of Salem. For more than a century chronic flooding had been an issue in Salem's Canal Street area, which serves as one of the primary entry points into the City This problem has been exacerbated by recent development in the floodplain that has increased the rate of stormwater runoff in this centrally located portion of the City's downtown business district. Worked with the City to design and permit a comprehensive stormwater management strategy and undertake measures that would maximize the capacity of the existing stormwater system, along with defining new drainage infrastructure options to mitigate chronic flooding. This resulted in a $23M flood mitigation and infrastructure improvement program that included reconstructing the City's drainage collection system and constructing a new 10,000 gallons-per-minute pumping station and a new 4 million gallon underground stormwater storage facility. The project also included rehabilitation of existing municipally-owned sewer and water system infrastructure and privately owned infrastructure within the project area and reconstruction of athletic fields/facilities at the drainage system outfall at Forest River Park located on Salem Harbor. A portion of the infrastructure improvements were constructed in 2014 with the remainder to occur in 2017.

City of Salem, MA – Jefferson Flood Mitigation Project. Project Engineer for the mitigation of flooding in the Jefferson Avenue area of Salem. This project specifically focused on climate projections to increase the area's ability to endure impacts associated with storms and the effects of flooding and sea level rise. The project includes public pre-

Education

- Bachelors, Civil Engineering, University of New Hampshire
- Bachelors, Philosophy, University of New Hampshire
- Rosgen Natural Channel Design Level I & II

Registrations

- Certified Floodplain Manager, US-11-05949
- NCEES License - National, 41504
- OSHA 10 Hour Construction, 11899762
- Professional Engineer - MA, 51304
- Professional Engineer - ME, 12443
- Professional Engineer - NH, 12059
- Professional Engineer - VA, 0402048692
- Professional Engineer - VT, 9171

Professional Associations

- Association of State Floodplain Managers
- American Society of Civil Engineers
- American Water Resources Association

sentations and a workshop series. Involved in the design and permitting a comprehensive stormwater management strategy consisting of rehabilitating and enhancing an existing flood berm/dike system in the area. Design and permitting activities were completed in 2015 and construction began in 2016.

Newington/Dover, NH – Railway Brook Restoration. As part of a NHDOT project, developed restoration plans for approximately 3,100 linear feet of Railway brook that was straightened back in the 50s when Pease Air Force Base was constructed. The project provides restoration of stream morphology, including a variety of natural rock/boulder structures, adjacent wetlands and improved water quality. Performed all hydrologic/hydraulic modeling required to ensure proper design including: estimating the 1-, 2-, 10-, 25-, and 100-year frequency design flows using Technical Release (TR) 20; and modeled design flows to validate long and short term channel stability using HEC-RAS. Also responsible for the final stamped engineering plans.

Town of Salem, NH – Policy Brook Restoration and Floodplain Mitigation. As part of a NHDOT project, developed a floodplain mitigation site to help offset impacts to floodplain associated with the expansion of I-93. The Town received a grant from the Federal Emergency Management Agency, allowing them to start buying the houses along Haigh Avenue, which have experienced periodic flood damage. Once these houses are removed, the area will be regraded to create additional flood storage and relocate Policy Brook, which was impacted by the original I-93 construction in the early 1960s. This relocation will allow for approximately 1,500 feet of Policy Brook to be reestablished into a more natural state. The project will proved restoration of stream morphology including a variety of grade control structures, adjacent wetlands and improved water quality. Performed all hydrologic/hydraulic modeling required to ensure proper design including: estimating the 1-, 2-, 10-, 25-, and 100-year frequency design flows using Technical Release (TR) 20; and modeling design flows to validate long and short term channel stability using HEC-RAS. Also responsible for the final stamped engineering plans.

Town of Exeter, NH – Great Dam Removal Feasibility and Impact Analysis. Senior Project Engineer for a feasibility study for the removal of the Great Dam in Exeter. The study supplements previous and on-going studies by others, providing additional information to facilitate the Town's formulation of and consideration of alternatives. The scope of work included geomorphic analysis, hydrological and hydraulic analysis, water supply, fish passage, dam and structural engineering, recreation and impacts to natural resources. This project was funded through NOAA, USEPA, USFWS and NHDES.

Town of Rye, NH – Eel Pond Restoration Hydrology and Hydraulics. Senior Project Engineer involved in a project for the Rye Beach Village District to perform a preliminary technical review of the hydrology and ecology of Eel Pond. Responsible for developing preliminary hydrology and analysis of existing culverts under Route 1.

Brewster/Orleans, MA – Namskaket Marsh Restoration. Project Engineer for the development of restoration plans for Namskaket Marsh and Hurley's Bog. The Cape Cod Rail Trail bisects the marsh. Down gradient of the rail trail crossing, Namskaket Marsh is a typical salt marsh with the interior mostly free of invasive plant species. Up gradient of the crossing, the marsh is dominated by Phragmites. The project consists of replacing the two culverts beneath the rail trail with larger culverts designed to provide enhanced tidal flushing to the up gradient marshes. A HydroCAD computer hydraulics model has been established to design the size of the culverts necessary to carry an average high tide into Namskaket Marsh. The intent of the proposed culverts is to restore as much tidal flow to the marshes are possible without causing problematic upstream flooding and to reduce the area coverage of Phragmites. Responsible for analyzing the hydraulics in order to determine the size of the new culvert that would be placed under the trail. Also responsible for the preliminary cost analysis of the replacement of the culvert, and developed the wetland restoration plans for Namskaket Marsh.

Town of Hull, MA – Strait's Pond Restoration. Project Engineer responsible for hydraulic modeling, utility coordination, utility relocation design, and bridge replacement. Strait's Pond is a 92-acre salt pond experiencing both water quality and habitat degradation as a result of poor flushing. Replacement of the existing state bridge will require extensive utility coordination and will be outfitted with an automated tide gate to reduce flooding impacts to low-lying properties.

Tyngsboro/Chelmsford, MA - Route 3 Wetland Mitigation. Project engineer for this design/build highway project.. This project required coordination between several engineering firms and state regulatory officials. Responsibilities included coordinating with the other engineering firms in order to develop 4 wetland restoration plans for the Route 3 corridor widening in Tyngsboro and Chelmsford, MA, calculated the areas of impact that were needed to create these wetlands and determined the elevations in which the different wetland plants would exist. This was also done in coordination with a wetland scientist.

Steven Calla – Steven Calla has been the Director of Public Works for the town of Winthrop since 2011. Prior to becoming the director of the department, Mr. Calla worked as the Operations Manager for Winthrop Public Works from 2007 to 2011. As Director, Mr. Calla has overseen millions of dollars of infrastructure improvements across the town, including roadway projects, water, sewer and drainage improvements, improvements to parks and improvements to other critical town facilities such as tide gates and pump stations. He has personally project managed most of those projects over the course of his tenure and is an expert in both the process for initiating and completing large scale public works projects and with the financial reporting and administration of those projects. In 2016, Mr. Calla project managed a major storm water drainage project in Winthrop's Point Shirley neighborhood, which cost a total of $835,000 and included $500,000 in federal FEMA pre-disaster Mitigation funding. Mr. Calla has previously worked as an Environmental Engineer, Electrician's apprentice and environmental and construction supervisor of his own construction and environmental services corporation. He earned a Bachelor Degree in Environmental Protection and Marine Safety from the Massachusetts Maritime Academy in 1996 and a Master in Public Administration at Suffolk University in 2017.

Education

Ph.D., Physical Oceanography – 1982, Purdue University
M.S., Geophysical Oceanography – 1976, Virginia Institute of Marine Science and College of William and Mary
B.S., Mechanical Engineering – 1972, Michigan State Univ.

Licenses and Registrations

- Professional Wetlands Scientist (PWS) 2005

Publications and Presentations:

122

Work Experience

1989-Present	Woods Hole Group, Inc.
1983-1989	U.S. Army Corps of Engineers
1973-1982	Purdue University (Research Coordinator, Research Fellow, Research Instructor)
1972-1973	F.W. Amend Company
1969-1972	Michigan State University (Research Assistant)

Lee L. Weishar, Ph.D., M.S., B.S., P.W.S
Senior Scientist/Coastal Engineer

Expertise

Dr. Lee Weishar has more than 30 years of experience in the fields of oceanography, coastal engineering, sediment transport, and nearshore processes. For the past 15 years, he has focused on developing resilient shoreline projects. These projects include developing soft engineering solutions to mitigate shoreline erosion such as sand filled tubes, coir bio-logs, beach nourishment, and other technologies that work with nature, mitigate erosion while allowing the shoreline respond to storms and hurricanes. He also has worked to develop fringe marsh projects to increase resiliency while stabilizing the shoreline. Dr. Weishar's projects also include the design, permitting, and construction oversight of beach nourishment projects that increase shoreline resiliency by allowing the shoreline to respond naturally to incident storms. These efforts promote living shorelines that will be more resistant to the effects of sea level rise and the projected increased storm activity that the east coast is projected to experience over the next decade.

Dr. Weishar also develops wetland restoration projects that specialize in the integration of biological, ecological, and hydraulic data to develop wetland restoration designs that allow Ecological Engineering to be successful and helps ensure that the project will meet the restoration objectives.

Scientific consulting in marsh ecology and the tidal hydraulics of wetlands. Salt marsh restoration as mitigation for power plant intake impacts (e.g., 316(b) restoration measures), and NRDA. Engineering consulting on the effects of tidal inlet and shore protection structures, longshore sediment transport, shoreline response, marsh hydrology and restoration. Conducted numerical model studies of channel stability, shoaling, and tidal flushing at tidal inlets. Designed field studies and performed numerical and physical modeling of waves, currents, water levels, and suspended sediment transport at tidal inlets. Field collection of oceanographic and geotechnical data. Designed and supervised several large beach nourishment projects requiring dune and beach design, construction oversight, and field monitoring.

Qualification Summary

- More than 30 years of experience in the fields of oceanography, coastal engineering, sediment transport, and nearshore processes
- Salt marsh restoration, planning, design, monitoring/adaptive management
- Ecological engineering for salt marsh/wetland habitat restoration
- Specification of hydrodynamic regimes suitable for salt marsh restoration, including increased salt water flows balanced with fresh and storm water inputs
- Specializes in developing and implementing complex data collection efforts, which require solving detailed and often-diverse logistic problems such as marsh restoration and sediment transport projects in MA, DE, NC, VA, FL, AL, NY, and Caribbean
- Excellent project management skills. Excels at managing large projects with multi-discipline investigators
- Managed projects which designed and completed investigations to determine the optimum offshore sand borrow site locations, which maximize grain size, and quantities of borrow material while minimizing project environmental impacts
- Managed and completed longshore sediment transport and examined shoreline response at numerous tidal inlets along the eastern coast of the U.S. Designed and completed large-scale field investigations to examine wave interaction on ebb and flood tidal shoals

Professional Affiliations

Sigma Xi
American Association for the Advancement of Science
American Geophysical Union
Society of Economic Paleontologists and Mineralogists
American Society of Civil Engineers – Coastal Oceans, Ports & Rivers Institute
Society of Wetland Scientist
Estuarine Research Federation
ASCE Wetlands & Sediment Management Committee
Chairman of ASCE Wetlands Engineering Guidelines Subcommittee
Certified as Professional Wetlands Scientist
American Shore & Beach Preservation Association – Secretary & Board Member
Coastal Zone Foundation – President
Department of Homeland Security Coastal Resiliency Advisory Board Member
Stevens Institute of Technology, Davidson Laboratory Advisory Board Member

Key Projects

Ninigret Pond Salt Marsh Restoration, Charlestown, RI
The Ninigret Pond restoration project is a thin layer deposition project designed to aid the Ninigret Pond marshes become more resilient by helping the marshes respond to the future effects of sea level rise. Dr. Weishar was the professional wetlands scientist for this project a served as the Woods Hole Group's project manager. The Woods Hole Group established the tidal datums for the Ninigret Pond estuary using data the Woods Hole Group had obtained for the Rhode Island Regional Sediment Management Project. These data were used to establish target elevations for the restoration of both high and low marsh. Additionally, the Woods Hole Group using a combination of GIS, LiDAR, and elevation data obtained with an RTK system within the marsh complex made recommendations for depth of fill and location of fill for the marsh restoration. This process established marsh diversity and allowed the project engineers to maximize the use and placement of dredged sediment on the marsh. The Woods Hole Group aided the agencies in formulating data collection, the location of reference marshes and the establishment of restoration goals and objectives. The goals and objectives were used to establish an adaptive management plan to monitor the restoration and to establish methodologies to determine if the marsh is restoring according to plan.

Comprehensive Plan for Docks, North Haven, NY, Coastal Scientist
Conducted field reconnaissance to characterize existing docks, public access, shoreline aesthetics and nearshore habitat. Wrote a Comprehensive Plan for Docks in North Haven, which highlighted existing dock policies, detailed the potential dock impacts on public access, aesthetics, water quality, and nearshore habitat, and documented the physical environment present along the coast of North Haven, including wave heights and flood elevations during storm conditions. Provided a series of recommendations for the Village to consider when approving new dock regulations. Attended a Village Meeting where the plan was presented to the public, approved and adopted by the Village.

Dredge Disposal Analysis, Chatham, MA, Coastal Scientist
Developed selection criteria to choose areas that are best suited for disposal of dredge material. Calculated fill capacity and designed potential nourishment templates for 14 potential disposal sites in Chatham, Harwich and Orleans. Potential dredge disposal site rankings were based on physical logistics (i.e. location, volume, equipment access, etc.), as well as each site's potential benefits (i.e. erosion protection, habitat restoration, coastal resiliency, etc.) and potential permitting and regulatory constraints (i.e. shellfish resources, presence of salt marsh or eelgrass, etc.). Compiled final rankings, analyses, maps, and fill cross-sections into a final report for the Town.

Monitoring Marsh Restoration in Delaware River Estuary, Public Service Electric and Gas Company
Dr. Weishar is the adaptive management evaluation team leader responsible for an ongoing project evaluating restoration plans, developing and implementing corrective mitigation strategies, required to insure the successful restoration of 20,000 acres of salt marsh in the Delaware River Estuary. As head of the adaptive management team Dr. Weishar assists the client in evaluating the restoration goals, objectives, and restoration timeline as outlined in the adaptive management plan. This project requires evaluation and dissemination of complex data to the public regulatory community and scientists to evaluate the performance of the project.

Key Projects (continued)

USACE IDIQ Task Order Contract – Program Manager
Dr. Weishar was the program manager for a 5-million dollar US Army Corps of Engineers IDIQ task order contract with the US Army Corps of Engineers District New England. During the life of this contract, Dr. Weishar was responsible for all aspects of the contract. He performed as program manager, project manager, and acted as the liaison with the District personnel. As program manager, Dr. Weishar's responsibilities included providing assistance to the Woods Hole Group project managers in developing contract cost estimates that provided a good value the USACE. Dr. Weishar also provided technical oversight for the projects and made sure the reports generated for the USACE. Occasionally the USACE would have a time sensitive project that just had to be completed. When this occurred, Dr. Weishar worked with both the USACE and the WHG project managers to expedite the project so that the time constraints were met without compromising the quality of the work product. As project manager on selected projects, Dr. Weishar worked helped generate Health and Safety Plans for many of the projects. Through his efforts, the IDIQ contract provided high quality products that helped the USACE complete its mission.

Evaluation of Wetland Remediation Techniques in an Arid Environment - Project Manager
Dr. Weishar was the project manager for this large remediation project and led the remediation efforts within the Kingdom of Saudi Arabia. This field study extends along the 750 Km of the Kingdom of Saudi Arabia Arabian Gulf shore from the Kuwait border to the industrial city of Al-Jubail. This complex shoreline is composed of an interlaced series of tide flats, beaches, embayments, lagoons, and salt marshes. Much of these ecosystems remain severely impacted from the oil spill. The year-long remediation demonstration project tested remediation technologies at the field scale for these arid ecosystems. The project demonstrated that large-scale marsh restoration was feasible through construction of a marsh remediation project. The project also demonstrated restoration of the other affected biotypes was feasible using indigenous equipment.

Restoration of a Restricted Tidal Marsh: South Cape Beach, MA. - Project Manager
South Cape Beach is a high marsh that has been isolated from the tidal source waters by culverts and artificial ditches. The installation of the ditches has muted the tidal range on the marsh plain and as a result *Phragmites* has begun to invade the marsh from the upland fringes. Dr. Weishar led the numerical modeling of the effort that formed the foundation for deriving marsh restoration designs that will help restore tidal circulation and prevent *Phragmites* encroachment onto the marsh plain.

Restoration of a Restricted Tidal Marsh: Nonquitt, MA. - Project Manager
Dr. Weishar was the project manager for this project and worked with the Woods Hole group team to develop restoration design alternatives. Nonquitt marsh has been isolated from tidal source waters of Buzzards Bay from approximately 40 years. The isolated pipe leading to the Bay mutes the tidal range from several feet to several inches. As a result the marsh sediments are highly saturated and a fresh water upland community has developed around the marsh perimeter. The preferred restoration alternative incorporated establishing a new tidal inlet in its historical footprint. Restoration design alternatives addressed large-scale marsh plain erosion, impacts to the adjacent wetlands, and increased flooding potential.

Marsh Restoration and Estuary Enhancement in Southern New Jersey, Hancock's Bridge, NJ, Public Service Electric and Gas Company - Oceanographer/Project Manager
As part of permit-required mitigation for nuclear facility with a once-through cooling system, Dr. Weishar reviewed feasibility of a program to restore 10,000 acres of degraded salt marshes through

Key Projects (continued)

on-site visits and analytical analyses. Performed critical investigation using hydraulic modeling, resource area evaluations, design review of marsh channel and tidal inlet design, and investigation and quantification of restoration effects on ground water, septic systems, and private drinking wells. The success of this project required close interaction between Woods Hole Group, Inc., NJ State environmental agencies, NJ Attorney General's Office, National Fish and Wildlife, US Army Corps of Engineers, National Marine Fisheries, and concerned citizens.

Beach Nourishment Design for Spectacle Island Massachusetts, Boston Harbor, MA, Massachusetts Water Resources Authority - Oceanographer/Project Manager
Completed a detailed beach nourishment design for the shorelines of Spectacle Island. Used refraction/diffraction model, REF/DIF1, to predict transformation of waves in areas where the bathymetry was irregular and diffraction was important. Used wave height results as input to longshore and cross-shore sediment transport models. These models were employed to simulate the performance of several different beach fill designs.

Design and Environmental Permitting for Pier and Dock Reconstruction at US Coast Guard Facility, Provincetown, MA, United States Coast Guard - Oceanographer/Project Manager
Performed coastal engineering analysis for the redesign and rehabilitation of a pier and dock facility and wave barrier for the US Coast Guard Station. Calculated design wave criteria for average and storm-induced conditions.

Beach Nourishment Design and Monitoring for the Southern Shore of Cape Cod, Cape Cod, MA, Great Island, Long Beach, and Dead Neck Homeowners Associations - Oceanographer/Project Manager
Performed shoreline change studies to evaluate rate of erosion and sediment loss for three different sites. Designed and participated in collection of high-resolution bathymetry, vibra cores, beach profiles, and sediment grain size data at each site. Developed and implemented beach nourishment plans for each site. Performed on-site topographic and bathymetric surveying before and after nourishment projects.

Environmental Impact Report (EIR) for Shore Protection Structures Between Aunt Lydia's Cove and Morris Island, Chatham, MA, Town of Chatham - Oceanographer/Project Manager
Prepared EIR to address impacts of revetments and other shore protection structures built to protect the Chatham mainland following the formation of the new inlet through the Nauset barrier, January 1987. Analyzed geologic history of the area, and studied evolution of Nauset barrier and tidal inlet system using historical maps, charts, and aerial photographs. Used a combination of existing studies and numerical analysis to quantify wave, tidal, storm surge and sediment transport processes. Prepared a plan of short-term action, long-term action, and short-term optional management alternatives for the Town of Chatham, property owners, and permitting agencies.

Numerical Model Analysis of Wave Climatology and Storm Surge for Seawall Design, Deer Island, MA, Massachusetts Water Resources Authority via Metcalf and Eddy, Inc. - Oceanography/Project Manager
Conducted numerical and physical model analyses of wave climatology, storm water levels, and wave run-up so that an effective and cost efficient shore protection plan could be developed for the island. Results from models runs were used to predict nearshore wave heights and water levels for 5-, 10-, 25-, 50-, and 100-year storm events and to optimize seawall design specifications. Two-

Key Projects (continued)

dimensional physical modeling of the seawall design was performed using a test facility to evaluate the proposed structural design.

Bathymetric and Side Scan Surveys of Fort Point Channel, Boston Harbor, MA, BSC Group, Oceanographer/Project Manager
Performed bathymetric and side scan sonar survey for part of the Central Artery/Tunnel Project. Bathymetry was plotted on the area basemap to ensure water depths were adequate for floating construction barges into the channel. Side scan data were reviewed for possible bottom debris or hazards. During the survey, field operations were restricted due to bridges crossing the channel, and barge and boat activity within the channel. Despite the navigational problems, full coverage of the channel was obtained.

Directional Wave and Current Meter Installation and Data Analysis, Townsend and Absecon Inlets, NJ, Offshore & Coastal Technologies, Inc. - Oceanographer/Project Manager
Collected wave and current data at the entrances to and nearshore region downdrift of the Townsend and Absecon inlets. Analyzed data for directional spectral parameters including significant wave height, wave direction, mean water depth, and the variance of water surface elevation.

Particle Tracking Analysis at the Salem Nuclear Generating Station, Hancock's Bridge, NJ, Public Service Electric and Gas Company - Oceanographer/Project Manager
Evaluated near- and far-field impacts to a nuclear generating station's intake basin using a particle tracking numerical model. Identified portions of the estuary providing potential detritus sources to the intake basin and evaluated the migration of detritus cleaned from the intake screens and dumped back into the estuary. Results of the particle tracking were collected in an effort to design a program to reduce and eliminate the detritus problem.

Bathymetry, Geophysical Survey, and Wave Refraction Analysis for Sand Borrow Site Analysis, Siasconset, MA, Town of Nantucket - Oceanographer/Project Manager
Completed a reconnaissance survey and analysis of two offshore sand borrow sites for a proposed beach nourishment project. Collected regional bathymetry, coring, beach sediment sampling, side-scan sonar, sub-bottom profiling, and magnetometer surveys. Modeled the wave climatology using collected data. Used model results to calculate sediment transport potentials and gradients in sediment transport to determine dredging from the proposed borrow sites.

Sub-bottom Investigations and Detrital Flux Analysis at the Salem and Hope Creek Nuclear Power Plant, Hancock's Bridge, NJ, Public Service Electric and Gas Company - Oceanographer/Project Manager
Designed a phased field data collection program to evaluate potential causes of detrital loading at the Salem and Hope Creek Nuclear Power Plant after detrital loading had forced the operating plant to shut down. Collected bathymetric data, conducted a sub-bottom survey, and monitored physical conditions: temperature, conductivity and current profile at the power plant. Conducted additional surveys to the north and south of the power plant to identify potential sources of the detritus.

Data Collection and Analysis of Tidal Current Characteristics at St. Lucie Inlet and Adjacent Waterways, Martin County, FL, Coastal Technologies Corporation - Oceanographer/Project Manager
Designed a survey to obtained high-resolution measurements of tidal current velocities and to map temporal variations in the spatial structure of flow through the Inlet and waterway cross sections.

Key Projects (continued)

Calibrated a numerical model of Inlet dynamics using survey results. Quantified the effect of Inlet geometry on the spatial structure of tidal flow and explained sediment accretion/scour characteristics within the Inlet.

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KIRK F. BOSMA, M.C.E., B.S., P.E.

Team Leader/Coastal Engineer

Qualifications Summary

- More than 19 years of diverse professional experience in the fields of coastal sciences and engineering, specializing in the areas of project management, numerical modeling, marsh restoration, field collection programs, sediment transport, and littoral processes
- Strong written and verbal communication skills
- Implemented technically advanced data collection, analysis, and numerical modeling techniques to assess marine, coastal and oceanographic environments
- Managed multi-disciplinary coastal and marine projects requiring team management, scientific analysis, environmental sensitivity, diverse coordination, and cost-effective solutions
- Developed various hydrodynamic and hydraulic models for water quality assessment, marsh restoration projects, discharge and mixing design, bridge scour, dredging impacts, and contaminated sediment fate and transport
- Managed and/or performed environmental impact studies for water resource projects, SUPERFUND sites, concentrate discharges into rivers and estuaries, and marine and coastal projects
- Numerical model experience with FVCOM, REF/DIF S, SWAN, STWAVE, BOUSS2D, GENESIS, RMA-Series of models, CMS-Flow/Wave, MIKE 21, EFDC, CGWAVE, SED-2D, ACES, CORMIX, SSTM, WAVAD, ADCIRC and EDUNE

Professional Affliations

Member, Association of Coastal Engineers (ACE)
Member, Coasts, Oceans, Ports, and Rivers Institute (COPRI)
Associate Member, American Society of Civil Engineers (ASCE)

Fields of Expertise

Managing projects and developing engineered solutions related to coastal structure design, beach nourishment, beach management, inlet stabilization, water quality, environmental permitting, impacts of offshore dredging, marsh restoration, and wave, tide, and current data collection. Coordinating field data collection and numerical modeling projects. Numerical modeling and analyses of sediment transport, nearshore spectral wave transformation, particle transport, bathymetric evolution, two-and three-dimensional hydrodynamic processes, water quality, and mixing processes. Extensive experience utilizing software packages and programming languages to present, analyze, and solve engineering and scientific problems. Experienced in coastal engineering design and planning, coastal restoration, beach nourishment plans, wave, current, and sediment transport modeling, evaluation of a variety of coastal protection alternatives, beach nourishment design, marsh restoration projects, borrow site impact assessment, and implementation of a comprehensive data collection and wave and sediment transport modeling programs. Providing expert testimony for marine and coastal physical processes and numerical modeling.

Higher Education

M.C.E., Civil Engineering-University of Delaware (1996)
B.S., Civil Engineering-Calvin College (1994)

Professional Licensing

P.E., Professional Engineer, Massachusetts License #45849

Employment History

2001-Present Coastal Engineer/Team Leader, Woods Hole Group
1997-2001 Coastal Engineer, Woods Hole Group
1994-1996 University of Delaware (Teaching and Research Assistant)
1992-1994 McNamee, Porter and Seeley, Inc.

Key Projects

MassDOT – FHWA Pilot Project for Climate Change and Extreme Weather Vulnerability Assessments and Adaptation Options of the Central Artery, Massachusetts Department of Transportation – Project Manager/Coastal Engineer and Modeler
Was a key project member on a technically advanced, leading-edge pilot project for the Federal Highway Administration evaluating the vulnerability to sea level rise and extreme weather events for the Central Artery in Boston, MA. The project combines a vulnerability assessment by conducting a new systems-level assessment and evaluated adaptation options to reduce risk to specific assets. The project also is geared towards integrating climate change vulnerability into MassDOT and FHWA overall practices. A highly resolved, numerical processes model was developed to assess the combined impact of sea level rise, storm events (tropical and extra-tropical), winds, tides, and waves. Results from the model were used to assess risk for various assets throughout the City of Boston, and subsequently investigate adaption options to reduce the identified vulnerabilities and to establish an emergency response plan for tunnel protection and/or shutdown. The investigation also included a cost benefit analysis, which helped MassDOT select the most efficient method of protecting valuable existing assets against today's weather events and future climate impacts. Climate scenarios and combined storm surge and sea level rise were developed for current day, as well as 2070 and 2100.

Coastal Climate Change Adaption and Engineering Alternatives East Boston, Massachusetts, The Boston Harbor Association – Project Manager/Coastal Engineer
Developed a range of engineering adaptation alternatives in response to potential sea level rise scenarios. The alternatives ranged from management approaches (e.g., evacuation, flood-proofing of structures, etc.), to soft-engineering options (e.g., beach nourishment, creation of wetlands, etc.). For each location, conceptual designs and associated cost estimates were developed and compared to the potential cost incurred by flooding and storm damages to the location without protective measures over a given time horizon.

Saco River and Camp Ellis Beach Section 111 Project, Saco, ME, U.S. Army Corps of Engineers – Project Manager/Coastal Engineer
Managed, coordinated, and conducted a comprehensive field data collection and numerical modeling scope of work for the Saco River and Saco Bay region. The field data collection effort consisted of a 2.5 month wave, current, and tidal observation deployment using two strategically located wave Acoustic Depth Current Profiler (ADCP) systems, a high resolution near shore bathymetric survey, and a ADCP current survey of the river hydrodynamics. The coastal monitoring data set is being utilized to calibrate and verify a series of state-of-the-art wave models ranging from generation scale (Atlantic Ocean), through transformation scale (regional), down to the local and near field scales. The advanced modeling effort includes spectrally based wind-generation (WAVAD), transformation (STWAVE and CGWAVE), and Boussinesq (MIKE 21BW) wave models. Model output is being used in sediment transport modeling on both a regional and local scale. The calibrated models are being used to assess a wide range of shore

Key Projects (continued)

protection alternatives aimed at mitigating the erosion caused by federally maintained coastal structures. The project involves a high level of coordination between regulatory agencies, the federal government, State of Maine senators, US army Corps of Engineers, Town officials, and the local community.

Town of Palm Beach Technical Review of Proposed Coastal Management Program, Palm Beach, Florida - Coastal Engineer
Provided technical review of the proposed coastal management program assembled by the Town of Palm Beach. The primary purpose of the project was to provide Town Council objective technical recommendations regarding next steps for the Town's coastal program and specific projects. The scope of work focused on a truly unbiased analysis of the plan with a focus on the feasibility of potential recommendations while providing guidance on prioritizing funding for the recommended coastal projects. Relevant materials were reviewed, stakeholders were consulted, and supplemental technical analyses were performed to help assess the cost effectiveness of various recommendations. Throughout the review, considerations were given for both island wide approaches (e.g., inlet management, regional coastal processes, beach nourishment performance, sediment sources, coastal structures, hardbottom resources, dunes, and sea level rise planning), as well as project specific approaches. The technical evaluation also included preliminary engineering calculations of life cycle project performance for the various coastal projects within the Town. Ultimately, prioritized and phased recommendations were provided to the Town for consideration and that were intended to assist the Town in both the long- and shore-term planning of coastal management.

Hydrodynamic Characterization And Sediment Transport Potential at The Former Callahan Mine Property, Brooksville, ME, Maine Department of Transportation – Project Manager/Coastal Engineer
Managed and conducted a field data collection program, developed a numerical hydrodynamic model, and performed a sediment transport evaluation for a Superfund Site in Brooksville, ME. Goose Pond Estuary is a site of environmental concern and is classified as a Superfund site on the National Priorities List by the Environmental Protection Agency (EPA). The site is the former location of a zinc/copper open-pit mine where mining operations were conducted adjacent to and beneath the tidal estuary. When mining operations ceased, the property was flooded and it is now hydraulically influenced by the tides of Penobscot Bay, as well as a small upland stream. Phase I included the collection of field hydrodynamic data to help provide insight into the overall circulation within Goose Pond, and the exchange with Goose Cove and Penobscot Bay. Phase I also provided a basis for understanding potential transport processes between Goose Pond, Goose Cove, and Penobscot Bay. The field data collection program was also designed to provide input and calibration data for the subsequent numerical modeling tasks. Utilizing the data collected, a 3-D hydrodynamic model was implemented, calibrated, and verified to characterize the circulation within the Goose Pond Estuary system. The model was used to simulate a range of conditions, including spring and neap tidal conditions, high and low freshwater inflow conditions, as well as storm surge events within Goose Pond. Hydrodynamic model results were used to evaluate overall circulation patterns within Goose Pond under a range of environmental conditions in order to identify the water and volumetric exchange between Goose Pond and Penobscot Bay. Finally, a sediment transport model was developed to

Key Projects (continued)

determine the fate and transport of contaminated material within the estuarine system and Penobscot Bay.

Coastal Climate Change Adaptation and Engineering Alternatives, Groton, Connecticut – Project Manager/Coastal Engineer
Worked with Battelle Ocean Sciences and the University of Southern Maine on assessing the impacts of Climate Change on coastal communities of Groton, Connecticut. Specifically, the regions of Groton Long Point and the infrastructure surrounding the Mystic River were evaluated. The evaluation included the impacts of sea level rise and storm events on potential flooding. For each location, conceptual designs of engineering adaptation alternatives were developed. The alternatives ranged from management approaches (e.g., evacuation, flood-proofing of structures, etc.), to soft-engineering options (e.g., beach nourishment, creation of wetlands, etc.), to more significant hard engineering structures (e.g., modular seawalls, revetments, tide gates, hurricane barriers, etc.). The community recommended alternatives for which cost estimates were determined. Engineering adaptations and costs estimates were provided for high and low rates of projected sea level rise, coupled with various return period storm events (10-, 20-, 50-, and 100-year) projected to the year 2070.

Coastal Climate Change Adaptation and Engineering Alternatives East Boston, Massachusetts - – Project Manager/Coastal Engineer
Developed a range of engineering adaptation alternatives in response to potential sea level rise scenarios. The alternatives ranged from management approaches (e.g., evacuation, flood-proofing of structures, etc.), to soft-engineering options (e.g., beach nourishment, creation of wetlands, etc.), to more significant hard engineering structures (e.g., modular seawalls, revetments, etc.). For each location, conceptual designs and associated cost estimates were developed and compared to the potential cost incurred by flooding and storm damages to the location without protective measures over a given time horizon.

Nantasket Beach Seawall Repair and Reservation Master Plan Services, Hull, MA, Massachusetts DCR - Project Manager/Coastal Engineer
Led a project ream to assess the Nantasket Beach Reservation Property. The Reservation has been used as a recreational beach by Greater Boston residents since the 1800s and is currently owned and operated by the Massachusetts Department of Conservation and Recreation (DCR). Nantasket Beach serves as a valuable resource from both a commercial and recreational standpoint. The beach and the associated waterfront amenities serve as the defining feature for the Town of Hull and represent a significant draw for visitors and summer residents. Nantasket Beach has experienced ongoing erosion over the past 150 years, especially the public beach at the southern end of the system. Woods Hole Group conducted a detailed coastal processes study focused on determining potential alternatives to address the ongoing coastal erosion. The barrier beach system was simulated using state-of-the-art wave and sediment transport models to understand existing conditions, and assess potential alternatives. The project evaluated the performance of the existing seawall, as well as determined potential structural alternatives to enhance the beach and improve beach nourishment performance. The performance and lifetime of the beach nourishment were assessed in order to provide guidance on potential long-term solutions and future nourishment requirements.

Key Projects (continued)

Herring River Estuary Restoration Project, Wellfleet, MA, Town of Wellfleet – Project Manager

Currently managing a project to restore the Herring River Estuary System, which represents a significant floodplain (the largest estuary on outer Cape Cod). The restoration is geared towards developing a plan to restore up to 1,000 acres of wetland area. Coordinating and developing a complex hydrodynamic numerical model that will address numerous concerns associated with re-establishing increased tidal exchange, as well as provide the necessary information to design an appropriate system of dikes, culverts, and road crossings. The modeling program involves evaluation and selection of the best model for application to the Herring River Estuary, model set-up, calibration, and verification, and simulation of a range of alternatives and physical conditions. The complex numerical modeling simulates both the hydraulics of the system and the salinity distribution throughout the estuary. The model results are used to design new engineering openings and water control structures.

Mixing Zone Evaluation, Whiting, IN, BP Products North America - Project Manager

Performed a third party peer review of an existing mixing zone submittal, including engineering design, confirmation of the mixing zone analysis (with specific evaluation of the implementation of the modeling), determination of the physical processes, and assessment of the diffuser design. The evaluation also included site-specific ambient water current measurements at the proposed discharge location to more accurately characterize the receiving waters. The water current observations were then used to develop more representative conditions and appropriate scenarios for modeling the dispersion and mixing zone. The distribution of water current observations and the percent occurrence of each mixing ratio were used to develop a probability density function of the dispersion ratios and provide design guidance/recommendations for diffuser orientation, design, and layout.

Ballard Street Salt Marsh Restoration Project, Saugus, MA, Division of Ecological Restoration – Project Manager

Managed a restoration and engineering assessment of the Ballard Street Salt Marsh system in Saugus, Massachusetts. The project evaluated the level of restoration potential in the Ballard Street marsh system through the observation of site-specific tide data, simulation of all the existing flow control structures in the system, verification of the proposed flow control structure design and necessary flood storage needs, and assessment of a number of approaches for modifying the hydraulic structures (as needed) in order to arrive at a conceptual design that meets the overarching goals of the project. A numerical model of the hydrodynamics and salinity throughout the system was developed and calibrated to measured field data. Model simulation were developed for normal tidal conditions, storm conditions (both rainfall and coastal storm surge), and sea level rise scenarios. Calibrated model results were subsequently used to evaluate proposed design conditions, including previous recommendations by scientific evaluations, as well as other potential design scenarios. Alternatives included: assessment of potential flow control structures that limited the amount of water directed to the northwest branch of the system (which is more densely populated and experience historic flooding issues), while allowing full tidal exchange to the southeast branch of the system, evaluation of potential flood storage increases through excavation of marsh plain area, and reconfiguration of the various culverts throughout the system.

Key Projects (continued)

Engineering Services and Environmental Impact Evaluation – Hammonasset State Park, Madison, CT, Connecticut DEP - Project Manager/Coastal Engineer
Managed and performed an engineering assessment and environmental impact study/report for Hammonasset Beach in Madison, Connecticut. Hammonasset Beach State Park contains Connecticut's largest public swimming beach and campground and is one of the region's most valued recreational and natural resources. During the winter of 2004-2005, severe storms resulted in the loss of a ¼-mile section of the beach on the western end of the park and significant damage to the boardwalk. Despite ongoing stop-gap measures to address the erosion problem, the beach continues to experience significant erosion and the boardwalk and beach remain at risk. Consequently, the Connecticut Department of Environmental Protection (DEP) was concerned about the viability of the western portion of the beach and park for recreational use and was seeking to identify the most cost-effective and long-term course of action to remedy this urgent situation. Therefore, an Environmental Assessment and Impact Evaluation was conducted to study the shoreline erosion problem, identify and evaluate the feasibility of alternative solutions, evaluate the potential impacts on Hammonasset Beach and the surrounding environment, and make recommendations as to the preferred solution. The proposed project consists of three distinct, but related elements: (1) Compilation and review of existing data and studies, as well as collection of new baseline topographic, bathymetric, sediment, and wave data; (2) an engineering feasibility study to identify and analyze beach management alternatives; and (3) an Environmental Impact Evaluation (EIE) pursuant to the Connecticut Environmental Policy Act (CEPA) to further analyze alternatives, identify potential adverse impacts and any necessary mitigation, and ultimately to support the selection of a recommended course of action.

Reverse Osmosis Concentrate Dilution Analysis and Ambient Water Characterization, Melbourne, FL, Reiss Environmental, Inc. - Project Manager and Coastal Engineer
Led a team of engineers and scientists in an evaluation of an existing Reverse Osmosis (RO) discharge. The scope of work included the collection of field data and application of a model to characterize the dilution of the existing RO discharge. The purpose of the evaluation was to assess whether a mixing zone could be permitted within the existing water quality regulations at the State and Federal level. Observations included bathymetry, a full suite of water quality constituents, and long-term, tide, current, and salinity observations. These data were used to develop a mixing zone model for constituents of concern.

Hydraulic Analysis of Flow Control Structures for Wetlands Restoration, Town Creek, Salisbury, MA - Project Manager and Coastal Engineer
Assessed and designed a modification to an existing embankment that served to restore marsh habitat and more efficiently alleviate flooding concerns in Salisbuty, MA. Approximately 350 acres of tidal and formerly-tidal wetlands existed upstream of an abandoned railroad embankment. Tidal exchange was prevented from entering/exiting the marsh by a wooden flap gate on the downstream side of the railroad culvert. Hired by the MCZM Wetlands Restoration Program and US Fish and Wildlife, a hydraulic study and model of the Town Creek system was completed to assess potential restoration options. The hydraulic study evaluated a range of potential alternatives. The preferred culvert and tide control alternative: 1) increased the capacity of the marsh to drain during flood events; 2) provided the Town with a greater ability to preserve flood storage capacity by closing off the system prior to predicted storm events; and 3)

Key Projects (continued)

provided the means for small, incremental increases in tidal range over an extended time period as part of a well-monitored, risk-adverse, adaptive management approach to tidal restoration.

Hydrodynamic Analysis and Engineering Design for the Restoration of the Bride Brook Estuary, Rocky Neck State Park, East Lyme, CT, Connecticut Fund for the Environment - Coastal Engineer
Evaluated and designed a restoration project for the Bride Brook Estuary system in East Lyme Connecticut. The project investigated the hydrodynamic characteristics of the Bride Brook estuarine system and evaluated potential alternatives to restore more natural conditions to a system that has been structured since the early 20th century.). Historically, Bride Brook was one of the largest anadromous fish runs the state of Connecticut. However, since the construction of twin elliptical culverts at the mouth of the estuary in 1934, alewife numbers declined. This decrease has been attributed to the reduced tidal flow and water column light caused by the 200-foot long structure, which obscures the fish passage upstream. Therefore, the primary objective of this project was to determine an engineered alternative to the existing structure that could effectively restore the tidal regime and fish passage of the Bride Brook estuary. This project is composed of three separate tasks: 1) Data Observations, 2) Analysis and Conceptual Design, and 3) Final Design and Engineering. The design to restore the system removed the existing, undersized twin culverts and replaced them with an open channel and box culvert through the dune system. The design was successfully constructed and opened in the spring of 2010.

Peer Review of the Florida Bay Hydrodynamic and Salinity Model, Florida, South Florida Water Management District – Coastal Engineer
Served as an expert peer reviewer of the hydrodynamic modeling effort for the Florida Bay and Florida Keys Feasibility Study. The model is required to simulate circulation, salinity stratification and distribution, and water quality behavior in the Florida Bay and Reef Tract utilizing a standardized set of field data. Offered expert opinions based on knowledge, expertise, and practical experience in conducting, analyzing, and applying similar hydrodynamic modeling strategies. The peer review included assessment of the grid methods and optimization techniques to determine spatial density, scale, and distribution, the adequacy of calibration and verification, and the quality and extent of the input data and model parameters.

Analysis of Shoreline Change for Western Beach, Scarborough, ME, U.S. Army Corps of Engineers - Project Manager
Led the project that used a computer-based shoreline mapping methodology, within a Geographic Information System (GIS) framework, was used to compile and analyze changes in historical shoreline position between 1864 and 2003 for Western Beach, Saco Bay, Maine. The purpose of this task was to quantify changes in shoreline position for three (3) specific periods, (1864-1944, 1962-1977, and 1986-2003) using the most accurate data sources and compilation procedures available, and to characterize areas of erosion and accretion. This project's overall goal was to evaluate changes in the coastline of Western Beach due to significant modifications to the Scarborough River Inlet and entrance region. In addition to evaluating the shoreline change data, a projected shoreline was produced using the shoreline movement rates of the pre-1962 or pre-Scarborough River jetty construction time from 1864-1944. Using the rates prior to project construction, a projected shoreline position was estimated assuming no project had taken place and the rates continued to exist over the entire 139-year time span. The results indicated had the shoreline continued to erode at the same rates as seen from 1864-1944, the shoreline

Key Projects (continued)

would have retreated significantly on either end of Western each, while experiencing a slight advance in the center.

Beach Nourishment and Inlet Stabilization at Sandwich Town Beaches and Dredging the East End of the Cape Cod Canal, Sandwich, MA, Town of Sandwich - Project Manager/Coastal Engineer
Managed and performed comprehensive beach management plan for all Town of Sandwich beaches, including evaluation of the physical processes governing sediment transport, alternatives analysis for shore protection measures and inlet stabilization, and appropriate beach maintenance and usage. The project consisted of numerical modeling of alternatives and final design for establishing a long-term beach/dune restoration plan, as well as relocation and design of a jettied tidal inlet. Required excellent communication and close coordination with numerous agencies, local officials, sub-contractors, and multiple clients. The regulatory process is currently underway.

Waquoit Bay Yacht Club Revetment Repair, Waquoit, MA, Waquoit Bay Yacht Club - Project Manager and Coastal Engineer
Assessed and designed a repair to an existing revetment protecting the Waquoit Bay Yacht Club. Significant gaps in the toe of the structure had developed allowing for removal of the finer grain sediments from the core. In this region of revetment, which is most critical, there is significant washout of the backfill of the revetment. At Waquoit Bay Yacht Club, continued cavity formation and subsequent collapse of the existing revetment would present an immediate threat to the structural stability of the clubhouse. A wide range of alternatives were assessed and the preferred alternative was selected and designed that consisted of the installation of filter fabric behind the existing structure, the addition of a bedding and drainage stone layer behind the structure, the addition of a stormwater runoff trench at the crest of the existing structure, the addition of clean backfill material behind the structure as needed, and addition of compatible beach material in front of the structure planted with marsh species and encouraged to develop into salt marsh. Also provided construction oversight and permit compliance inspections.

Nonquitt Salt Marsh Restoration, South Dartmouth, MA, EA Engineering – Project Manager
Managed and performed a numerical circulation model directed at the restoration of the Nonquitt Salt marsh system. The project consisted of implementation of a field data collection program, development and calibration of a numerical circulation model (RMA-2), and the application of the calibrated model to determine the potential impact of design changes aimed at improving circulation. Working with the National Oceanic and Atmospheric Administration, and the U.S. Fish and Wildlife Service, the purpose of the study is to assess the effects of anthropogenic effects on the marsh ecosystem.

Numerical Modeling of Storm Surge Induced Hydrodynamics and Pollutant Transport, New Bedford, MA, Confidential Client - Project Manager/Coastal Engineer
Simulated the hydrodynamics and resulting pollutant transport due to the effects of a historical hurricane in the New Bedford Harbor Region, including the immense flooding of the upland due to the accompanying storm surge, and the release and transport of chemicals from a confidential entity. Through numerical modeling of this complex phenomena, hydrodynamic results, coupled with pollutant input data, pollutant mass rate, duration of release, and time of release, pollutants

Key Projects (continued)

were released from a single specific area to quantify the transport pathways and concentrations due to the storm surge caused by the hurricane. This project also requires expert testimony and technical analysis of wave energy, breaking, set-up, diffusivity, and mixing.

Thermal Modeling Analysis for Proposed Cooling Plant on Lake Waban, Wellesley College, Wellesley, MA, Vanasse Hangen Brustlin, Inc. - Project Manager
Performed thermal and analytical modeling of design alternatives for a proposed cooling water discharge plant on Lake Waban in Wellesley, MA. Two methods of analysis (analytical and computer model) were used to determine the mixing of temperature concentration, and the ability of the Lake to receive the discharged waters under peak demand (representing a worst-case scenario under August conditions). The purpose of this analysis was to simulate the mixing and dilution of the discharge waters with the ambient water of Lake Waban under worst-case conditions, discuss the results of the modeling effort, and provide recommendations related to potential design modifications.

Characterization Study of Delaware River Detritus, Hancock's Bridge, N.J., PSE&G, - Project Manager
Conducted an assessment of the ability of hydroacoustic technology to detect detrital material throughout the water column. Never utilized for this specific application, use of the innovative technology saved the client from other costly alternatives. Phase I of the study consisted of controlled laboratory testing in an enclosed basin and was performed with samples taken from the Delaware Bay Estuary. The results indicated that hydroacoustic technology could be utilized for identifying detritus within the Delaware Bay Estuary. Phase II of the study consisted of implementation of the hydroacoustic technology in the Delaware Bay Estuary. Field sampling also included Acoustic Doppler Current Profiler (ADCP) measurements, net captures, Conductivity Temperature Depth (CTD) casts, and Optical Backscatter Sensor (OBS) profiles. Responsible for project management, analysis and interpretation of the acoustic return signals, and reporting. Biomass estimates were determined from the measured currents and captured detrital material and compared to the integrated hydroacoustic signal. Future phases consist of detailed field measurements, 3-dimensional detrital transport modeling, and evaluation of mitigation oriented engineered solutions and management strategies.

3 Related Studies:
a) Environmental Studies Relative to Potential Sand Mining on the Continental Shelf for Beach Replenishment, Offshore Alabama, Alabama, U.S. Mineral Management Service.
b) Environmental Survey of Potential Sand Resource Sites: Offshore New Jersey, NJ, U.S. Mineral Management Service.
c) Collection of Environmental Data within Sand Resource Areas Offshore North Carolina and the Environmental Implications of Sand Removal for Coastal and Beach Restoration, North Carolina, U.S. Mineral Management Service - Coastal Engineer/Numerical Modeler
The following is a description of projects a, b, and c:

Key member of a vast multi-disciplinary team conducting large-scale studies to address environmental issues raised by the potential dredging of sand from the inner continental shelf offshore New Jersey, Alabama, and North Carolina. Quantified the potential modifications to waves that cross within identified borrow areas due to offshore dredging. Determined the impacts of offshore dredging and subsequent beach nourishment on local and regional sediment

Key Projects (continued)

transport patterns, coastal and nearshore sedimentary environments, and local shoreline processes. Performed state-of-the-art spectral wave modeling for assessing modifications to the wave field and input into nearshore circulation and offshore and nearshore sediment transport models. The results of the ongoing studies will enable Minerals Management Service to monitor Key Projects (continued) and assess the potential impacts of offshore dredging activities and to identify ways in which dredging operations can be conducted to minimize or preclude long-term adverse impacts to the environment.

Observations of Ocean Wave, Tide, and Current Processes Offshore of Little Bay, Montserrat, Montserrat, U.K., Mouchel Consulting, Ltd. - Project Manager/Coastal Engineer/Field Data Collection
Installation and monitoring of a real-time data acquisition system connected via a cable link to the shoreline in Little Bay, Island of Montserrat. Ocean wave, tide, and current data were collected and analyzed. Responsible for QA/QC of collected data. Observations from the one-year deployment will be utilized to develop and design a new harbor on the Island.

San Francisco Airport Expansion Project, San Francisco, CA, URS Corp. - Coastal Engineer
Served as a Team Engineer working on the preparation of an Environmental Impact Report/Environmental Statement (EIR/EIS) for the San Francisco Airport Expansion Project. WHG has deployed a suite of Sediment Transport Monitoring Systems (STMS) to collect seasonal current, wave, and suspended sediment concentration measurements in each of the Bay's characteristic environments. Responsible for analysis and interpretation of hydrodynamic and sediment dynamic measurements, estimation of sediment flux, modeling of sediment transport, and report generation.

Physical Sampling and Sediment Transport Analysis at Weymouth Neck, Weymouth, MA, Massachusetts DEP - Project Manager/Coastal Engineer
In this region, concerns have been raised that the metals (arsenic, copper, lead, and zinc) found in upland areas may have migrated into the sub-tidal area surrounding the peninsula. As a precursor to the chemical sampling, developed an analytical sediment transport model that was geared towards assisting in defining appropriate areas to perform sub-tidal chemical sampling. The model required a field investigation in order to determine the physical characteristics of the sub-tidal sediment within the Weymouth Neck region (including Upper Neck Cove, Lower Neck Cove, and Weymouth Back River), as well as generation of local physical processes (winds, waves, tides, and currents) in the vicinity of Weymouth Neck Peninsula. The analytical model was used to identify areas of erosion and deposition in the sub-tidal regions surrounding the peninsula. The results of the model are used as a tool to assess, justify, and bound the chemical sampling locations around the peninsula.

Evaluation of the Great Creek Outlet Structure, Milford, CT., Fuss & O'Neill, Inc. - Project Manager/Coastal Engineer
In an ongoing project, provided coastal processes analysis, analytical modeling, outlet structure assessment, and design support services for evaluating the impact of an outlet structure on downdrift erosion. Engineering alternatives are being evaluated through sediment transport analytical modeling to determine potential mitigation measures. Wave transformation modeling and sediment transport modeling are focused to assess the parameters of the outlet structure (e.g.,

Key Projects (continued)

height, length, culvert depth, etc.) and provide design guidance for corrective action and potential nourishment.

Hydrodynamic Modeling and Sediment Transport Analysis During Temporary Tunnel Storage in Fort Point Channel, Boston, MA, Gannett Fleming, Inc. - Coastal Engineer/Project Manager
Conducted a hydrodynamic and sediment transport modeling study of Fort Point Channel, MA to determine the impact caused by temporary storage of floating tunnel sections on existing conditions and industrial water usage. Completed technical report presenting the hydrodynamic and potential sediment transport results, which was utilized to assist in engineering methodology and design.

Analysis and Design of Revetment Structures at Hingham Shipyard, Hingham, MA, Sea Chain, L.L.C. - Coastal Engineer
Completed a fast-track study and design of revetment structures at Hingham Shipyard on Weymouth Back River. The study focused on analyzing the relevant coastal processes, and optimizing the design to gain the most upland area, while minimizing adverse impacts to the nearby salt marsh and other nearshore wetland resource areas. Analysis for the design included wave modeling, storm surge analysis, extremal analysis, wave reflection analysis, wave runup and overtopping analysis, revetment design and stone sizing, and sediment transport analysis.

Power Plant Effluent Mixing Zone, FL, Confidential Client - Coastal Engineer
Project Engineer involved in the investigation of the discharge from a once-through cooling system at a coastal power plant. The cooling water effluent at this station was found to have seasonally low dissolved oxygen. Woods Hole Group's investigation sought to identify the source of the dissolved oxygen depression, investigate regulatory issues, and to examine potential technologies for increasing effluent dissolved oxygen. Specifically, performed numerical particle tracking simulations in order to identify water pathways to the intakes. Additionally, a review of existing data and previous work was conducted. This revealed that the seasonally low dissolved oxygen was a widespread phenomenon in ambient waters. Because the station was not responsible for the overall dissolved oxygen depression, a mixing zone was identified as a potential regulatory solution to any minor impacts from the discharge. Engineering alternatives to raise the effluent's oxygen content were also investigated.

Particle Tracking Analysis and Improvements to the Near-Field Boundary Condition, Hancock's Bridge, NJ, Public Service Electric and Gas Company - Coastal Engineer
Completed a numerically driven particle tracking study for the Delaware Bay and estuary system to identify detrimental sources of detritus within the system. The particle tracking model, utilized in concert with a validated hydrodynamic model, was utilized to statistically evaluate near- and far-field impacts to a cooling water intake. Recommendations were provided to improve management and recycling practices, as well as provide future steps for numerical modeling of appropriate engineered solutions, which would result in safer and more cost-effective operations.

Ocean Currents Offshore Eastern Trinidad, Trinidad, Amoco Production Company - Coastal Engineer
Developed and performed in-depth data analysis of ocean conditions off the eastern coast of Trinidad based on data collected during recent measurement programs in the area. Observations

Key Projects (continued)

were utilized to investigate coastal ocean processes active at the site and extrapolate the observations to predict future extremal and operational conditions. Conducted a detailed literature review, assessed the structure and variability of the observed currents, separated the current into specific process components using advanced numerical analysis techniques, formulated an extremal value analysis, and completed technical writing of a final report. Results of the study provided recommendations for design criteria and operational procedures.

Historical Shoreline Change Analysis: Western Town Line to Horton Point, Southold, NY, Town of Southold - Coastal Engineer
Conducted an assessment of the history of storm activity in Long Island Sound. Wind and tide records were analyzed and Generalized Extremal Value (GEV) calculations were completed to determine the historical behavior and return periods of major storm events. Results of the analysis were correlated to historical shoreline change and incorporated to determine the rate and extent of erosion and accretion along the Southold coastline.

Tidal Current Characteristics of St. Lucie Inlet, St. Lucie, FL, Coastal Technologies Corporation - Coastal Engineer
Performed data analysis of observations of tidal currents in the St. Lucie Inlet to map the temporal variation in the spatial structure of flow through several Inlet cross-sections. These high-resolution measurements of tidal current velocities were obtained using a vessel-mounted Acoustic Doppler Current Profiler (ADCP) coupled with a GPS-based integrated navigation (IN) system. Results of the surveys show current energy focused in the deeper southern and center channels of the Inlet. The south channel was characterized as 'flood dominant', with stronger flood currents than ebb currents, which tend to transport sediments into the Inlet interior. The center channel was characterized as 'ebb dominant', with stronger ebb currents than flood currents, tending to move sediments out of the Inlet to form an ebb tide shoal. The geometry of the waterway, hard structures, and the alongshore coastal currents appeared to modify the spatial structure of the tidal currents through the Inlet cross section.

Coastal Flood Protection Structure Evaluation, Chatham, MA, Coastal Engineering, Inc. – Coastal Engineer
Completed an independent review of an existing coastal revetment in Chatham, MA to determine structural integrity related to wave forces. The existing stone revetment structure was evaluated to ensure that adequate design, construction, and maintenance have been undertaken to provide reasonable assurance that the structure can provide durable protection during the 100-yr (base) flood. The analysis included development of the physical parameters that represent the 100-yr flooding event and then evaluated the structural design against the 100-yr flooding physical parameters, including toe protection, backfill protection, pressure distribution and wave forces, structural stability at the minimum and critical water levels, material adequacy, etc.

Publications and Presentations

25

Other

NOAA Planning for Sea Level Rise in the Northeast: Considerations for the Implementation of Tidal Wetland Habitat Restoration Projects – Steering Committee Member.

Elise Leduc, M.E.M.
Coastal Scientist

Expertise

Coastal environmental management, wetland delineation and restoration, shellfish and eelgrass surveys, coastal planning, geospatial analysis, shoreline change analysis, environmental impact analyses, ecological risk assessment, conservation prioritizations, field and water quality sampling, Massachusetts environmental regulations.

Education

M.E.M., Coastal Environmental Management - 2011 Duke University

B.A., Biology – 2006 Williams College

Certificates of Training

OSHA 40-Hour HAZWOPER

Wetland Delineator Certification

Publications and Presentation

6

Qualification Summary

- Adept at spatial data acquisition and geospatial analysis using ESRI's ArcGIS to analyze and display data for coastal and marine projects.
- Experience conducting shoreline change analyses.
- Experience with wetland delineation, shellfish and eelgrass surveys, and field data collection of sediments, water, and invertebrates for environmental studies.
- Experience with local, state, and federal permitting of coastal and environmental projects.
- Experience developing beach management plans, and coastal management and conservation documents.
- Strong written and verbal communication skills, and the ability to engage diverse groups of stakeholders.
- ESRI ArcGIS; ETGeowizards; MATLAB; Microsoft Office; Adobe Photoshop and Illustrator

Work Experience

2012-Present	Coastal Scientist, Woods Hole Group, Inc.
2011-2012	Watershed Management Fellow, Charles River Watershed Association
2011	Coastal Conservation Planner, North Carolina Division of Coastal Management
2010	Conservation GIS Analyst, Great Land Trust
2009-2010	Wetland Laboratory Technician, Duke University Wetland Center
2006-2008	Rural Aquaculture Extension Agent, Peace Corps Zambia

Key Projects

Ninigret Pond Salt Marsh Restoration, Charlestown, RI, Coastal Scientist
Conducted a wetland evaluation and provided restoration planning guidance for a large scale (~40 acre) salt marsh restoration project using thin layer sediment deposition. Selected targeted restoration areas based on level of existing vegetation degradation and elevation. Compiled and analyzed tidal, salinity, vegetation, soil core, and elevation data to develop a restoration plan and target marsh platform elevations. Developed adaptive management guidelines for moving forward with maintenance and monitoring of the project in the future.

Flood Mitigation and Ecological Resilience Project, Weymouth, MA, Coastal Scientist
Conducted a site evaluation and wetland delineation of a salt marsh wetland, which is currently tidally restricted due to an improperly sized and poorly maintained culvert. Performed vegetative community assessments, an evaluation of hydrology, and a hydric soils assessment. Reconnaissance level assessments were also conducted at two reference wetlands to identify opportunities for function improvement and restoration design. Based on the wetland survey and evaluation of the site, the results of the hydrodynamic modeling, and the information obtained from the two reference areas, a permit level restoration plan will be developed.

Evaluation and Restoration Plan for Whidah Road Salt Pond, Chatham, MA, Coastal Scientist
Served as project manager for a salt pond evaluation to determine the best course of management for the pond, which was experiencing frequent inlet closures. Conducted an elevation survey of the salt pond, salt marsh, inlet, coastal beach and nearshore area, collected water quality measurements, and performed a vegetation and habitat assessment for the pond and marsh. Combined an analysis of historical aerial photos to determine the frequency of inlet closure, with an assessment of the hydraulics at the site to determine at what tidal elevations and for how long during the daily tidal cycle water would flow between the pond and the bay, to evaluate the need and the feasibility of opening the inlet. Prepared a summary report and graphics detailing the findings of our study.

Dredge Disposal Analysis, Chatham, MA, Coastal Scientist
Developed selection criteria to choose areas that are best suited for disposal of dredge material. Calculated fill capacity and designed potential nourishment templates for 14 potential disposal sites in Chatham, Harwich and Orleans. Potential dredge disposal site rankings were based on physical logistics (i.e. location, volume, equipment access, etc.), as well as each site's potential benefits (i.e. erosion protection, habitat restoration, coastal resiliency, etc.) and potential permitting and regulatory constraints (i.e. shellfish resources, presence of salt marsh or eelgrass, etc.). Compiled final rankings, analyses, maps, and fill cross-sections into a final report for the Town.

Town of Sandwich Beach Management Plan, Coastal Scientist
Conducted a review of historical documents, maps, and existing data for Sandwich public beaches. Reviewed, mapped and described existing conditions and historical shoreline change through site visits and geospatial analysis. Performed historical shoreline change analysis for Sandwich public beaches. Documented existing activities being undertaken by the Town as on-going management of the public beaches. Identified and proposed new management activities that could improve the recreational or conservation functions of the public beaches. Compiled all existing management practices and new recommendations into a final Beach Management Plan document.

Comprehensive Plan for Docks, North Haven, NY, Coastal Scientist
Conducted field reconnaissance to characterize existing docks, public access, shoreline aesthetics and nearshore habitat. Wrote a Comprehensive Plan for Docks in North Haven, which highlighted existing dock policies, detailed the potential dock impacts on public access, aesthetics, water quality, and nearshore habitat, and documented the physical environment present along the coast of North Haven, including wave heights and flood elevations during storm conditions. Provided a series of recommendations for the Village to

Key Projects (continued)

consider when approving new dock regulations. Attended a Village Meeting where the plan was presented to the public, approved and adopted by the Village.

Modeling the Effects of Sea Level Rise on Coastal Wetlands, MA, Coastal Scientist
Worked for the Massachusetts Office of Coastal Zone Management to model the effects of sea level rise on coastal wetlands statewide. Data inputs required by SLAMM, such as topographic data, mapped wetlands, accretion and erosion rates, salinity, tide levels and ranges, percent imperviousness, and freshwater inputs, were identified, compiled and processed in order to run the model. The North Shore's Great Marsh was chosen as a sub-site for pilot testing and sensitivity analysis due to the amount of data available for the system. Final model simulations were be run for both the sub-site, as well as state-wide simulations involving 18 regionals panels, for three out-year scenarios and four projected sea level rise rates based on IPCC predictions. These results will aid CZM in identifying areas along the Massachusetts coast where wetlands can and cannot migrate and adapt to sea level rise, given current elevations and development.

Shellfish Survey, Chatham, MA, Coastal Scientist
Conducted a shellfish survey in Pleasant Bay consisting of 9 transects and 162 sampling stations, in response to a proposed pier development. Utilized a 12-inch modified bullrake to collect samples. Identified and recorded all live animals. Reported information on sediment type and grain size from each sample. Summarized resulting data in tabular form and wrote a final summary report detailing findings from the survey.

Newtown Creek CERCLA Environmental Risk Assessment, New York City, NY, Coastal Scientist
Review and comment on ecological risk documents, such as the RI/FS Work Plan, Screening Level Ecological Risk Assessment (SLERA), Baseline Ecological Risk Assessment (BERA), Risk Analysis Plan (RAP), etc. Conduct data synthesis and analysis, calculations and research to support CERCLA comments and recommendations. Provide technical review and recommendations on toxicity tests, site selection, benthic community analysis, weight-of-evidence method, and technical documents. Create presentations, figures, maps and comments to submit to EPA on behalf of the City.

Chilmark Pond Property Evaluation, Chilmark, MA, Coastal Scientist
Served as project manager for a coastal property evaluation along the southern coast of Martha's Vineyard. Researched and investigated the historic and potential future shoreline changes, and how they might impact a new house to be built on site. Conducted a site visit to evaluate the existing conditions at the site. Acquired and georeferenced historical aerial photographs and charts from the 1800s to the present, and utilized these to document the location of mean high water over time along 2 miles of the southern Martha's Vineyard coastline. Performed a shoreline change analysis using the digitized shorelines to compute a historical shoreline change rate, and help inform projections of future shoreline change rates. Compiled data and wrote a summary report of findings to provide guidance for future planning and construction on the property.

Status and Resilience of the Westport Harbor Barrier Beach, Westport, MA, Coastal Scientist
Compiled and georeferenced aerial photography and historical charts to perform a shoreline change analysis for the Westport Harbor Barrier Beach system. Used the data generated through the shoreline change analysis to projected future shoreline change with and without sea level rise. To incorporate sea level rise into future estimates, LiDAR elevation data in conjunction with the predicted sea level rise scenarios in *Global Sea Level Rise Scenarios for the United States National Climate Assessment* were used. Developed projections for 25, 50 and 100 years into the future.

Key Projects (continued)

Coastal Pond Management Plan, Chilmark, MA, Coastal Scientist
Managed a project for a private client to develop a comprehensive pond management plan for a coastal salt pond on Martha's Vineyard. Conducted a site visit to evaluate existing conditions, investigate pond depth and sediment type, and make observations about the stability of the nearby barrier beach. Performed a shoreline change analysis for the southern barrier beach, a critical component to the future management of the pond and the rest of the property. Gathered background information on past and current practices for *Phragmites* control and pond management activities, as well as on general geology and soil conditions in the area, flood zone designations, and ecology of the pond to accurately identify and understand the problems facing the pond, and to develop alternatives for managing the pond. The Pond Management Plan will address preserving and/or restoring the open water pond habitat, and minimizing erosion on the barrier beach, which is necessary for the longevity of the pond. Alternatives considered for preserving and/or restoring the open water pond habitat included mechanical Phragmites removal, seasonal targeted herbicide use, and dredging to increase the depth of the pond. Alternatives considered for reducing erosion along the barrier beach included installation of sand fencing, localized dune restoration or reconstruction after major storms, and restoration of current dune footpaths. The plan provided background and reasoning, estimated effectiveness, estimated cost, and projected time frame for each proposed alternative.

Technical Evaluation of Preliminary 2013 FEMA FIRMs for the Towns of Scituate, Marshfield, and Duxbury, MA, Coastal Scientist
Evaluated draft FEMA maps, and identified errors and inconsistencies in FEMA's analyses, such as oversights along a particular transect or a flawed assumption. Reanalyzed flood area delineations along FEMA's existing transects, and created additional transects to document and accurately map the flooding potential around location-specific topography. Utilized a geographic information system (ArcMap) to adjust and reclassify mapped flood zones and Base Flood Elevations (BFEs) to reflect updated modeling. Produced updated flood maps.

Shoreline Change Analysis for Saco Bay, ME, Coastal Scientist
Acquired and georeferenced historical aerial photographs and maps for use in project analyses. Analyzed multiple historical aerial photographs to digitize the shoreline and to calculate long-term rates of shoreline change along transects through the beach and dune. Utilized MATLAB to compute annual rates of shoreline change between all available time periods between 1864 to 2010 using the end point method, as well as the linear regression method. Contoured LiDAR data from three time periods to compare to contemporary shoreline positions and incorporate into the shoreline change analysis. Performed error analyses for shorelines derived from aerial photos and LiDAR data.

Publications and Presentations

Cura, J.J., E. Leduc, C. Prabhu, and E. Mahoney. 2015. "Sediment Toxicity in Different Classes of Reference Area and in the Newtown Creek Superfund Site." Poster Presentation at the Society of Environmental Toxicology and Chemistry (SETAC), Salt Lake City, UT, November 2015.

Leduc, E. 2011. "An Evaluation of GIS Prioritizations for Selecting Wetland Mitigation Sites: Cook Inlet Case Study" Master's Project, Duke University's Nicholas School of the Environment, Durham, NC.

Leduc, E., K. Price, and T. Miller. 2011. "State of North Carolina 2011 Coastal and Estuarine Land Conservation Program (CELCP) Plan" NC Department of Environment and Natural Resources, Division of Coastal Management.

"A Prioritization of Land Parcels for Wetland Mitigation around Knik Arm" prepared for Great Land Trust, Anchorage, AK. 2011.

Publications and Presentations (continued)

"A Prioritization of Land Parcels for Conservation in the Matanuska-Susitna Borough" prepared for Great Land Trust, Anchorage, AK. 2010.

Leduc, E. 2006. "Effects of the invasive ant, Myrmica rubra, on the local ant-treehopper mutualism" Senior Thesis, Williams College Biology Department, Williamstown, MA.

ATTACHMENT C: COMMUNITY RESILIENCY BUILDING WORKSHOP – SUMMARY OF FINDINGS

Town of Winthrop, MA

Community Resiliency Building Workshop

Summary of Findings

May 2018

(Funding for this project was provided by EEA's Municipal Vulnerability Preparedness Planning Grant Program)

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1. OVERVIEW

A coastal community, the Town of Winthrop, Massachusetts has a unique perspective on planning for climate change and preparing for a sustainable future. The evidence for the need to further address resiliency and adaptation to natural hazard events continues to become more evident each year. While several larger storm events have received much notoriety in recent years (Tropical Storm Irene, Tropical Storm Sandy, Nor'easter NEMO), in the first quarter of 2018 alone, two major coastal storm events pounded communities throughout Massachusetts causing coastal flooding, heavy-rain induced inland flooding, wind damage, power outages, coastal erosion and damage to property, including the Town of Winthrop.

Some areas where Winthrop has been particularly hard hit in recent years include:

- **Flooding at Jefferson Street/Putnam Street Intersection –** Flooding has occurred in this location on a frequent basis.
- **Ingleside Park/Walden Street –** This area of Winthrop floods when intense storm events coincide with rising tides.
- **Flooding Continues at the Winthrop Golf Course**
- **Morton Street, Pico Avenue, Washington Avenue and Shirley Street -** Significant flooding has occurred in these areas during recent storms.
- **Coughlin Park Shoreline -** Significant erosion continues to occur along this shoreline and the Town is working on a shoreline stabilization concept.

In June 2017, the Baker-Polito Administration announced over $1 million in grant funding to 71 cities and towns throughout Massachusetts for the Municipal Vulnerability Preparedness (MVP) program. The MVP Planning Grant Program was designed to provide support for communities to plan for climate change resiliency and implement priority projects. Upon completion of the MVP program, communities can become certified as an MVP Community and become eligible for MVP Action Grant funding and other opportunities in the future. The Town of Winthrop applied for a MVP Planning grant and was successful. In April 2018, Winthrop undertook the Community Resiliency Building (CRB) Workshop process, a requirement of receiving MVP funding and this report serves as the Summary of Findings for that planning process.

The CRB workshop process is based on a risk matrix exercise while also utilizing current information regarding natural hazard events, understanding the latest climate change projections, evaluationg information on Town efforts to address resiliency and reviewing recent action items and projects to address resiliency issues.

1.1 Workshop Core Team

The Winthrop Community Resiliency Building Workshop was led by a local Core Team which included the following individuals and Town departments:

- Joseph Domelowicz, Assistant Town Manager | Lead Project Manager for MVP/CRB
- Laurisa Wojcik, Administrative Secretary
- Kara Campbell, Conservation Agent
- Steve Calla, DPW Director
- Norman Hyett, Conservation Commission
- Chief Paul Flanagan, Fire Department
- Police Department

In addition to staff participants, the Core Team involved residents and local business owners who participated in both the MVP Kick-Off Meeting and the CRB Workshop. Sign in sheets for the kick off meeting and workshop have been included in **Appendix A**.

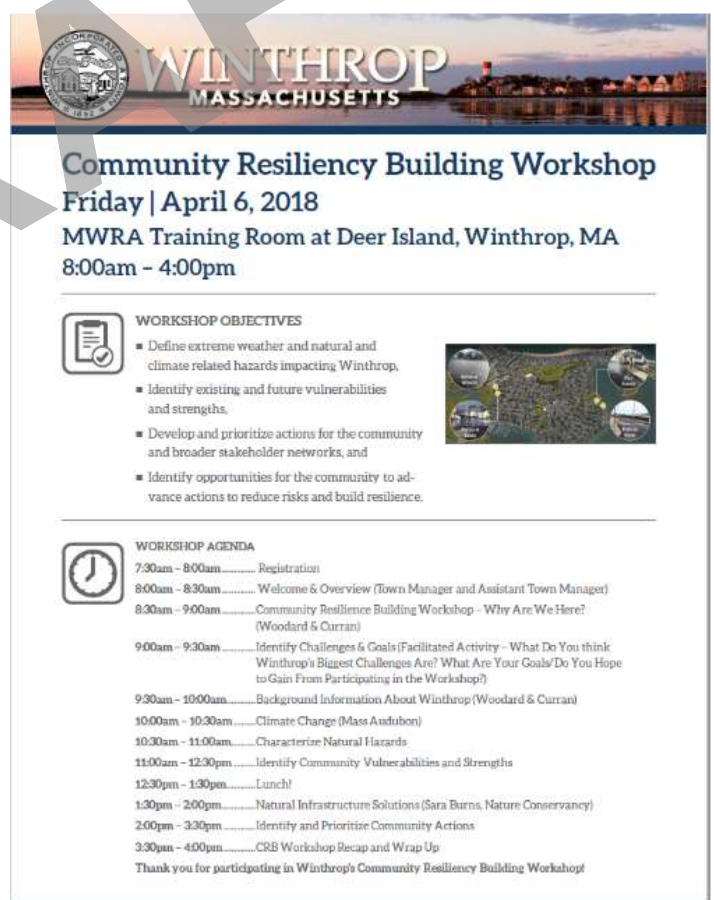
Together, Winthrop's Lead Project Manager and Woodard & Curran (hired MVP Technical Services provider) formed the project team responsible for directing, preparing for and ensuring the success of the CRB Workshop.

1.2 Workshop Objectives

The Town of Winthrop held its Community Resiliency Building Workshop on April 6, 2018 at the Deer Island Wastewater Treatment Plant Training Room. Partners for the CRB Workshop included technical services provider Woodard & Curran, the Massachusetts Water Resource Authority (MWRA), The Nature Conservancy and MassAudubon. The workshop's central objectives were to:

- Define extreme weather and natural and climate related hazards impacting Winthrop,
- Identify existing and future vulnerabilities and strengths,
- Develop and prioritize actions for the community and broader stakeholder networks, and
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

The focus of the workshop was to educate participants and increase awareness of risks facing the Town of Winthrop from natural and climate-related hazards. Identifying vulnerabilities and strengths in Winthrop from an infrastructure, societal and environmental perspective would serve as the foundation for discussion. Prior to the workshop, outreach to key municipal staff, residents, businesses and organizations was conducted through the kick-off meeting.


WINTHROP
MASSACHUSETTS

Community Resiliency Building Workshop
Friday | April 6, 2018
MWRA Training Room at Deer Island, Winthrop, MA
8:00am – 4:00pm

WORKSHOP OBJECTIVES
- Define extreme weather and natural and climate related hazards impacting Winthrop,
- Identify existing and future vulnerabilities and strengths,
- Develop and prioritize actions for the community and broader stakeholder networks, and
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

WORKSHOP AGENDA

7:30am – 8:00am .... Registration
8:00am – 8:30am .... Welcome & Overview (Town Manager and Assistant Town Manager)
8:30am – 9:00am .... Community Resilience Building Workshop - Why Are We Here? (Woodard & Curran)
9:00am – 9:30am .... Identify Challenges & Goals (Facilitated Activity - What Do You think Winthrop's Biggest Challenges Are? What Are Your Goals/Do You Hope to Gain From Participating in the Workshop?)
9:30am – 10:00am .... Background Information About Winthrop (Woodard & Curran)
10:00am – 10:30am .... Climate Change (Mass Audubon)
10:30am – 11:00am .... Characterize Natural Hazards
11:00am – 12:30pm .... Identify Community Vulnerabilities and Strengths
12:30pm – 1:30pm .... Lunch!
1:30pm – 2:00pm .... Natural Infrastructure Solutions (Sara Burns, Nature Conservancy)
2:00pm – 3:30pm .... Identify and Prioritize Community Actions
3:30pm – 4:00pm .... CRB Workshop Recap and Wrap Up

Thank you for participating in Winthrop's Community Resiliency Building Workshop!

1.3 Acknowledgements

The Winthrop Community Resiliency Building Workshop was managed by the Winthrop, MA Core Team in partnership with Woodard & Curran. The Core Team guided the work throughout the project and numerous public officials and industry professionals provided leadership, technical expertise, ideas and insight during workshop planning and execution.

Special thanks to the MWRA, The Nature Conservancy and MassAudubon for their participation and support during Winthrop's CRB Workshop.

2. SUMMARY OF FINDINGS

The purpose of the Community Resiliency Building Workshop Summary of Findings is to develop a comprehensive summary of the event with the goal of Winthrop using this information to continue its focus on reducing vulnerabilities, reinforcing strengths and continuing on the path toward greater community resilience. Winthrop's CRB was held on Friday, April 6, 2018 at the Deer Island Wastewater Treatment Plant Training Room. In total, there were 53 attendees who were present for the daylong event. With the goal of the workshop being to listen and learn from attendees on how to meet the overall workshop objectives, prior to starting the formal CRB agenda, participants were asked to think about and write down on a note card answers to the following two questions:

1) What are Winthrop's biggest challenges? (think infrastructure, societal, environment)

2) What are your goals for the day and what do you hope to gain from your participation in the workshop?

Participants provided feedback for both of these questions which is summarized in **Appendix B**.

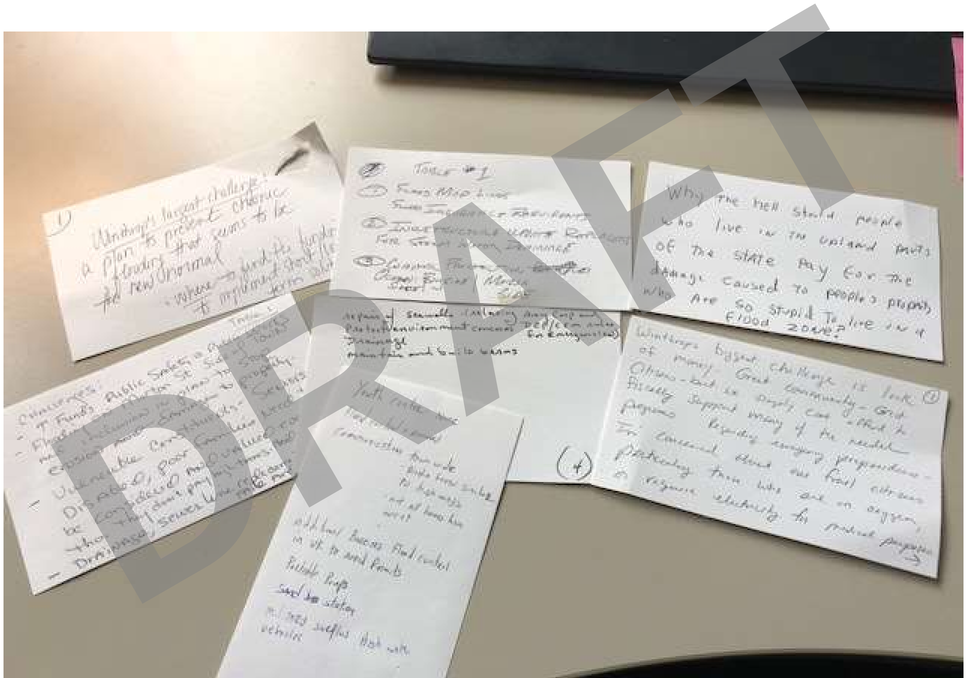


Photo: April 6, 2018 Winthrop CRB Challenge and Goal Comment Cards

2.1 Top Natural Hazards for Winthrop, MA

Prior to discussing the top natural hazards faced by Winthrop, MA, participants in the CRB workshop listened to two presentations that included background information about Winthrop and up to date information regarding Climate Change and its impact to the community and surrounding area (see **Appendix C**). Upon completion of these two presentations, attendees were asked to work with the other participants at their table to define and characterize the top natural hazards being faced by Winthrop. In total, there were six separate tables working on this task and participants were encouraged to come up with their own list of natural hazards that they felt to be the most relevant and pressing to the community.

Winthrop is a densely developed coastal town with a population of approximately 18,000. Located on a peninsula (approximately 1.6 square miles) with a seven-mile shoreline, the majority of the flooding experienced by Winthrop is related to its coastal location due to impacts from coastal storms, waves, storm surge and sea level rise. The natural hazards facing Winthrop that were identified at the CRB workshop include:

- Sea Level Rise
- Flooding
- Hurricanes/Wind/Extreme Storms
- Wave Action/Storm Surge
- Extreme Heat
- Fire
- Erosion
- Increasing Precipitation
- Isolation

Sea level rise was identified by all of the tables as one of the top natural hazards while flooding was identified by five of the six tables. **Table 2-1** indicates the top natural hazards that were identified by each table of CRB participants.

Table 2-1: Natural Hazards Identified By CRB Participants

Table 1	Table 2	Table 3	Table 4	Table 5	Table 6
• Flooding • Wind/Storms • Wave Action • Sea Level Rise	• Flooding • Sea Level Rise • Hurricane • Heat or Extreme Weather	• Flooding • Sea Level Rise • Wind • Isolation	• Flooding • Wind/Storms • Wave Action • Sea Level Rise	• Flooding • Sea Level Rise • Heat Wave • Fire	• Sea Level Rise • Increased Precipitation • Heat or Extreme Weather • Wind

2.2 Identified Vulnerable Areas in the Community

During the CRB process, the entire Town was highlighted as being vulnerable to natural hazard events due to its location and the fact that it is surrounded by the ocean – not just a specific neighborhood. There were specific areas mentioned by attendees at the workshop as being vulnerable and those include:

- **Neighborhoods:**
  - Morton Street/Belle Isle Marsh – Low lying area, coastal surge and flooding.
  - Pico Avenue/Fisherman's Bend – Experiences flooding during storm events.
  - Ingleside Park – Backup and flooding due to lack of stormwater storage capacity and undersized drains. Floods during coastal storm/precipitation events.
  - Point Shirley/Shirley Street – Low-lying street and adjacent seawall experience wave overtopping and flooding during storm events.

- Lewis Lake – Serves as a drainage area for part of the downtown area – lake overflows during storm events and causes localized flooding in adjacent areas.
- Yirrell Beach – Coastal surge and flooding
- Lower Nahant Avenue – Coastal surge, high tide and high precipitation events all cause backup in undersized drain lines and flooding within adjacent neighborhood.
- Coughlin Park – Coastal erosion and flooding during coastal storms.
- Bayou Street Neighborhood – Flooding due to undersized drainage line that backs up during high precipitation events.

- **Ecosystems:** Belle Isle Marsh, Coughlin Park, Yirrell Beach, Ingleside Park, Lewis Lake, Beaches
- **Transportation:** Route 145 and Winthrop Parkway (also evacuation routes), Shore Drive, Morton Street, bridges, all roads in Town
- **Infrastructure:** Drainage system, Water/Sewer Infrastructure, Pump Stations, Sea Walls, Utility Power, Public Safety Building, Culverts, MWRA Deer Island Treatment Plant, Municipal Services (police, fire, emergency, shelters), Existing Buildings, Proximity to MassPort/Logan International Airport

2.3 Current Concerns & Challenges Presented by Hazards

The Town of Winthrop faces numerous challenges and has major concerns related to the impacts of natural hazard weather events from the past and those that will occur in the future and be further exacerbated by climate change. In the first quarter of 2018 alone, Winthrop was severely impacted by two large coastal storm events in January and March which caused coastal flooding, heavy-rain induced inland flooding, wind damage, power outages, unpassable streets, coastal erosion and damage to residential homes and businesses.

Photo: Pico Avenue, March 3, 2018

In prior years, Winthrop has suffered from similar coastal storms in addition to Tropical Storm Irene (August 2011), Tropical Storm Sandy (October 2012) and a Nor'easter referred to as NEMO (February 2013). In general, Winthrop is subjected to three types of flooding – coastal, inland/riverine and urban. The FEMA Flood Insurance Rate Maps (FIRM) issued in 2016 for Winthrop indicate that approximately 45% of the town is within the 1% annual chance flood (also known as the 100-year storm).

The impacts from the 2018 storm events to date as well as previous storms have made the topic of natural hazards and climate change in Winthrop of high importance. Improving the community's ability to be resilient before, during and after a storm event was discussed in detail at the Community Resiliency Building workshop.

Photo: Morton Street at Banks, March 3, 2018

2.3.1 Road Network Vulnerability & Isolation

Access to the Town of Winthrop is primarily along Route 145, Winthrop Parkway or across the Belle Isle Bridge (Main Street). Winthrop Parkway connects the town to Revere along a narrow strip of land and this connection has been closed by the Town of Revere in the past due to storm conditions resulting in unsafe passage. With only two main roadways to access Winthrop, managing this infrastructure is critical for emergency evacuation and response. Or, if evacuation and response is not possible, managing isolation and sheltering in place becomes critical. Discussion included the town's preparedness to remain isolated for a period of time and successfully shelter in place. CRB attendees expressed their concern over the need to be better prepared for this type of situation.

2.3.2 Proximity to MWRA Deer Island Treatment Plant & MassPort's Logan International Airport

The enormity of the road network vulnerability issue is raised even further since the primary travel route to MWRA's Deer Island Sewage Treatment Plant (which treats wastewater from 2.5 million people in Greater Boston) is located in Winthrop and can be compromised. In addition, concern was raised over the potential for a major incident to occur at the treatment plant or nearby Logan International Airport which could impact Winthrop and/or require the evacuation of the community.

2.3.3 Water, Wastewater & Drainage System

During a coastal storm or heavy precipitation event, Winthrop's drainage system can become overwhelmed and cause flooding at the street level. Future climate change impacts, sea level rise and more sever storms will continue to exacerbate the conditions that the community has seen repeatedly in the past. This combined with the age of the drainage system and changing underground conditions can cause additional damage – the magnitude which may currently be unknown.

Photo: April 6, 2018 Winthrop CRB Workshop

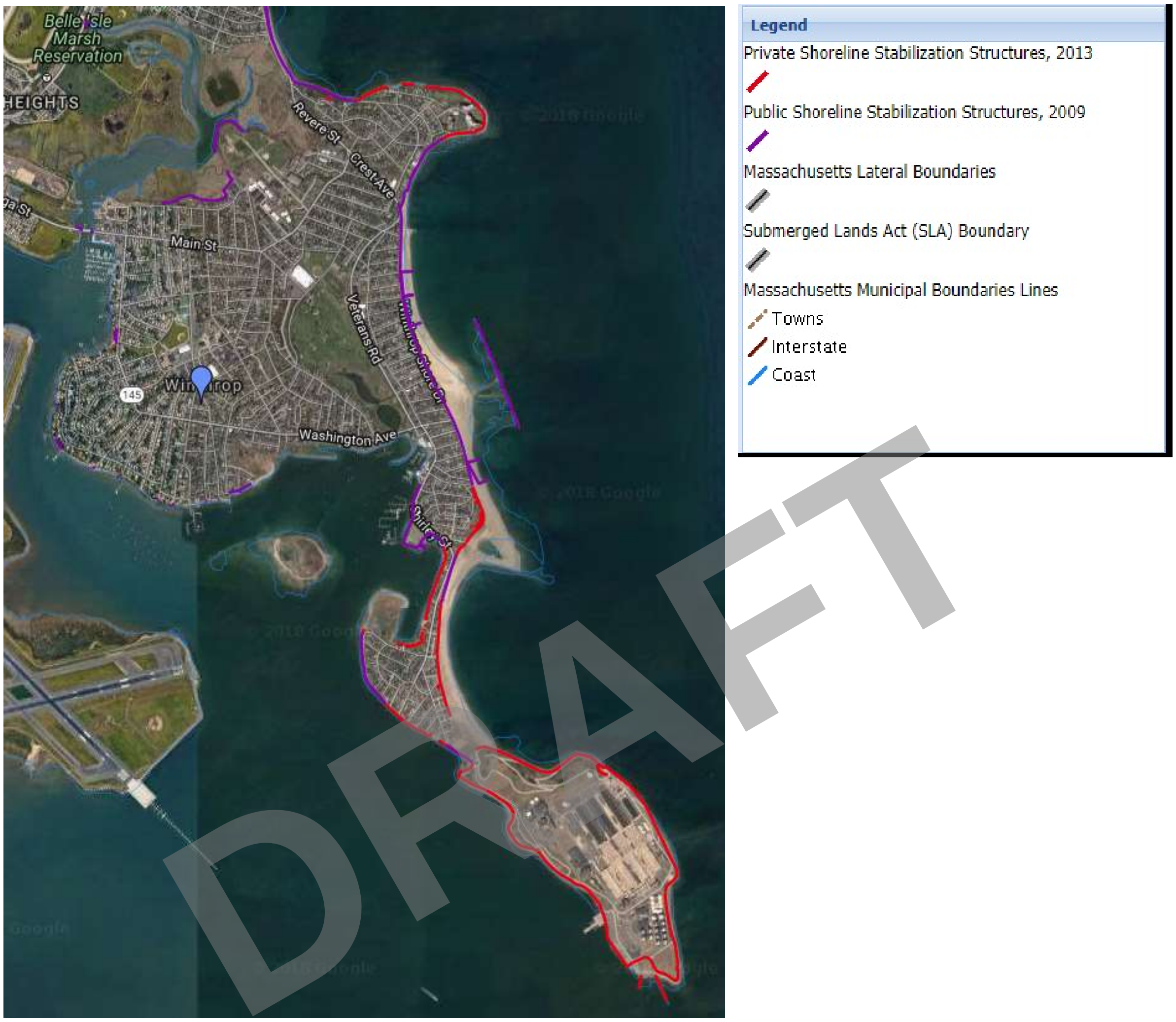
The water and wastewater systems in Winthrop are owned by the Department of Public Works and the Massachusetts Water Resources Authority (MWRA). Sewer pump stations are located at Revere Street, Pico Avenue and Pleasant Court. Winthrop's stormwater system has over 20 miles of underground piping, outfalls, catch basins and manholes. Approximately 115 outfalls are installed throughout Town in low-lying areas to help with some of the inland flooding during certain types of storm events. Many of these outfalls do not have check valves to prevent coastal flooding from entering the system.

Workshop participants discussed the need for drainage system upgrades and cleaning and education about how the drainage system functions in Winthrop. Other suggestions include identifying a local staff person to work with DPW and other Town departments on increasing the visibility of this infrastructure and developing Low Impact Development/Green Infrastructure solutions that would improve their function and condition along with funding opportunities to pay for the projects. Starting programs such as adopt a drain, using artwork to better identify location and seeking out funding opportunities for upgrades are all suggestions for improving this critical infrastructure.

2.3.4 Shoreline Structures

The Town of Winthrop has a variety of shoreline structures in place that offer a barrier between the built environment and the ocean. Some of the infrastructure includes stone revetments, concrete seawalls, bulkheads and breakwaters. According to data managed by the Massachusetts Office of Coastal Zone Management (CZM) regarding coastal infrastructure, Winthrop has six structures owned by DCR and 27 town owned structures in varying condition. Half of the public shoreline structures need moderate to significant levels of repair (see **Figure 1**).

Figure 1: Winthrop, MA Shoreline Structures



At the CRB workshop, participants expressed the need to preserve and maintain existing and exposed seawalls so they continue to function and provide protection for the built environment. Suggestions included making the existing seawalls higher, expandable (or flexible) or investigating floating dams.

2.3.5 Local Capacity, Communication, Emergency Management

During the Community Resiliency Building process, the topic of local capacity, communication and emergency management was discussed. Concern was raised about the use of the Senior Center as a shelter and accepting residents who need to be evacuated from their homes during severe weather. Currently there is no back up power or generator at the Senior Center should a power outage occur during a storm event. Another issue identified by the Housing Authority was that in the past, some of their senior housing developments have lost power, but it is difficult to get their tenants to evacuate. More communication is needed about how to manage these types of situations in the community.

In addition, a more clear, defined means of communication was indicated as an area of improvement during emergencies. Currently information is shared via phone but continuing to use resources like Facebook and Twitter will be beneficial. There was also a discussion of creating a formal Emergency Manager position (even part time) who helps manage current emergencies including operations, but also the recovery. Documentation and photographs are all necessary to obtain and manage for proper recovery and reimbursement depending on the severity of the event. Currently, Winthrop does this on an as needed, informal basis. Having designated staff for residents and businesses to call would allow for other departments like Police, Fire and DPW to focus on their roles during an emergency event. An Emergency Manager could also oversee operations during an emergency, manage a command center, help deploy/manage town staff and work with other towns and regional dispatch to provide the best service possible.

The need for a consolidated, updated Public Safety Building was identified during the CRB workshop as one of Winthrop's biggest challenges.

2.3.6 Condition and Functioning of Natural Barriers

Winthrop is fortunate to have numerous beaches, conservation areas and places of recreation to offer residents and visitors in the community. They include:

- Winthrop Beach
- Yirrell Beach
- Donovan's Beach
- Pico Playground & Beach
- Fisherman's Bend
- Belle Isle Marsh
- Coughlin Park
- Lewis Lake/Winthrop Golf Club
- Ingleside Park

One of the key issues raised during the CRB was the need to preserve, maintain and enhance natural infrastructure in Winthrop so that it can continue to function as a natural barrier for the community. Ideas include dune enhancement, building additional trees to lessen heat island impact, add more natural vegetation where it is needed, develop an overall Town wide natural barrier enhancement plan and conducting feasibility studies to determine what types of enhancement will make sense and their anticipated impact. Additional education regarding the benefits and importance of natural resource areas including regulations was also identified as important so that the value in helping reduce risk and improve resilience is better understood.

2.4 Current Strengths & Assets

Winthrop has had the opportunity during recent storm events to see how the community functions and identify areas of strength. The presence of natural barriers for residential neighborhoods in Winthrop was recognized as beneficial to the community in addition to existing seawalls and other barriers.

Other strengths identified during the CRB include:

- The local conservation commission has been working with homeowners to provide information about natural resources, building code requirements and homeowner incentives.

- Wetland restoration, floodplain and open space and enhancement through various projects in the community were recognized as a strength and continuing to support these projects and find funding for next phases is critical – Coughlin Park is an example where the Town has been investigation the feasibility of mitigating shoreline erosion using living shoreline techniques to increase coastal resiliency. A plan was prepared that quantified sea level rise for the location, assessed existing conditions, performed an alternatives analysis and identified an appropriate living shoreline project. CRB attendees expressed their support for the Town to continue doing this type of work (specifically this project) and reach the implementation phase.

- Winthrop has dedicated Police, Fire and DPW personnel who respond during natural hazard events.

- The existing reverse 911 system was recognized for the role it plays during emergency events and continuing to maintain and advertise the availability of this system will be key for future emergencies.

- Winthrop's existing water, wastewater and drainage infrastructure was identified as a strength. The need to keep this updated, maintained and managed was recognized. Recent upgrades to some of the sewer pumping stations such as elevating them, installing water resistant panels and emergency generators was recognized as a strength. Other recent infrastructure improvements include:
  - Sewer improvements on Putnam Street, Putnam Place and Walden Street.
  - Water main replacement on Jefferson Street and Fremont Street and upgrades to a section of the drainage system at the intersection of Jefferson Street and Putnam Street.
  - Sewer, water, drain and sidewalk improvements on Walden Street, Lincoln Street, Read Street, Walden Place and Jerald Street.
  - Water main, drain and sewer improvements on Bellevue Avenue, Prescott Street, Somerset Avenue, Nahant Avenue and Sewall Avenue.
  - Water main improvements with some sewer repairs on Plummer Ave., Woodside Ave, Woodside Park, Frances St., Sunnyside Ave, Pico Ave, Corinha Beach Rd. and throughout the neighborhoods surrounding the water tower.
  - Sewer and water main improvements on Franklin Street and Harvard Street.
  - Lewis Lake Tide Gate project included replacement of existing failed automated tide gate with new automated tide gate.
  - Miller Field/Lewis Lake Drainage and Site Improvements included a complete renovation of Miller Field including site drainage improvements and improvements to swales along the Veterans Road and Cross Street at the Winthrop Golf Club.

- Supportive social services such as the local health center, Senior Center, Senior Housing and Housing Authority.

- Proximity to MWRA Deer Island Treatment Plant & MassPort's Logan International Airport was identified as a challenge but also a strength. The Town of Winthrop acts as a natural buffer to both of these key regional economic and environmental resources.

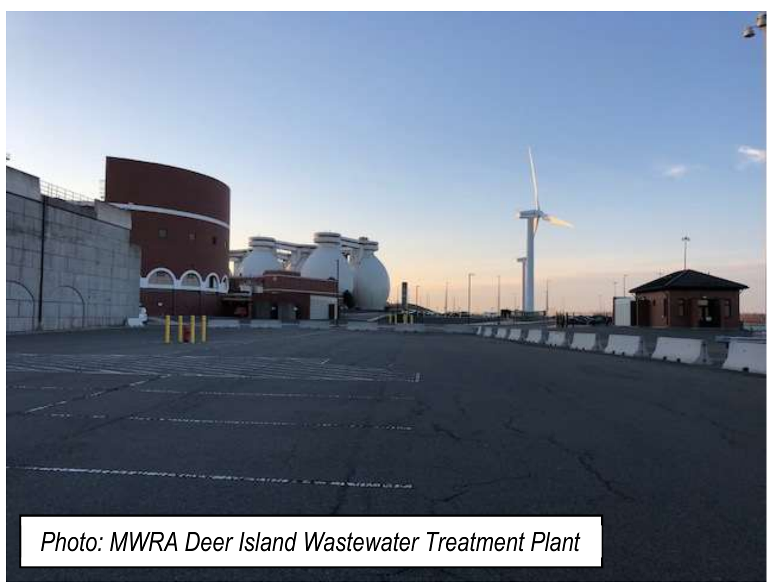


Photo: MWRA Deer Island Wastewater Treatment Plant

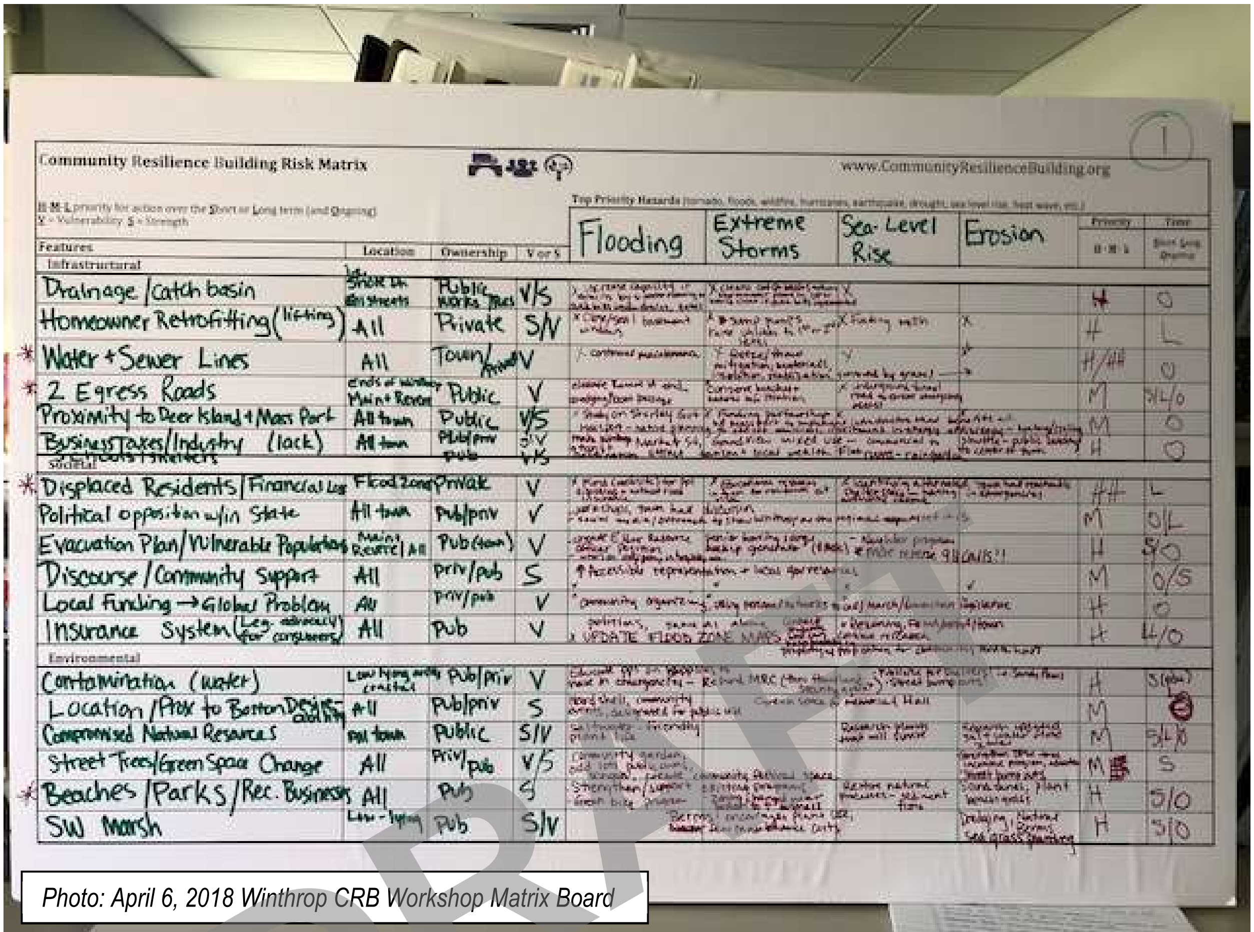


Photo: April 6, 2018 Winthrop CRB Workshop Matrix Board

3. RECOMMENDATIONS TO IMPROVE WINTHROP'S RESILIENCY

Improving Winthrop's resiliency was discussed by each individual group at the CRB based on the natural hazards, strengths, vulnerabilities and actions that they defined. At the end of the CRB workshop, each group presented their findings on key actions the community should focus on to improve overall resiliency and they were asked to identify their top three. Upon completion of each group's presentation, each attendee was given six dots to identify of all the key actions each group mentioned, which is the most critical/most important for the community. **Table 3-1** is a summary of the dot exercise.

Table 3-1: Top Six Recommendations to Improve Resiliency

Rank	Action	Notes
1	Sewer & Drainage Infrastructure	Clean, maintain and upgrade (particularly in the Town Center and low-lying areas) sewer and drainage infrastructure. Seek funding for repair and replacement, design additional storage capacity and modify bylaws and incentives that would support improved conditions for projects. Work would also include flood control projects.
2	Maintain, Replace, Upgrade Seawalls	Various existing infrastructure is in place throughout Winthrop and is in need of repair and upgrade.
3	Natural and Green Infrastructure Solutions, Low Impact Development	To support or enhance the functioning of seawalls and the shoreline as a barrier and for improved stormwater management. Work would also include flood control projects.
4	Develop or redevelop a new public safety building (police, fire, ambulance)	This includes finding a site, designing the building, securing funding and completing construction of a new facility.
5	Maintain and protect Belle Isle Marsh, Coughlin Park and beaches as assets to the community for both recreation and resiliency support.	Work for areas of the community that act as natural barriers includes dune enhancement, plantings, berms, etc.
6	Identify funding for projects to increase resilience	This includes further developing the tax base to increase revenue in the community and securing the money along with leveraging local resources and representatives to seek out and secure funding for Winthrop.

Resiliency actions that were in the top three for the groups when they reported out but did not receive the most votes include:

- Development of an Evacuation and/or Shelter In Place Plan to be better prepared for storm events. This would include consideration of food, a formal evacuation plan, multi-phase shelter strategy, emergency response and emergency communication.
- Development of a culvert ID owner and repair program where someone would be assigned to monitoring the functioning of culverts and informing the Town of any potential needed repairs.

The following are additional recommendations for the Town of Winthrop generated by the CRB Workshop participants organized from highest to lowest priority.

Highest Priority

- Develop and implement an Evacuation Plan and Shelter In Place Plan – this includes discussion bridge and tunnel routes and coordinating with MWRA and Deer Island. This plan would include a discussion of where charging, warming and cooling stations in Winthrop are located. Reevaluate Winthrop's current emergency communication and improve the plan. Need to include emergency information in multiple languages. Consideration should be given to having Town Hall be reachable during an emergency. There is a need to publicize pet shelters and where to get emergency supplies.
- Evaluate emergency power during emergencies and make sure the Emergency Operations Center, Beach Fire Station and Council on Aging can all function.
- Evaluate back up power for elderly housing and confirm shelter in place plans for these locations.
- Update building codes to ensure that utilities are built above flooding levels and also encourage the planting of living trees and vegetation to support resiliency.
- Evaluate the need for stormwater pump stations at various locations throughout Town that would improve flooding conditions.
- Develop a Master Plan for the Town and incorporate building code and zoning.
- Complete the MVP Planning process and apply for MVP Action Grants.
- Define low lying areas of the Town that would benefit from mobile pumps during storm events and proactively position them.
- Evaluate manhole covers protecting underground utilities and floodproof if necessary.
- Support homeowners to retrofit their properties to better withstand storm events including flooding. Educate homeowners about potential funding support. This could include developing a website for people who have been displaced or do not have flood insurance. Monitor additional changes to FEMA Floodplain maps and proactively communicate about this. Offer incentives to homeowners who desire to make improvements either through community grants, low interest loans or tax incentives.
- Relocate key community functions out of floodplains and consider moving utilities or modifying utilities to better allow for their function during storm events.
- Increase and expand the Town's capacity to seek out and secure funding sources for projects and action item implementation.
- Seek to enhance and develop a better relationship with Deer Island Treatment Plant and MWRA. Participate in climate change and emergency planning discussions with these two organizations.
- Support the Conservation Commission and undertake more education and outreach to local homeowners to build their awareness for accountability of their property during storm events and flooding.
- Use message boards at key locations to inform people about the potential for flooding. Purchase or fund the purchase of these if needed.

- Develop a culvert program that identifies volunteer ownership of the structure and create a plan to decrease flooding.

- Designate neighborhood captains to know and understand who may need help in their designated area during an emergency. Where vulnerable people are identified, indicate any special needs they may have (medication, power for oxygen) and make sure they are prioritized for evacuation or storm assistance.

- To support Winthrop's business and help the community be more economically resilient, make the Town a tourist destination through marketing and attracting visitors. Support more mixed use and commercial development. Offer a shuttle from the public landing to the center of town.

- Concrete revetment on Deer Island that causes flooding needs attention from the MWRA.

- Need a seawall solution for Pico Avenue and elsewhere in Town that would improve existing conditions and help mitigation flood impacts and damage.

- Investigate the use of Yacht Clubs and Marinas during emergencies and ask them to open to non-members.

- Raise public awareness about electrical currents during flooding events and teach them how to shut off circuit breakers.

Moderate Priority

- At school and shelter locations, evaluate and maintain renewable power sources (solar, batteries) so that these community resources can function during emergencies or natural hazard events.

- Stockpile food and medical supplies like water and dry goods to support any shelter in place plans Winthrop develops should the community become isolated.

- Focus on smart Harbor Development and Management and include Low Impact Development techniques and environmentally friendly yacht clubs and marinas. Leverage Harbor Management Plan.

- Analyze past 911 data to pinpoint historic calls and more specifically how Winthrop will respond and where during storm events. Work will include proactive measures/advanced planning.

- Develop ability to mobilize a special marine rescue unit with necessary boats and equipment.

- Conduct regionalized service discussions for evacuation coordination and emergency response.

- Consider elevating Revere Street for boat passage.

- Investigate the potential of an underground tunnel for egress to ensure that everyone can evacuate Winthrop if needed.

- Address perceived politics of Winthrop not being a regional asset by having workshops and Town Hall style discussions to show Winthrop as the asset that it is. Use of social media and other outreach platforms could support this effort.

- Address community discourse by increasing local government resources and accessibility to staff and representatives.

- Research and understand the best type of salt water vegetation that would benefit the community and the existing natural resources and seek to incorporate this where it makes sense.
- Develop a hazardous waste collection program that would allow people to dispose of hazardous waste safely and more regularly.

Lower Priority

- Maintain and advertise the Reverse 911 system.
- Maintain, update and enforce the Town's regulations for property maintenance at Yacht Clubs and Marina Buildings.
- Maintain and support the local health center on Route 145 so that it can continue to provide services during natural hazard events.
- Plant trees and maintain condition of town parks, cemeteries and the golf course.
- Conduct an erosion feasibility study for the Water Tower location to determine any potential future issues.
- Engage youth in emergency management and have them help increase awareness and participation through training.

3.1 CRB Workshop Project Team: Organization and Role

Town of Winthrop, MA
Joseph Domelowicz, Assistant Town Manager | Lead Project Manager for MVP/CRB
Laurisa Wojcik | Support
Kara Campbell | Table Facilitator

Woodard & Curran
Mary McCrann, AICP | Lead Facilitator
Michael Hansen, PE, CFM | Table Facilitator

The Nature Conservancy
Sara Burns | Presenter & Table Facilitator

MassAudubon
Stefanie Covino | Presenter & Table Facilitator
Ariel Maiorano | Table Facilitator

APPENDIX A: EVENT ANNOUNCEMENT, AGENDA & SIGN-IN SHEETS

MUNICIPAL VULNERABILITY PREPAREDNESS
KICK-OFF MEETING
TOWN OF WINTHROP, MA
MARCH 6, 2018 | 10:00AM
SIGN IN SHEET

	Name	Email
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19.	Larry Powers	LPowers@town.winthrop.ma.us
20.	Ron Vecchia	RVecchia@town.winthrop.ma.us

Winthrop, MA

Community Resilience Building Workshop

When: Friday, April 6, 2018 | Time: 8am to 4pm
Where: MWRA Training Room on Deer Island

The Town of Winthrop received funding from the Executive Office of Energy and Environmental Affairs to complete a Community Resilience Building Workshop. Given previous and ongoing events like the January and March coastal storm events, like other Massachusetts communities, Winthrop now finds itself in a new era of more unpredictable and severe weather that can potentially cause more damage to our community. We are working on a Municipal Vulnerability Preparedness project that will involve an 8 hour workshop which must include input from community members. **Please consider participating!**

We will be providing breakfast and lunch to those who participate. If you are interested please contact the Town Manager's office at (617) 846-1705 or townmanageroffice@town.winthrop.ma.us by March 30th to pre-register or to receive more information on this program. **Space is limited so please sign up today!**

Please contact Terence Delehanty, Town Manager if you have any questions at townmanageroffice@town.winthrop.ma.us

WOODARD &CURRAN

WINTHROP
MASSACHUSETTS

Community Resiliency Building Workshop

Friday | April 6, 2018

MWRA Training Room at Deer Island, Winthrop, MA

8:00am – 4:00pm

WORKSHOP OBJECTIVES

- Define extreme weather and natural and climate related hazards impacting Winthrop,
- Identify existing and future vulnerabilities and strengths,
- Develop and prioritize actions for the community and broader stakeholder networks, and
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

WORKSHOP AGENDA

7:30am – 8:00am............. Registration

8:00am – 8:30am............. Welcome & Overview (Town Manager and Assistant Town Manager)

8:30am – 9:00am.............Community Resilience Building Workshop – Why Are We Here? (Woodard & Curran)

9:00am – 9:30am.............Identify Challenges & Goals (Facilitated Activity – What Do You think Winthrop's Biggest Challenges Are? What Are Your Goals/Do You Hope to Gain From Participating in the Workshop?)

9:30am – 10:00am............Background Information About Winthrop (Woodard & Curran)

10:00am – 10:30am.........Climate Change (Mass Audubon)

10:30am – 11:00am..........Characterize Natural Hazards

11:00am – 12:30pm.........Identify Community Vulnerabilities and Strengths

12:30pm – 1:30pm............Lunch!

1:30pm – 2:00pm..............Natural Infrastructure Solutions (Sara Burns, Nature Conservancy)

2:00pm – 3:30pm.............Identify and Prioritize Community Actions

3:30pm – 4:00pm.............CRB Workshop Recap and Wrap Up

Thank you for participating in Winthrop's Community Resiliency Building Workshop!

Community Resilience Building Workshop
April 6th at the MWRA

53 total attendees!

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60	~~Terence Delehanty~~	tdelehanty@town.winthrop.ma.us

RICHARD Profetto

Patricia Kuschel

additional attendees!

1

Community Resilience Building Workshop
April 6th at the MWRA

Sign In

1. ~~[illegible]~~ John Dowd
2. Paul O'Brien – Town of Winthrop
3. Bill Harris
4. Rich Cifuni – Town of Winthrop
5. Fred Silke – Winth Housing Auth
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APPENDIX B: COMMUNITY CHALLENGES & GOALS

COMMITMENT & INTEGRITY DRIVE RESULTS
40 Shattuck Road | Suite 110
Andover, Massachusetts 01810
www.woodardcurran.com
T 866.702.6371
T 978.557.8150
F 978.557.7948

MEMORANDUM

TO: Joe Domelowicz, Assistant Town Manager

FROM: Mary McCrann, AICP

DATE: April 27, 2018

RE: Winthrop CRB – Community Challenges & Goals

TABLE 1

What are Winthrop's biggest challenges?

- The community is in need of a plan to prevent chronic flooding which seems to be the new normal.
- Where to find the funding to implement short/long term solutions.
- Flood map lines and flood insurance requirements.
- Infrastructure update and replacement for stormwater drainage.
- Coastal protection on the ocean side and bayside of town.
- Increase funds for public safety and public works.
- Flooding on Morton Street side of town and inclusion in plan to stop erosion and damage to property.
- Vulnerable constituents – seniors, disabled, poor families need to be considered and valued even though they don't pay high taxes. They need a voice.
- Drainage, sewer line replacement to be fair and equitable.
- Question about why people who live in upland areas of the town/state pay for damage caused to people's property who live in a flood zone.
- Lack of money. Winthrop is a great community, great people, but it can't afford to fiscally support many of the needed programs. Regarding emergency preparedness… concern over frail citizens, particularly those who are on oxygen or require electricity for medical purposes. Concern with the limited ability to get around town during emergencies. People need to do a better job of clearing their own areas.
- Parking/getting cars off the street.
- Flooding!
- The Town does not have a youth center.
- Flood control and recovery.
- Communication – town-wide… radio frequency similar to highways, not all homes have WCAT
- Additional barriers are flood control and avoiding permits
- Portable pumps and a sand bag station
- Military surplus vehicles
- High water
- Funding, grants, loans
- Drainage
- Seawall in marsh – move our heat and light funding money to do this.
- Helping people get back in their homes and saving our own homes.
- Army Corps of Engineers
- Flooding on Morton Street at Belle Isle Marsh – Pleasant Park Road. 10 feet of soil on Morton Street eroded into the marsh and bay. Channels are clogged with mud, etc. Need for dredging? Deepening center of the bay off the marsh?

What are your goals for the day?

- To arrive at a more clear picture of how I would like to become more involved with action items toward solutions.
- Gather insight into concerns and proposed improvements from other Winthrop citizens.
- To be the voice of vulnerable seniors who feel irrelevant and not valued because of money or disability.
- Information gathering
- Triage in order of effectiveness.
- Can waterway by Belle Isle Marsh be dredged? Soil eroded in recent storms… mud flats.
- Find resources to get my community back to the way it was.

TABLE 2

What are Winthrop's biggest challenges?

- Engaging the community
- Science/education
- Understanding short and long term trade offs of nature based solutions.
- Create inclusive action plan.
- Winthrop is the #1 most vulnerable community in MA to sea level rise/flooding.
- Winthrop is broke.
- Winthrop is not perceived as a municipality of regional importance.
- Winthrop is geographically isolated and lacks political and municipal accountability. Can't afford even basic maintenance/state of repair.
- Infrastructure/streets and maintain/improve
- Safety and protection of waterfront properties
- **Emergency Evacuation Plan** for Point Shirley Residents
- Flooding throughout the town
- Police security 24/7 on Deer Island – prohibiting public use after sundown.
- Add sand dunes at Yerrill Beach
- Limited ability to come and go in and out of town
- Repeated flooding of some homes in big storms
- Airport pollution
- Most vulnerable community to storms
- Would like to see Senators support for federal funding. Get Senator Warren to visit Winthrop or Governor baker!
- Use of natural stabilization for Coughlin Park erosion.
- Flooding and not enough resources (money, equipment)
- Evacuation routes – you can be stranded for hours in certain parts of town.
- Power outages
- Communication from officials
- Get state representative to exercise leadership (DeLeo) in the state house to address climate change mitigation and adaptation
- Coastal flooding

What are your goals for the day?

- Understand the community's understanding/knowledge of climate change and nature based solutions
- Understand work accomplished to date
- Share our communities strengths and weaknesses to better inform the action plan.
- Identify funding opportunities.
- Increase local political will and leadership.
- Community engagement
- Identify target priorities
- Better understanding of how to help with emergency preparedness
- Communicate concerns regarding flood insurance
- Communicate concerns regarding Grand View rip rap
- Communicate concerns over being cut off/pump outs/senior neighbor impacts from storm events
- Communicate concerns about the disconnect/inability to protect personal home and rip rap on property
- Assistance with seasonal berms – presently berms slowly erode and we need money and equipment to keep up.
- Seawall repair and building
- Natural dunes to minimize flooding
- Educated interpretation of future flood potential and ocean levels!
- Better understand how Winthrop is being affected by climate change
- Network with community members and leaders and connect with people who wish to take action to influence Representative DeLeo
- To gain knowledge and insight to help the community
- Want to understand and be able to communicate efforts to date to the community, funding partners and developers/businesses

TABLE 3

What are Winthrop's biggest challenges?

- Would like to see the storm drainage system updates, repaired and maintained
- Infrastructure
- Coastal flooding/erosion
- Implementing productive change
- Low lying land
- Surrounded by the ocean
- Winthrop is essentially an island with only two ways in or out
- On the coast with rest of the state less concerned than coastal communities about climate change
- Over development
- Infrastructure including drainage
- Upgrade the sewer system (street, storm drains) in the low lying areas of town with an upgrade of pumping stations in those areas

What are your goals for the day?

- To make the town aware of what actually happens during a storm… what I have personally done (built a seawall) and what needs to be done to further remedy the situation.
- To create a group of ideas that will lead to an actionable plan, allowing for funding to execute the plan.
- Learn about legislative actions and potential money

- Learn more about Winthrop's challenges
- Express concerns about severe impacts to Winthrop courtesy of climate change
- Better understand how to secure my property
- How the neighborhood can better partner in emergencies
- Better understand the future plans for our town.

TABLE 4

What are Winthrop's biggest challenges?

- Repair of seawalls – relaxing ACOE and DEP/CZM rules for emergencies
- Protect environmental concerns
- Drainage
- Maintain and build berms
- Looking at temperature change from a facilities standpoint
- The need for EMS systems and equipment – how an we better insulate our facilities to sustain preferred temperatures for longer periods. Change power sources or have multi fuel options
- Need for beach nourishment involving the movement of sand from Point Shirley
- Weather changes and flood mitigation
- Insurance coverage and affordability of premiums
- Funding to make building improvements to be better prepared for severe storms
- Drainage, infrastructure, erosion
- Figure out the future of homes in low lying areas
- Improving parks
- Improvement water, sewer and stormwater
- Education
- Investment in trees and their maintenance
- Funding, storm surge, flooding, aging infrastructure, drainage, sand
- Located on the ocean – limited to two egresses in and out of town
- Need for an evacuation plan from extreme weather or an incident at the airport or Deer Island
- Isolation of the community
- Funding
- Storm surge as sea level rises
- Seawall protection
- Flooding
- How does the community reduce carbon footprint and increase energy efficiency
- Public safety issue of coastal flooding and preparing for future storms now that we have seen the impacts three times in 2018
- Getting enough money for sand removal, wall building without overrides and burdening people
- Drainage (aged system, reliant on tide cycles, insufficient capacity)
- Water and sewer systems (funding upgrades, aged systems)
- Coastal resiliency (erosion, unable to extend seawalls, maintenance costs to existing)
- Rising sea levels
- Isolation during storms
- Aging infrastructure
- Limited budget

What are your goals for the day?

- Learn more about long term effects of extreme weather and the impact to Winthrop
- What improvements and funding solutions can be considered to protect Town buildings from severe weather conditions and costly repairs?
- Support the Governor's energy star home rating system
- Funding incentives for solar and efficiency
- Adding wave energy buoys and barriers
- Removal and relocation of sand on Yirrell Beach and reinforce walls along the harbor
- Save Coughlin Park
- Be given the ability to replace sand from private property back to where it came from
- To heighten awareness
- To contribute solutions

TABLE 5

What are Winthrop's biggest challenges?

- Please keep Winthrop a cute, small town and not an overcrowded City.
- Building coastal infrastructure to mitigate flooding, high tides and damage as a results of storms and rising tides.
- Improve drainage system to expedite flood recession, reduce ground table levels and minimize road/street damage.
- Implement a plan for future disaster readiness, awareness and safety.
- Fix remedy problem areas
- Need more help and collaboration with MWRA and Airport where Winthrop protects them.
- Repair erosion and maintain
- Isolation during storms – no help
- Building a seawall at Frances Street/Pico Area (wooden wall with slats as of now which stops nothing)
- Help in restoring homes that were affected in the Frances Street/Pico area.
- Better preparation in that area including sandbags, etc by the Town for future coastal storms until a wall is built.
- Better flow of the water when it comes over the walls/drainage.
- Actually putting these plans into action.
- Lack of education of importance of vegetation in retaining floodwater.
- Need more nature-based infrastructure solutions instead of hard seawalls and gray infrastructure.
- Flooding, wind
- Golf course sinking
- Business development
- Ingleside Park flooding
- Town Center development
- Recreation, youth, family, senior
- Harbor Walk
- Golf Club/Course sinking
- Fortify Winthrop Beach, but don't ruin use

What are your goals for the day?

- Learn about where flood zones are

- Learn about coastal resiliency – a good outcome is a decision to not build in flood zones (could new construction at Suffolk Downs cause more flooding in Winthrop Marsh?)
- Realistic report identifying Winthrop's MVP in order to obtain grant money to address coastal infrastructure
- To learn and grow.
- Grants, communication, have a community go to station identified and supplied.
- Advocate for seawall at Pico Beach and close up openings.
- To see funding for damage to our homes.
- Repair erosion areas and private property erosion areas.
- Take home ideas to implement
- Develop relationships with homeowners to help them with permitting process and development (pervious pavement, green infrastructure)

TABLE 6

What are Winthrop's biggest challenges?
- Flooding
- Groundwater (Lewis Lake, Ingleside Park)
- Coastal flooding (infrastructure, aging system)
- Funding
- Economic development and growth
- Smart development
- Winthrop Beach flood prevention and protection of beach neighbors
- Public safety response at all parts of Winthrop
- Plan for public education using Cable TV and Social Media
- Plan for sea wall protection
- Not enough is being done to address climate change
- Sea level rise, especially looking at Category 4 Hurricane near Deer Island on the map
- Need innovative trash solutions (ban plastic composting, paper solutions
- Energy resilience – would like to increase battery storage capabilities for town to help longevity of emergency shelter locations for long term displacement or destruction of natural gas pipeline infrastructure.
- Resilient construction practices for new development being in building codes – equipment above groundwater levels, etc.
- More state assistance for residents to electrify their heating systems and implement battery storage

What are your goals for the day?
- Learn about what long term preventative changes can be set in place to ensure changed needed to be ready for future conditions.
- Gain better understanding of Winthrop's vulnerabilities
- To meet other neighbors
- Action plan
- Specific tasks ahead
- Hope to gather enough information to be a strong advocate and participate towards greater resiliency
- Better understand concerns and desires of residents and how they want the town to focus on climate mitigation.

- Push to electrify heating systems, this and residential electric battery storage capability can island homes and provide power when electric grid is down.
- Effective flood mitigation technologies for commercial buildings, pump stations, etc. A lining that rolls out over walls – can this be adapted and subsidized for homeowners to protect basements from flooding??
- New construction requirements – green/cool roofs, green space requirements/stormwater runoff maintenance/gray water reuse and rainwater collection.

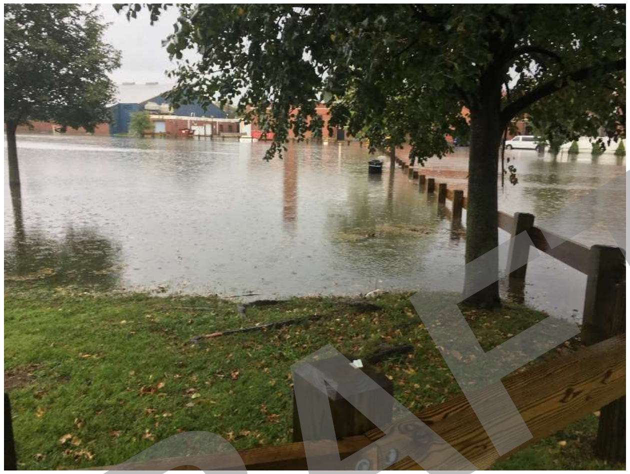
Winthrop, MA

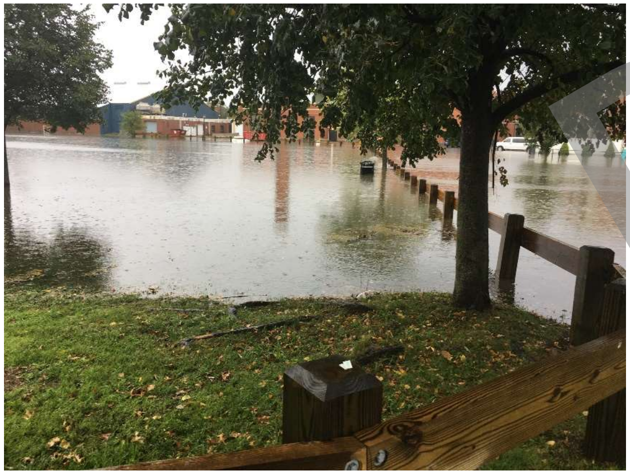
Recent Storm Event Photographs

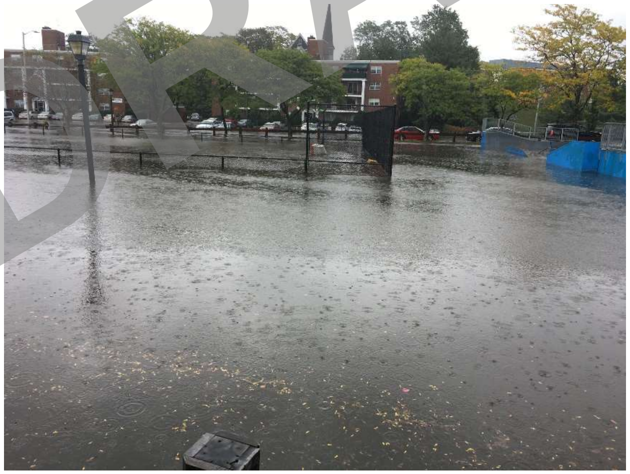
2018

WOODARD & CURRAN

Ingleside Park







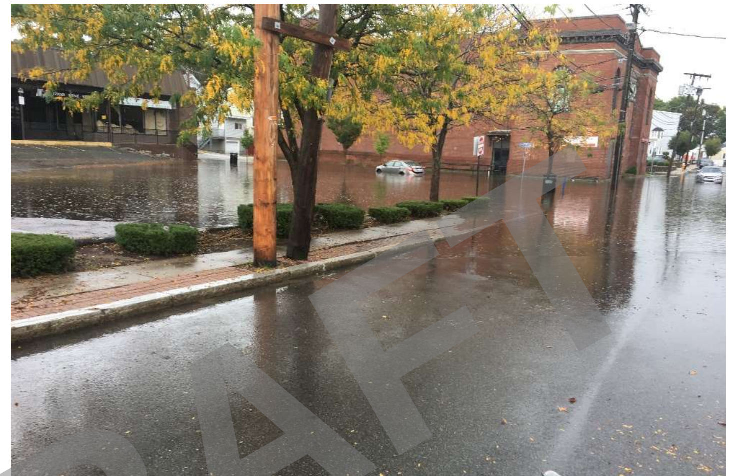
Winthrop Golf Course






Morton Street

Town Center



APPENDIX C: COMMUNITY RESILIENCY BUILDING WORKSHOP PRESENTATIONS

GOOD MORNING & WELCOME!

Winthrop Community Resiliency Building Workshop

April 6, 2018

Winthrop, MA

Community Resiliency Building Workshop

April 6, 2018

WOODARD
&CURRAN

Community Resiliency Building Workshop

thank you

WOODARD
&CURRAN

Community Resiliency Building Workshop

Mass Audubon
Protecting the Nature of Massachusetts

Water Resources Authority
Massachusetts

The Nature Conservancy

WOODARD & CURRAN

Agenda

- 7:30 – 8:00 | Registration
- 8:00 – 8:30 | Welcome & Overview
- 8:30 – 9:00 | CRB Workshop Why Are We Here?
- 9:00 – 9:30 | Identify Challenges & Goals
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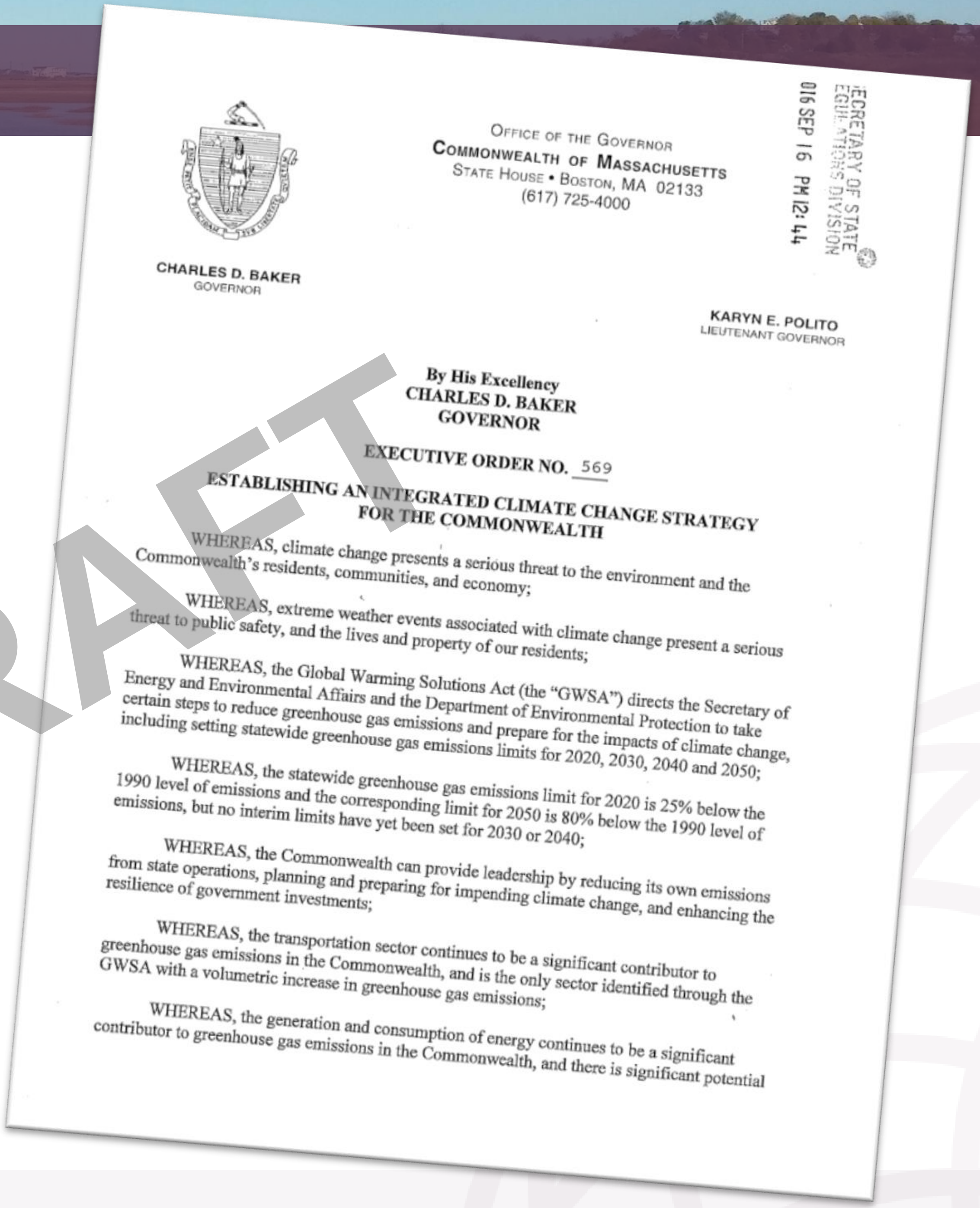
- **12:30 – 1:30 | LUNCH!**
- 1:30 – 2:00 | Natural Infrastructure Solutions **(The Nature Conservancy)**
- 2:00 – 3:30 | Identify & Prioritize Community Actions
- 3:30 – 4:00 | CRB Workshop Recap & Wrap Up

Executive Order 569

- In September 2016, Governor Charlie Baker signed Executive Order 569, instructing state government to **provide assistance to cities and towns to complete climate change vulnerability assessments and resiliency planning**.



OFFICE OF THE GOVERNOR
COMMONWEALTH OF MASSACHUSETTS
STATE HOUSE • BOSTON, MA 02133
(617) 725-4000

SECRETARY OF STATE
REGULATIONS DIVISION
016 SEP 16 PM 12:44

CHARLES D. BAKER
GOVERNOR

KARYN E. POLITO
LIEUTENANT GOVERNOR

By His Excellency
CHARLES D. BAKER
GOVERNOR

EXECUTIVE ORDER NO. 569

ESTABLISHING AN INTEGRATED CLIMATE CHANGE STRATEGY FOR THE COMMONWEALTH

WHEREAS, climate change presents a serious threat to the environment and the Commonwealth's residents, communities, and economy;

WHEREAS, extreme weather events associated with climate change present a serious threat to public safety, and the lives and property of our residents;

WHEREAS, the Global Warming Solutions Act (the "GWSA") directs the Secretary of Energy and Environmental Affairs and the Department of Environmental Protection to take certain steps to reduce greenhouse gas emissions and prepare for the impacts of climate change, including setting statewide greenhouse gas emissions limits for 2020, 2030, 2040 and 2050;

WHEREAS, the statewide greenhouse gas emissions limit for 2020 is 25% below the 1990 level of emissions and the corresponding limit for 2050 is 80% below the 1990 level of emissions, but no interim limits have yet been set for 2030 or 2040;

WHEREAS, the Commonwealth can provide leadership by reducing its own emissions from state operations, planning and preparing for impending climate change, and enhancing the resilience of government investments;

WHEREAS, the transportation sector continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and is the only sector identified through the GWSA with a volumetric increase in greenhouse gas emissions;

WHEREAS, the generation and consumption of energy continues to be a significant contributor to greenhouse gas emissions in the Commonwealth, and there is significant potential

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March 2018 Legislation

- Baker/Polito filed $1.4B legislation to authorize investments for safeguarding municipalities from the impacts of climate change, protecting environmental resources, and investing in communities.
- Hearing on the Bond Bill held on April 3rd to see if there is enough money available.

CHARLIE BAKER
Governor

KARYN POLITO
Lt. Governor

FOR IMMEDIATE RELEASE:
March 15, 2018

CONTACT
Brendan Moss, Governor's Office
brendan.c.moss@state.ma.us
Katie Gronendyke, Energy and Environmental Affairs
katie.gronendyke@state.ma.us

Baker-Polito Administration Files Legislation Committing Over $1.4 Billion to Climate Change, Environmental Protection, and Community Investments

Projects Will Continue the Baker-Polito Administration's Strong Leadership on Climate Change Adaptation and Mitigation, and Environmental Stewardship

WOODARD &CURRAN

Municipal Vulnerability Preparedness (MVP) Grant Program

- The MVP grant program provides support for cities and towns in Massachusetts to begin or continue the process of planning for resiliency.
- The state awards communities with funding to complete vulnerability assessments and develop action-oriented resiliency plans.




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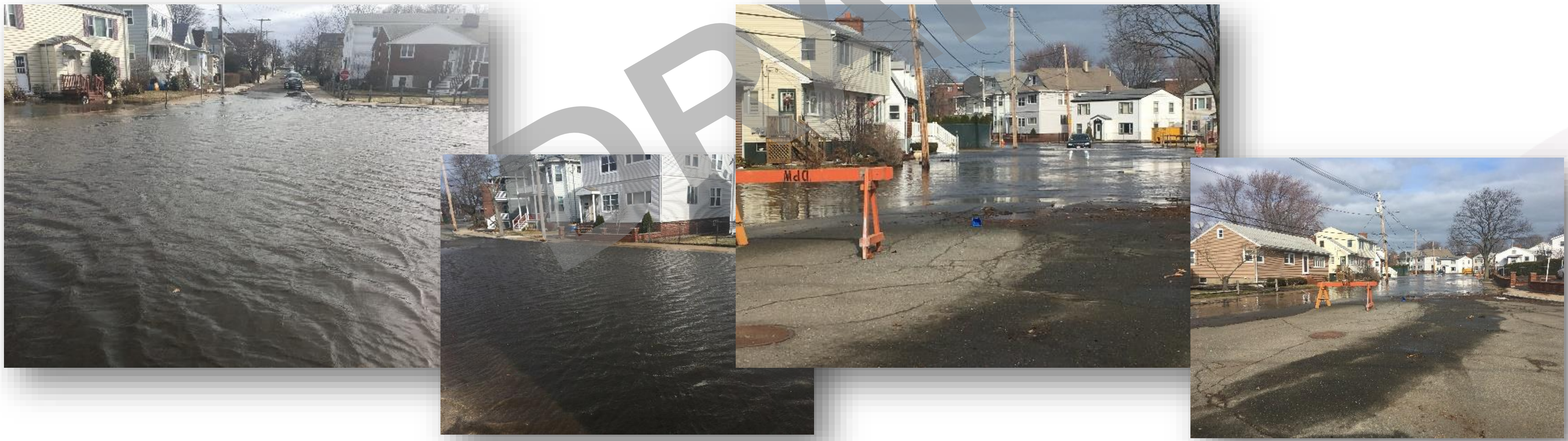
Municipal Vulnerability Preparedness (MVP) Grant Program

- The program helps communities achieve the following objectives:
  - Define extreme weather and natural and climate related hazards
  - Identify existing and future vulnerabilities and strengths
  - Develop and prioritize actions for the community
  - Identify opportunities to take action to reduce risk and build resilience



WOODARD & CURRAN

Winthrop, MA

Photo: Ingleside Park (2017)

Photo: January 2018

Photo: Banks at

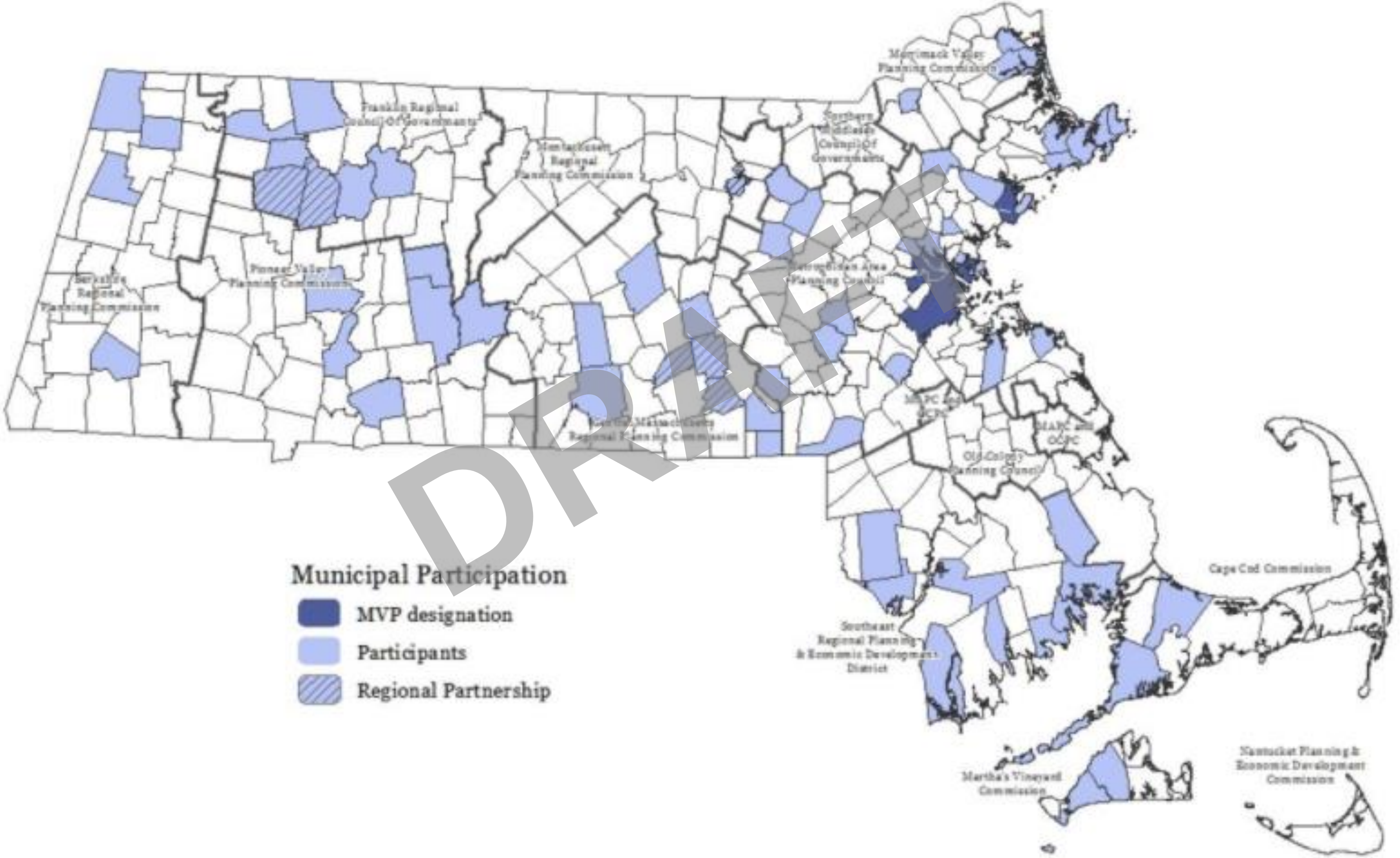
Photo: Morton at Banks

WOODARD & CURRAN

Municipal Vulnerability Preparedness (MVP) Grant Program

- Communities who complete the MVP program become certified as an MVP community and are eligible for potential follow-up grant funding and other opportunities.

What Other Communities Are in the MVP Program?



WOODARD & CURRAN

Community Resiliency Building Workshop

- As part of the MVP program, participating communities MUST complete a Community Resiliency Building Workshop!
- Upon completion of the workshop, a summary report will be submitted to EEA.
- Winthrop will continue to use this guiding report to reinforce future planning and action item implementation.

WINTHROP MASSACHUSETTS

Community Resiliency Building Workshop
Friday | April 6, 2018
MWRA Training Room at Deer Island, Winthrop, MA
8:00am – 4:00pm

WORKSHOP OBJECTIVES

- Define extreme weather and natural and climate related hazards impacting Winthrop,
- Identify existing and future vulnerabilities and strengths,
- Develop and prioritize actions for the community and broader stakeholder networks, and
- Identify opportunities for the community to advance actions to reduce risks and build resilience.

WORKSHOP AGENDA

7:30am – 8:00am .... Registration
8:00am – 8:30am .... Welcome & Overview (Town Manager and Assistant Town Manager)
8:30am – 9:00am .... Community Resilience Building Workshop – Why Are We Here? (Woodard & Curran)
9:00am – 9:30am .... Identify Challenges & Goals (Facilitated Activity – What Do You think Winthrop's Biggest Challenges Are? What Are Your Goals/Do You Hope to Gain From Participating in the Workshop?)
9:30am – 10:00am .... Background Information About Winthrop (Woodard & Curran)
10:00am – 10:30am .... Climate Change (Mass Audubon)
10:30am – 11:00am .... Characterize Natural Hazards
11:00am – 12:30pm .... Identify Community Vulnerabilities and Strengths
12:30pm – 1:30pm .... Lunch!
1:30pm – 2:00pm .... Natural Infrastructure Solutions (Sara Burns, Nature Conservancy)
2:00pm – 3:30pm .... Identify and Prioritize Community Actions
3:30pm – 4:00pm .... CRB Workshop Recap and Wrap Up

Thank you for participating in Winthrop's Community Resiliency Building Workshop!

WOODARD & CURRAN

Two Questions for You!

The goal of the workshop is to listen and learn from attendees regarding your thoughts and ideas for meeting workshop objectives!

- **What are Winthrop's biggest challenges?**
  - Think infrastructure, societal, environment
- **What are your goals for the day and do you hope to gain from your participation in the workshop today?**

WOODARD &CURRAN

Agenda

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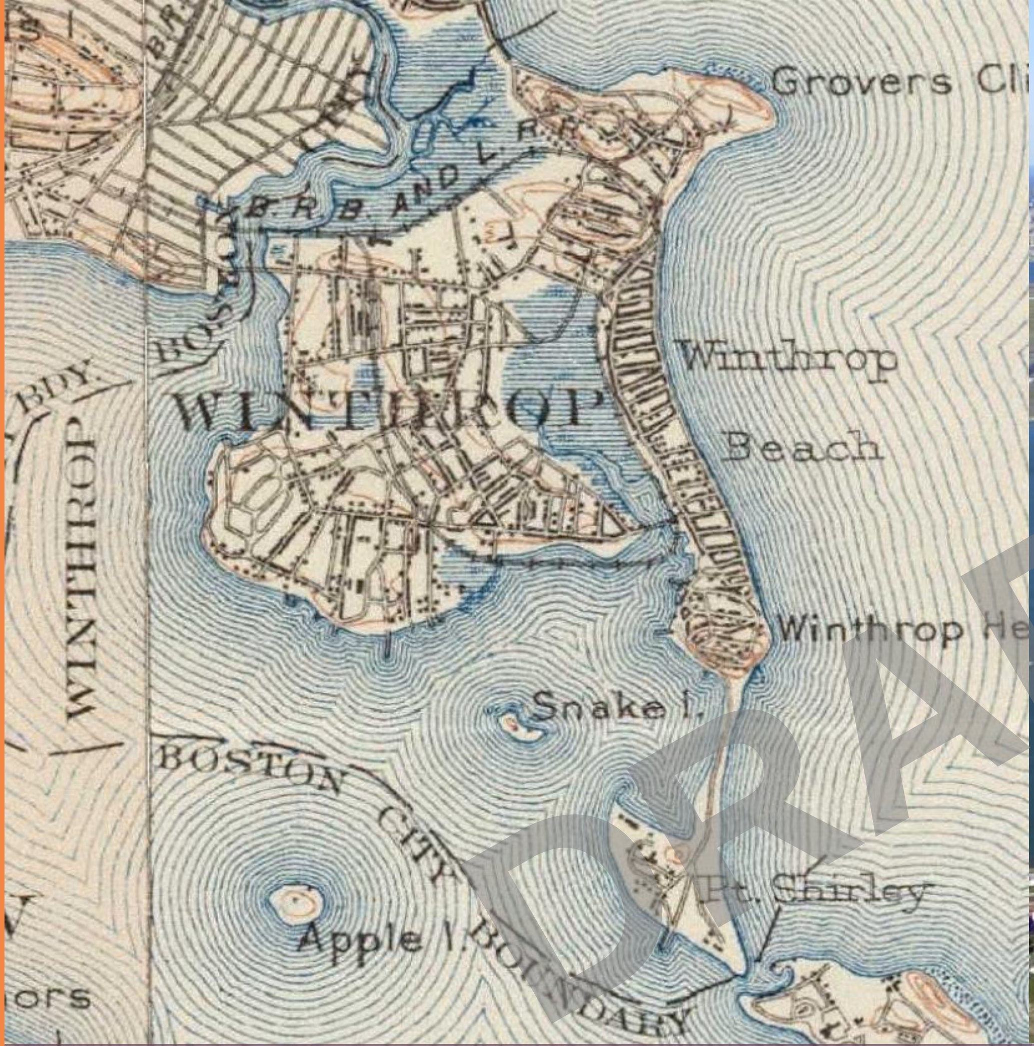
WOODARD & CURRAN

Winthrop, MA

Community Resiliency Building Workshop

April 6, 2018

WOODARD & CURRAN



Winthrop, MA

Background Information

April 6, 2018

WOODARD & CURRAN

Agenda

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WOODARD & CURRAN

Background Information

- Population: 17,497 (as of 2010 Census)
- Located on a peninsula
- 1.6 square miles | 7 mile shoreline
- Connected to Revere by a narrow piece of land and to East Boston by a bridge over the Belle Isle Marsh
- Densely populated
- One of the oldest communities in the United States (settled in 1630)

WOODARD &CURRAN

Winthrop Age Distribution

- Median Age in 2010: 43.7

Table 3 Age Distribution: 2000 and 2010				
Age Group	**2000 Number**	**2000 Percentage**	**2010 Number**	**2010 Percentage**
Under 5 years	906	4.95	886	5.06
5 to 9 years	947	5.17	850	4.85
10 to 14 years	1,020	5.57	871	4.97
15 to 19 years	900	4.92	893	5.10
20 to 24 years	970	5.30	894	5.10
25 to 34 years	2,820	15.41	2,150	12.27
35 to 44 years	3,248	17.75	2,551	14.56
45 to 54 years	2,697	14.74	2,974	16.98
55 to 59 years	1,029	5.62	1,300	7.42
60 to 64 years	742	4.05	1,234	7.04
65 to 74 years	1,443	7.88	1,518	8.67
75 to 84 years	1,140	6.23	987	5.63
85 years and over	441	2.41	409	2.33
Total	***18,303***	***100.00***	***17,517***	***100.00***
Source: U.S. Census				

Population Projections

- Population projected to get older
- Slight increase in age 25 – 34

Table 9
Population Projections by Age Group: 2010-2030

Age Range	2010	2020	2030	Change 2010-2020
00-04	884	896	909	+12
05-09	880	838	889	-42
10-14	978	892	905	-86
15-19	949	835	763	-114
20-24	1,109	1,043	921	-66
25-29	1,194	1,344	1,187	+150
30-34	1,120	1,280	1,222	+160
35-39	1,355	1,285	1,477	-70
40-44	1,534	1,231	1,412	-303
45-49	1,487	1,158	1,082	-329
50-54	1,479	1,383	1,115	-96
55-59	1,154	1,289	986	+135
60-64	926	1,069	952	+143
65-69	752	994	1,094	+242
70-74	607	919	1,063	+312
75-79	570	687	911	+117
80-85	505	449	687	-56
85+	642	638	731	-4

Environmental Justice Population – English Isolation

Legend:

- Minority
- Income
- English Isolation
- Minority and Income
- Minority and English Isolation
- Income and English Isolation
- Minority, Income and English Isolation

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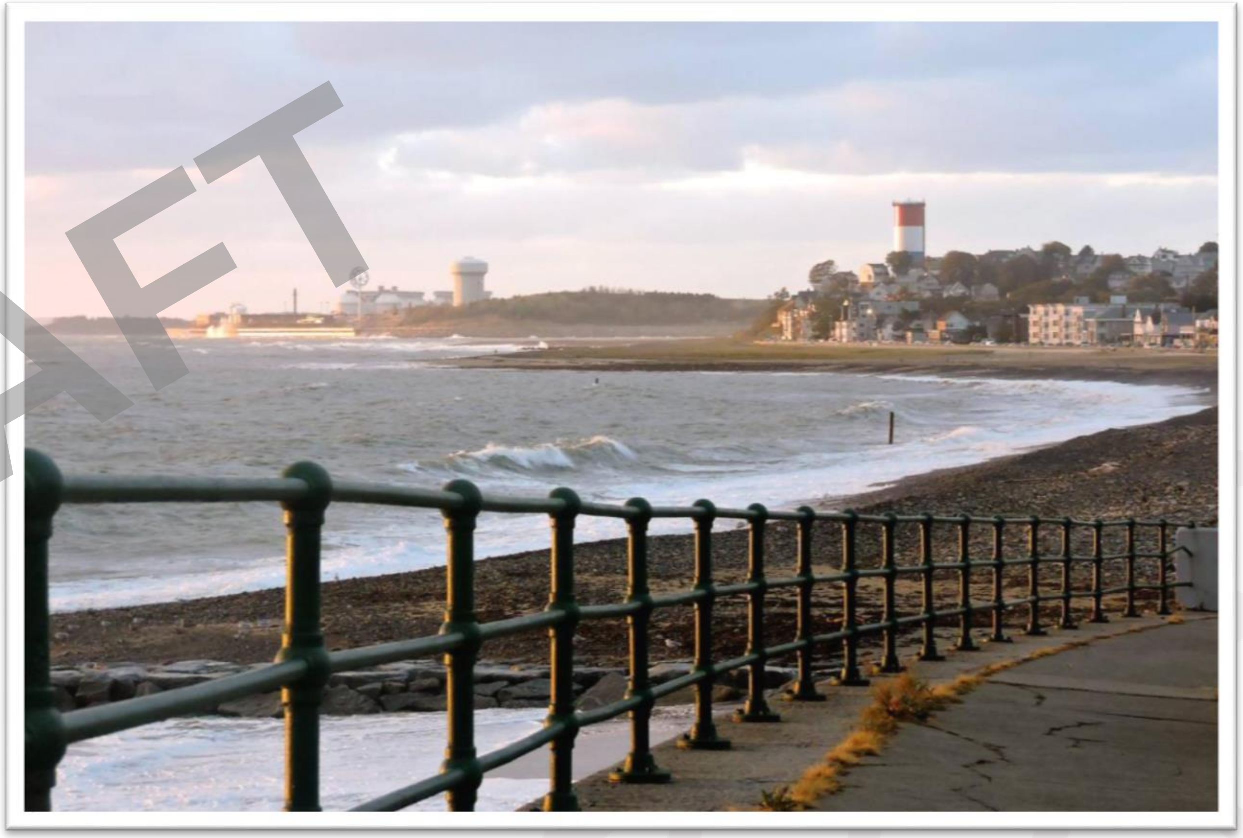
&CURRAN

Background Information

- Winthrop is the only landside connection to the Massachusetts Water Resource Authority Deer Island Wastewater Treatment Plant
- The plant removes human, household, business and industrial pollutants from wastewater that originates in homes and businesses in 43 greater Boston communities.

Transportation, Water, Sewer & Solid Waste

- Winthrop is served by State Route 145 which connects community to Revere.
- Served by bus service.
- Water is supplied by the MWRA.
  - The Town maintains an extensive distribution system.
- Sewer is Town owned and maintained – connects to MWRA interceptor and is treated at Deer Island.
- Curbside solid waste recycling contract managed by DPW.



WOODARD &CURRAN

Environmental Features

- Located in Mystic River Watershed.
- Only body of surface water in town is Lewis Lake.
- Home to a portion of Belle Isle Marsh – the last remaining salt marsh in the metro Boston area.
- Major wetland areas in Town are all coastal/tidal.

WOODARD &CURRAN

Environmental/Natural Features & Parks

- Winthrop Beach
- Yirrell Beach
- Donovan's Beach
- Pico Playground & Beach
- Fisherman's Bend
- Belle Isle Marsh
- Lewis Lake/Winthrop Golf Club
- Coughlin Park
- Ingleside Park

Severe Weather

- 16 coastal flood events between 2006 – 2014 resulting in over $3M in property damage
  - **3 coastal flood events during the first quarter of 2018!**
- 40 heavy snowfall events between 1996 – 2014
- 10 severe winter storms recorded between 1978 – 2013 – seven of which occurred after the year 2000

Winthrop Hazard Mitigation Plan

- FEMA Approved
- Identifies the following natural hazards that impact Winthrop: **flooding, wind, hurricane, nor'easter, wildfire, tornado, landslide, earthquake**

Hazard Mitigation Goals

1. Ensure that critical infrastructure sites are protected from natural hazards.
2. Protect existing residential and business areas from flooding.
3. Maintain existing mitigation infrastructure in good condition.
4. Continue to enforce existing zoning and building regulations.
5. Educate the public about zoning, flooding and building regulations, particularly with regard to changes in regulations that may affect tear-downs and new construction.
6. Encourage future development in areas that are not prone to natural hazards.
7. Educate the public about natural hazards and mitigation measures.
8. Make efficient use of public funds for hazard mitigation.
9. Protect the Town's ability to respond to various natural hazard events.

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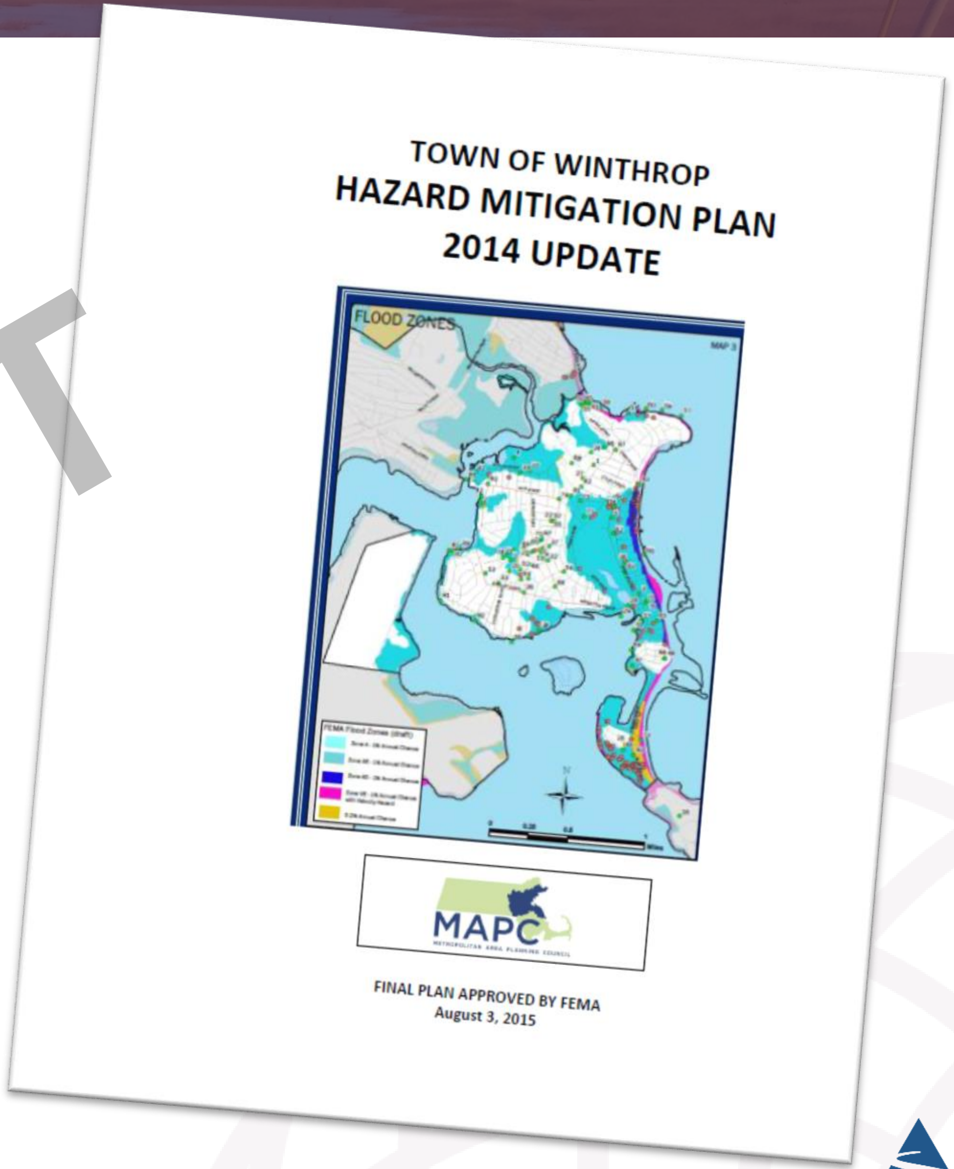
&CURRAN

Winthrop Hazard Mitigation Plan

Highlighted Potential Hazard Mitigation Actions

- Complete the Yirrell Beach seawall extension.
- Upgrade the storm drain system in the area between Winthrop Shore Drive and Lewis Lake.
- Add coastal storm surge and flooding protection for the Shirley Street neighborhood adjacent to Winthrop Shore Drive.
- Complete the drainage assessment at Ingleside Park and upgrade existing drainage infrastructure.
- Provide for more frequent maintenance of Town-owned drainage infrastructure.
- Finish mapping all stormwater outfalls and catch basins on GIS.
- Incorporate hazard education awareness, mitigation planning and natural hazard incentives into Town planning and community development operations.

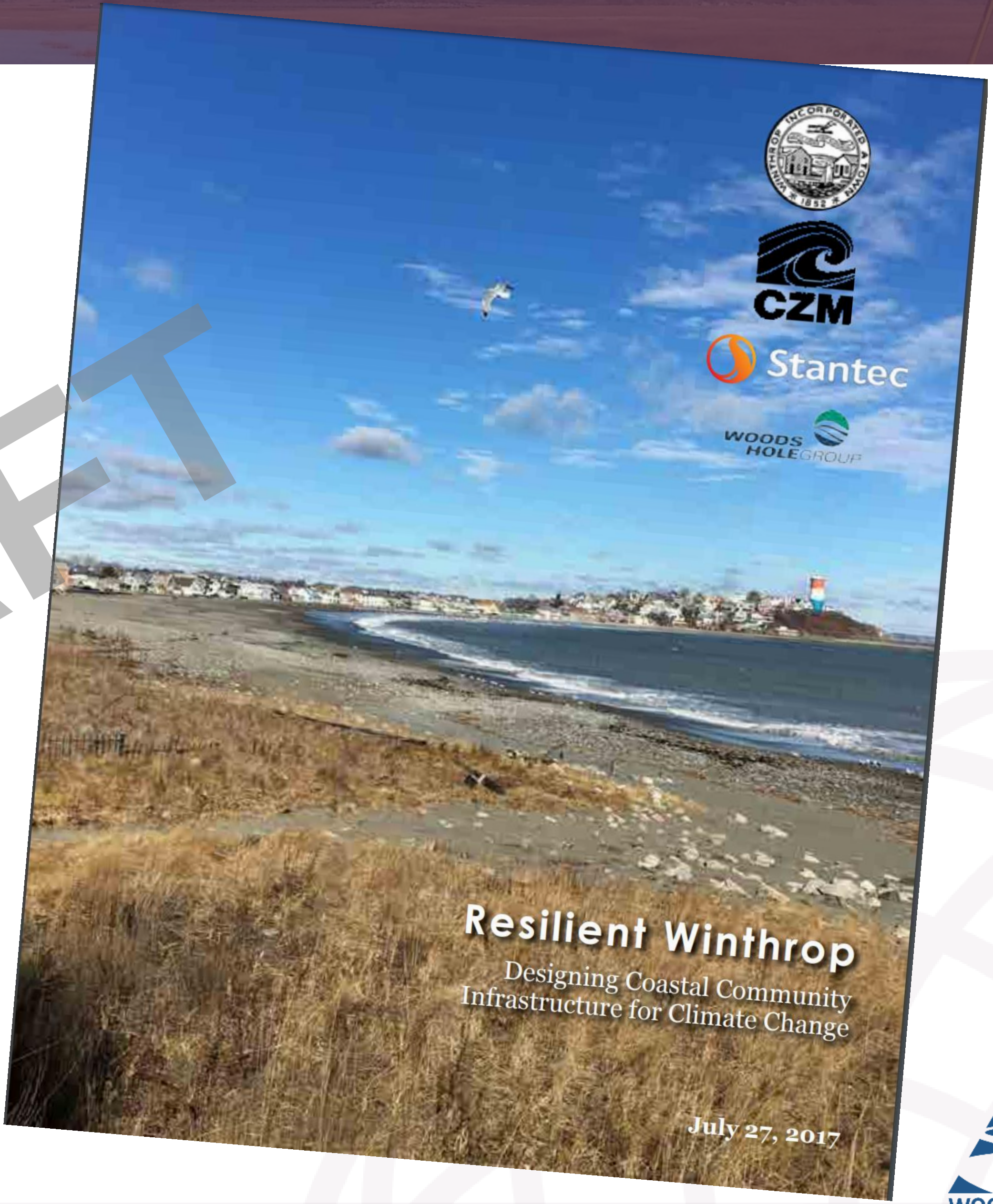

TOWN OF WINTHROP
HAZARD MITIGATION PLAN
2014 UPDATE

FINAL PLAN APPROVED BY FEMA
August 3, 2015

WOODARD &CURRAN

Resilient Winthrop

- Goal of project to identify and prioritize critical public infrastructure and explore adaptation measures to improve infrastructure and natural resource resilience in a number of future conditions.
- Within mapped coastal flooding areas are critical public infrastructure assets/facilities that support daily life in Winthrop
  - Sewer Pump Stations, Evacuation Routes, Substation, Pressure Reducing Valve Stations, Winthrop High School, Fire Station, Town Landing, others…



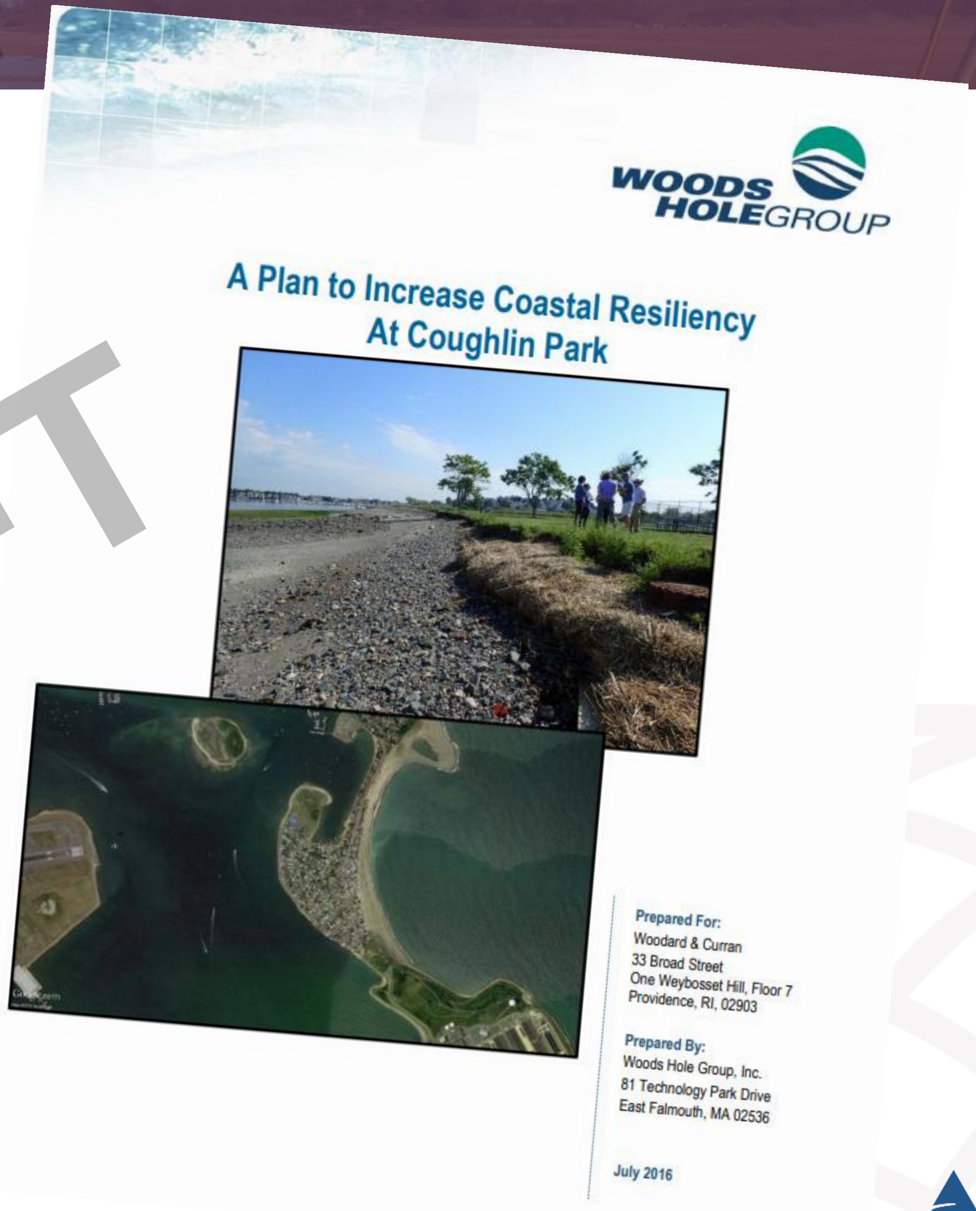
Critical Public Infrastructure

- Ⓐ Beach Fire Station
- Ⓑ Belle Isle Bridge
- Ⓒ Loring Rd. Boat Ramp
- Ⓓ Main Street (evacuation route)
- Ⓔ Pico Sewer Pump Station
- Ⓕ Pleasant Court Sewer Pump Station
- Ⓖ Pleasant Street (evacuation route)
- Ⓗ Power Substation (Argyle Street)
- Ⓘ Pressure Reducing Valve Station (Bayview Ave)
- Ⓙ Pressure Reducing Valve Station (Revere St)
- Ⓚ Pressure Reducing Valve Station (Underhill St)
- Ⓛ Public Landing
- Ⓜ Revere St. Sewer Pump Station
- Ⓝ Shirley Street (evacuation route)
- Ⓞ Washington Street (evacuation route)
- Ⓟ Winthrop High School

Figure 4-1 Town-Identified Critical Public Infrastructure Locations

Coastal Resiliency at Coughlin Park

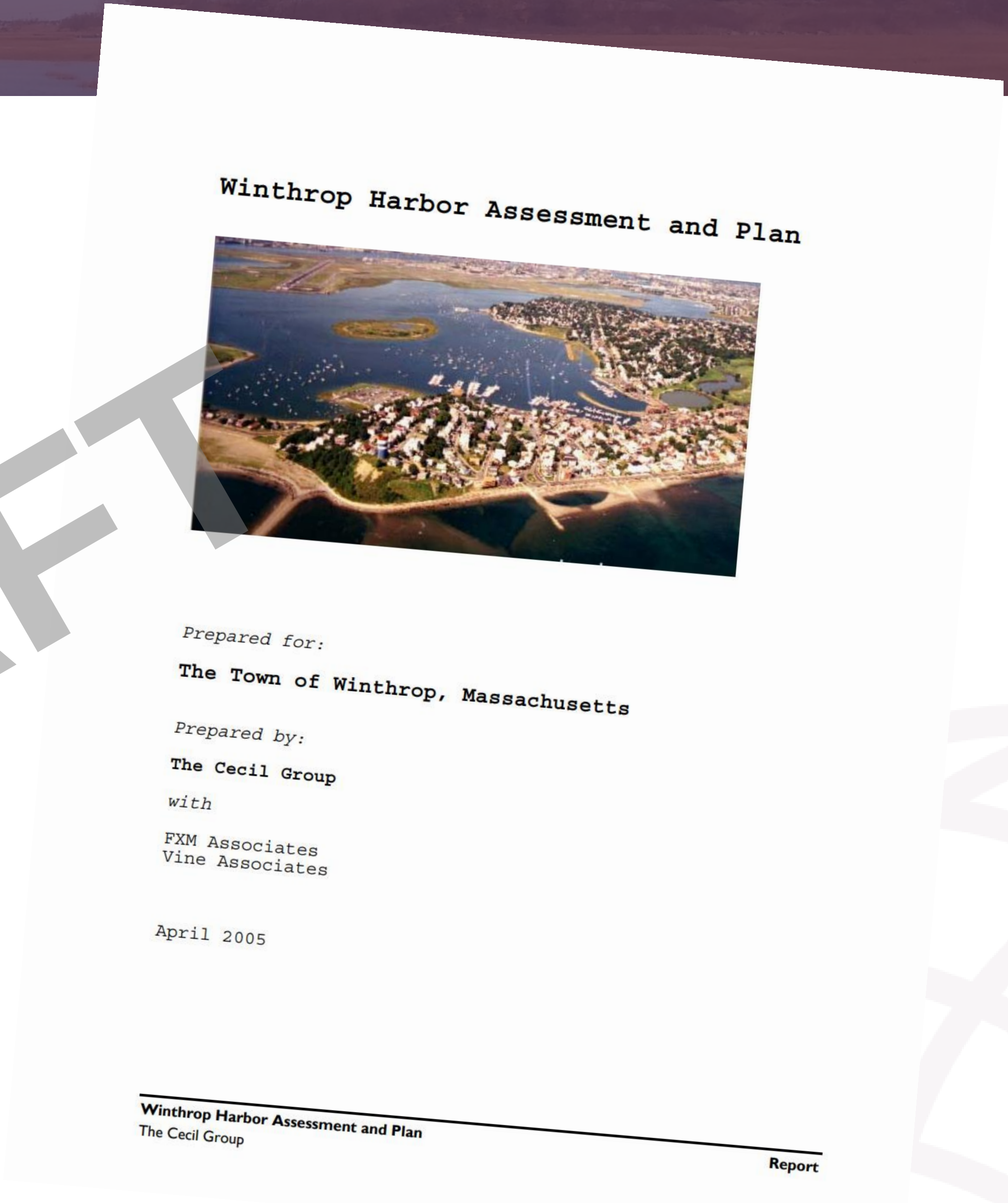
- Specific plan to increase resiliency at Coughlin Park.
- Report evaluated installations that could help slow erosion and identified green infrastructure along the western shoreline as the best alternative to increase coastal resilience of the park.



WOODARD &CURRAN

Other Work in Winthrop

- Winthrop Harbor Plan
- Improvements along Winthrop Shore Drive, Winthrop Beach, Tafts Avenue, Lewis Lake
- Community Development Plan


Winthrop Harbor Assessment and Plan

Prepared for:

The Town of Winthrop, Massachusetts

Prepared by:

The Cecil Group

with

FXM Associates
Vine Associates

April 2005

Winthrop Harbor Assessment and Plan
The Cecil Group

Report

WOODARD & CURRAN

Other Work in Winthrop

- Sewer improvements on Putnam Street, Putnam Place and Walden Street. Project included water main replacement on Jefferson Street and Fremont Street and upgrades to a section of the drainage system at the intersection of Jefferson Street and Putnam Street.
- Sewer, water, drain and sidewalk improvements on Walden Street, Lincoln Street, Read Street, Walden Place and Jerald Street. Drainage improvements included upgrading existing drainage to increase capacity in portions of Walden St., Lincoln St. and approximately 550 LF along Brookfield Rd. to the outfall structure at Donovan's Beach.
- Water main, drain and sewer improvements on Bellevue Avenue, Prescott Street, Somerset Avenue, Nahant Avenue and Sewall Avenue.
- Water main improvements with some sewer repairs on Plummer Ave., Woodside Ave, Woodside Park, Frances St., Sunnyside Ave, Pico Ave, Corinha Beach Rd. and throughout the neighborhoods surrounding the water tower.
- Sewer and water main improvements on Franklin Street and Harvard Street.

Other Work in Winthrop

- Water main on Central Street, South Main Street, Hutchinson Street, Taylor Street and Underhill Street. Drainage improvements on Taylor Street and Hadassah Way. Pavement and sidewalk improvements on Winthrop Street.
- Lewis Lake Tide Gate – Replace existing failed automated tide gate with new automated tide gate. Provided a manually operated tide gate on seaward side to provide needed redundancy.
- Miller Field/Lewis Lake Drainage and Site Improvements: Complete renovation of Miller Field including site drainage improvements and improvements to swales along the Veterans Road and Cross Street at the Winthrop Golf Club.
- Various water and sewer emergency repairs.
- Current projects include infrastructure improvements in the Centre Business District and shoreline stabilization at Coughlin Park.

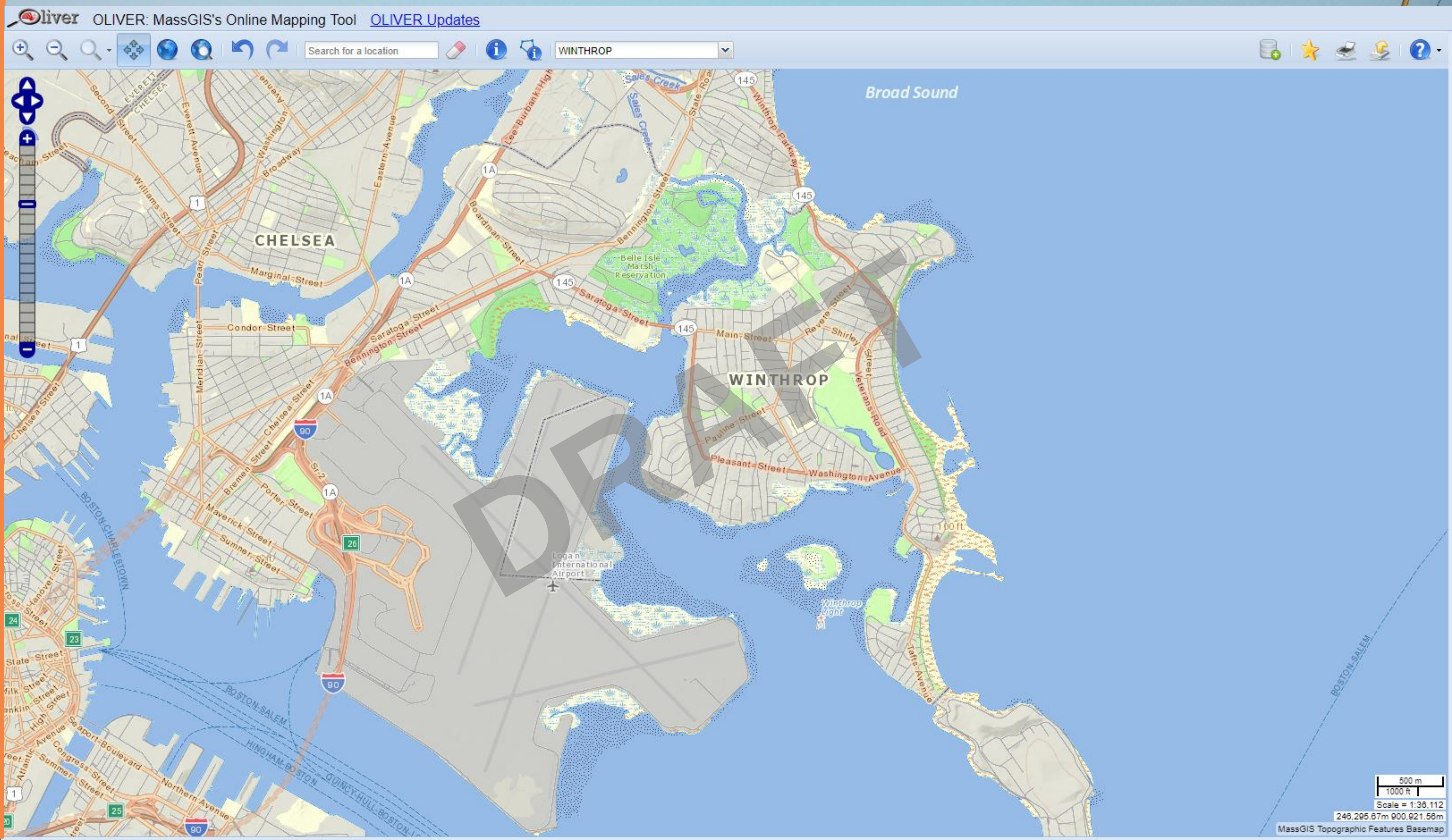
Severe Weather

- Areas of local flooding include:
  - Yirrell Beach
  - Nahant Avenue
  - Belle Isle Marsh
  - Winthrop Beach
  - Point Shirley
  - Lewis Lake
  - Ingleside Park
  - Lower Nahant Avenue
  - Coughlin Park
  - Fisherman’s Bend Marsh
  - Pico Avenue
  - Morton Street

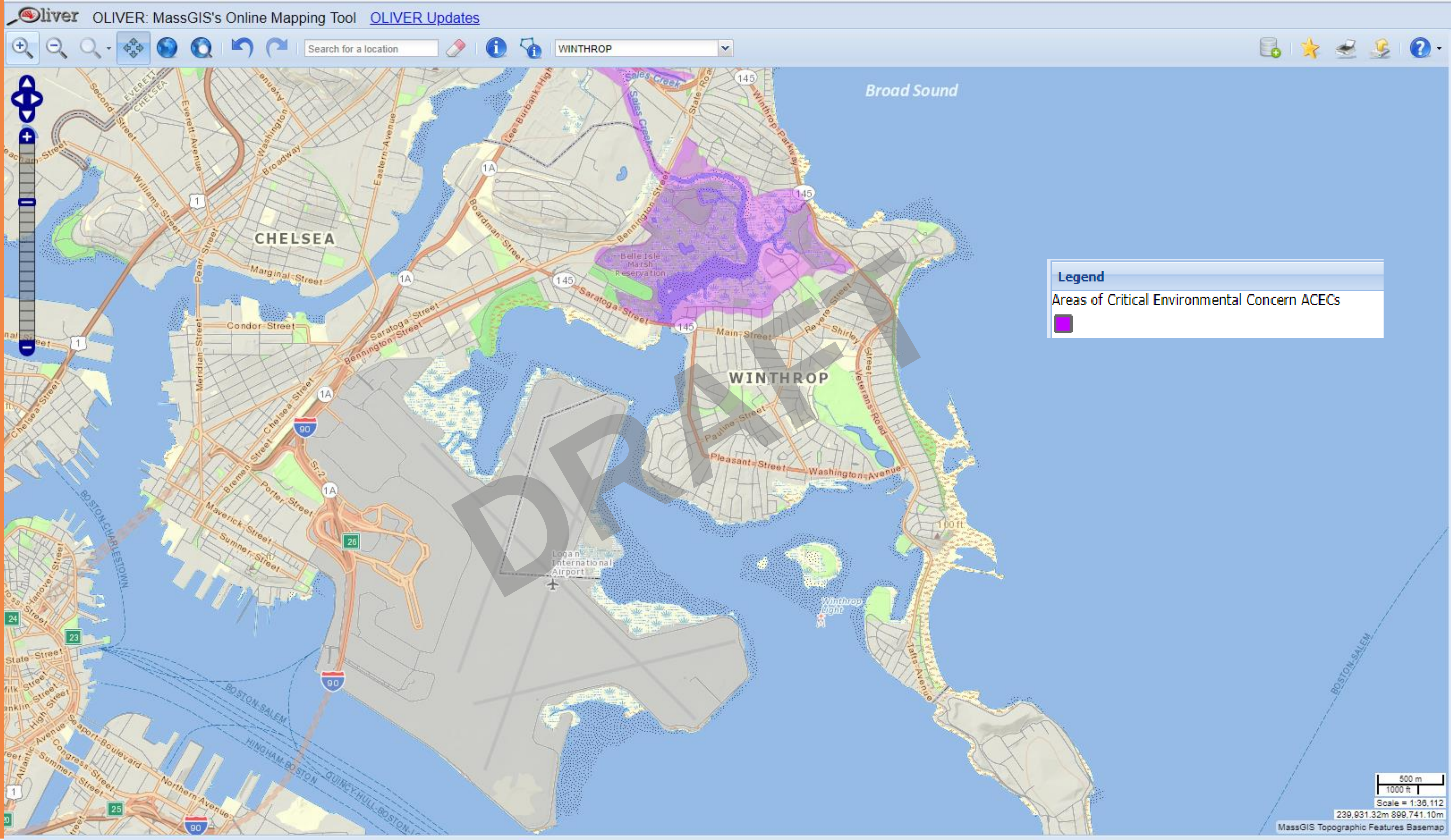
WOODARD &CURRAN

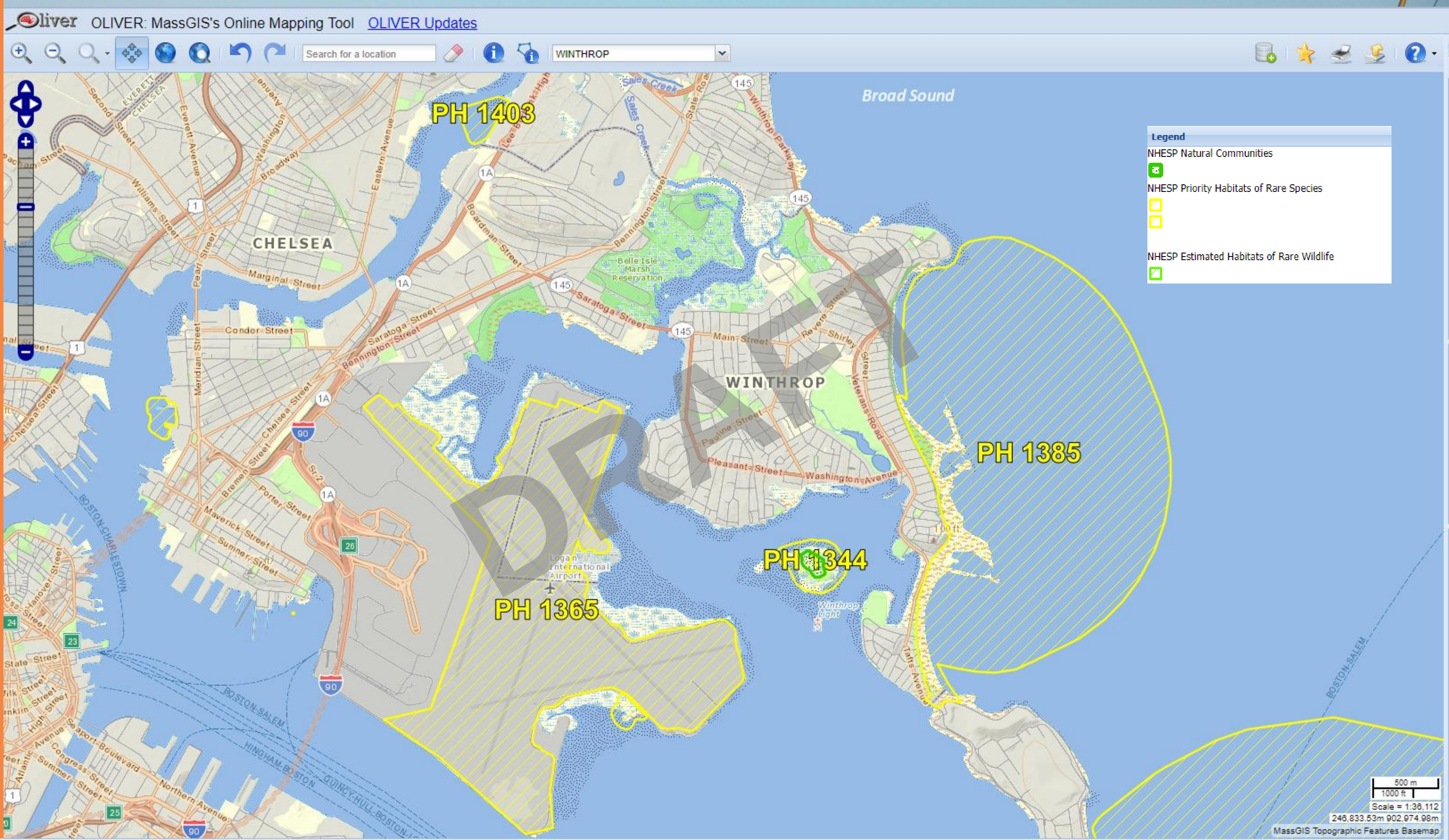
Severe Weather

- Flooding at Jefferson Street/Putnam Street intersection: Previous improvements helped reduce the frequency of flooding in this area. Additional infrastructure improvements planned under the Centre Business District project are designed to provide additional capacity for larger storm events.
- Ingleside Park/Walden Street: Area floods when intense storm events coincide with rising tides. Previous improvements have reportedly helped alleviate the frequency and duration of flooding in this area. Additional improvements to the outfall and outfall structure at Donovan's Beach and the drainage system in Ingleside Park have been recommended to further alleviate flooding issues.
- Flooding continues at the Winthrop Golf Course. Grading proposed to improve these conditions under the Miller Field/Lewis Lake Drainage and Site Improvements project were not constructed due to funding concerns.
- Morton Street, Pico Avenue, Washington Avenue and Shirley Street: Significant flooding has occurred in these areas during recent storms. The Town will be evaluating options to improve these conditions.
- Coughlin Park shoreline: Significant erosion continues to occur along this shoreline. The Town is in the process of permitting improvements for a shoreline stabilization project. Construction of these improvements is anticipated to begin in late 2018 or early 2019.

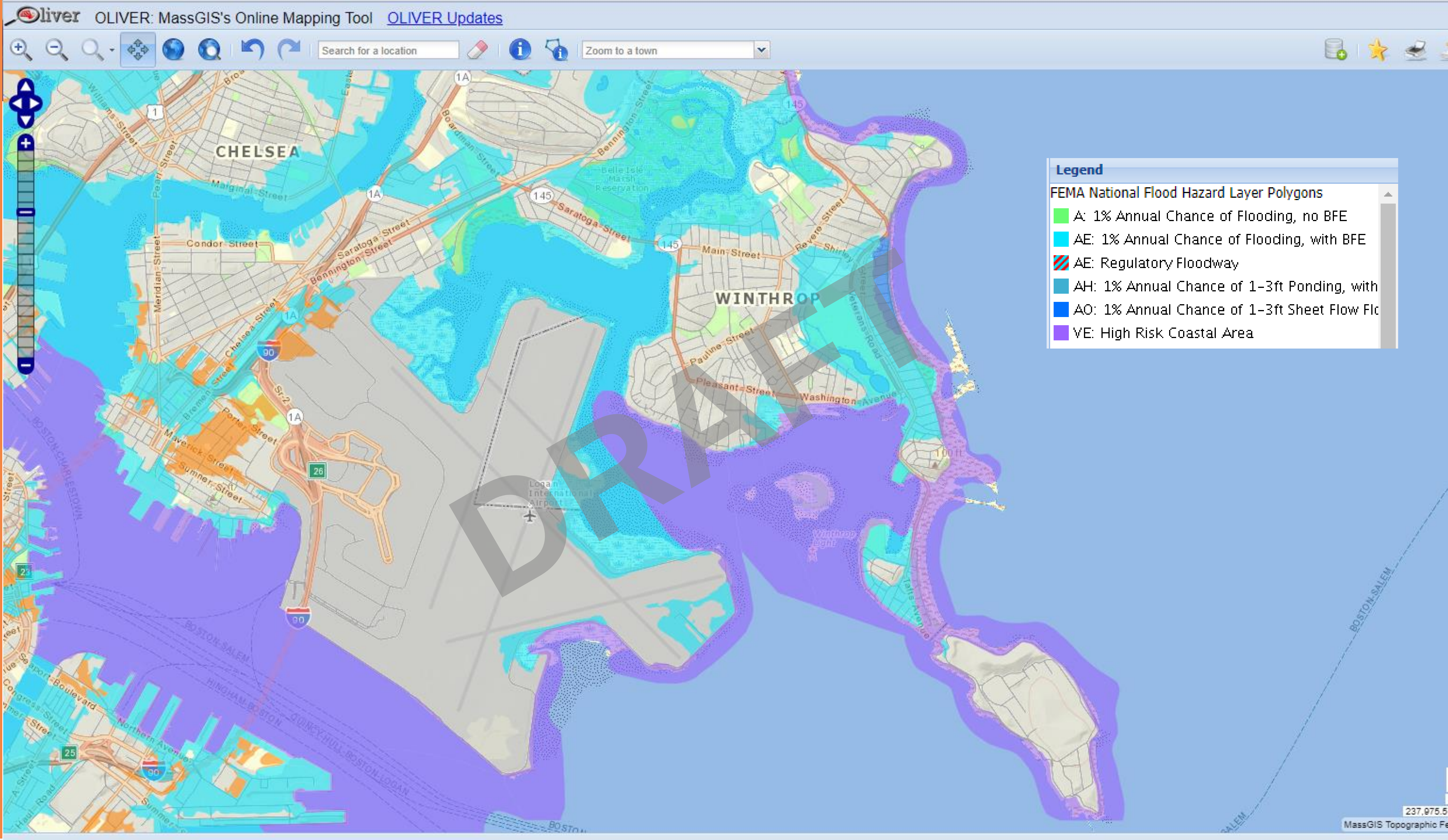


Oliver
OLIVER: MassGIS's Online Mapping Tool
OLIVER Updates
Search for a location
WINTHROP
Broad Sound
CHELSEA
WINTHROP
DRAFT
Belle Isle Marsh Reservation
Logan International Airport
Winthrop Light
Saratoga Street
Bennington Street
Main Street
Revere Street
Shirley Street
Veterans Road
Pauline Street
Pleasant Street
Washington Avenue
Tafts Avenue
Winthrop Parkway
Boardman Street
Condor Street
Marginal Street
Meridian Street
Chelsea Street
Maverick Street
Sumner Street
Porter Street
Bremen Street
Broadway
Washington Avenue
Everett Avenue
Eastern Avenue
Williams Street
Pearl Street
Second Street
Lee Burbank Highway
State Road
Sales Creek
Seaport Boulevard
Congress Street
Summer Street
Northern Avenue
Atlantic Avenue
High Street
State Street
Hanover Street
BOSTON-SALEM
HINGHAM-BOSTON
QUINCY-HULL-BOSTON
BOSTON-CHARLESTOWN
EVERETT CHELSEA
500 m
1000 ft
Scale = 1:36,112
246,295.67m 900,921.56m
MassGIS Topographic Features Basemap

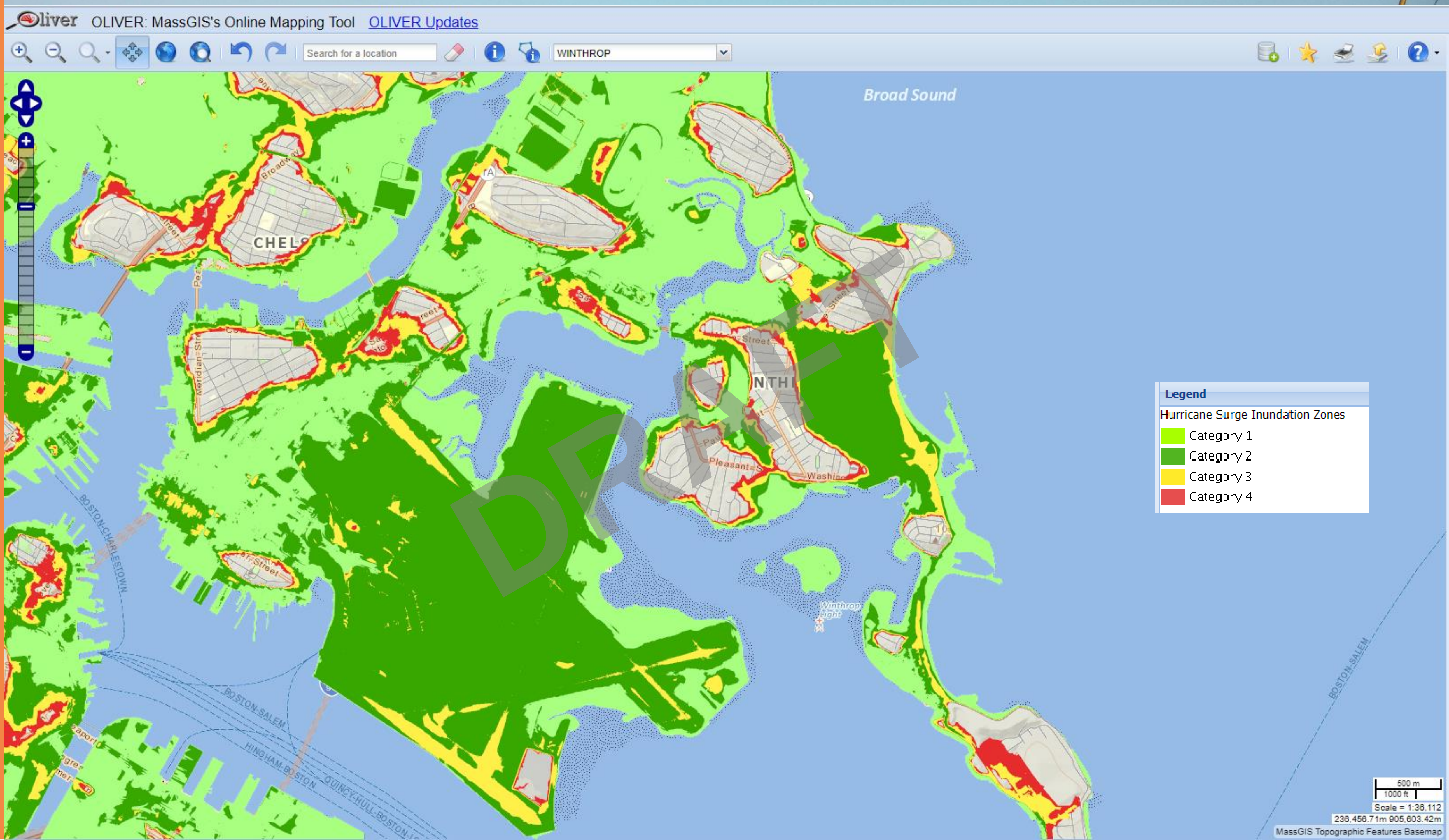

Oliver
OLIVER: MassGIS's Online Mapping Tool
OLIVER Updates
Search for a location
WINTHROP
Broad Sound
CHELSEA
WINTHROP
Belle Isle Marsh Reservation
Logan International Airport
Winthrop Light
DRAFT
Legend
Areas of Critical Environmental Concern ACECs
500 m
1000 ft
Scale = 1:36,112
239,931.32m 899,741.10m
MassGIS Topographic Features Basemap



OLIVER: MassGIS's Online Mapping Tool
OLIVER Updates
Search for a location
WINTHROP
Legend
NHESP Natural Communities
NHESP Priority Habitats of Rare Species
NHESP Estimated Habitats of Rare Wildlife
Broad Sound
PH 1403
PH 1385
PH 1344
PH 1365
CHELSEA
WINTHROP
Belle Isle Marsh Reservation
Logan International Airport
DRAFT
Scale = 1:36,112
MassGIS Topographic Features Basemap



OLIVER: MassGIS's Online Mapping Tool
OLIVER Updates
Search for a location
Zoom to a town
Legend
FEMA National Flood Hazard Layer Polygons
A: 1% Annual Chance of Flooding, no BFE
AE: 1% Annual Chance of Flooding, with BFE
AE: Regulatory Floodway
AH: 1% Annual Chance of 1-3ft Ponding, with
AO: 1% Annual Chance of 1-3ft Sheet Flow Flo
VE: High Risk Coastal Area
CHELSEA
WINTHROP
DRAFT
Marginal Street
Condor Street
Saratoga Street
Bennington Street
Main Street
Pauline Street
Pleasant Street
Washington Avenue
Maverick Street
Porter Street
Sumner Street
Belle Isle Marsh Reservation
Logan International Airport
MassGIS Topographic Fe

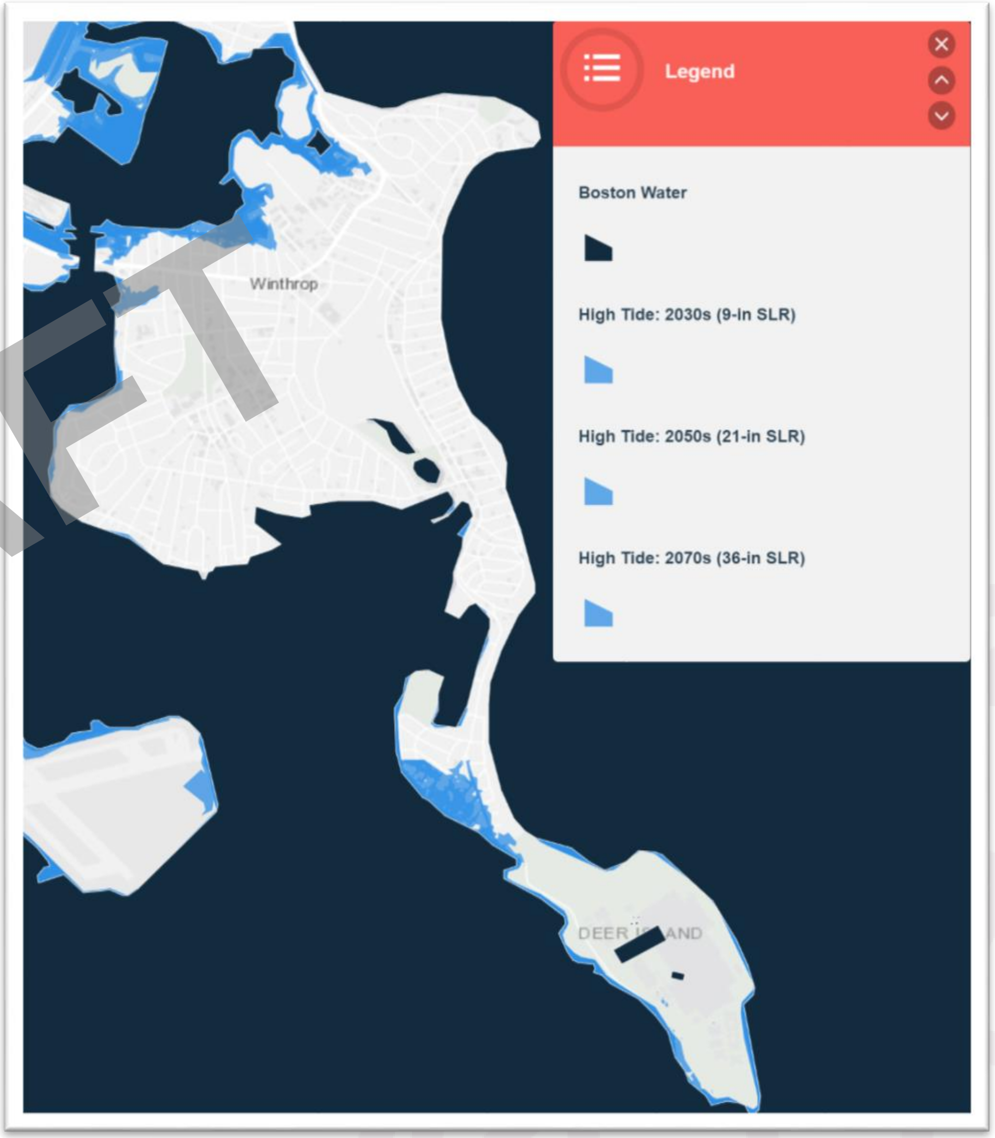


Oliver
OLIVER: MassGIS's Online Mapping Tool
OLIVER Updates
Search for a location
WINTHROP
Broad Sound
CHELS
NTHI
DRAFT
Legend
Hurricane Surge Inundation Zones
Category 1
Category 2
Category 3
Category 4
Winthrop Light
BOSTON-SALEM
HINGHAM-BOSTON
500 m
1000 ft
Scale = 1:36,112
236,456.71m 905,603.42m
MassGIS Topographic Features Basemap

WHAT ABOUT THE FUTURE?

Flood Risk

- According to Boston Harbor Flood Risk Model – 480 acres (45%) of Winthrop's 1.6 miles is within a coastal flooding area.
- By 2070, 800 acres (60%) will be within a coastal flooding area.
- The flood area does not expand dramatically, but the depth of flooding during a storm event DOES.



WOODARD &CURRAN

Areas of Probable Flooding

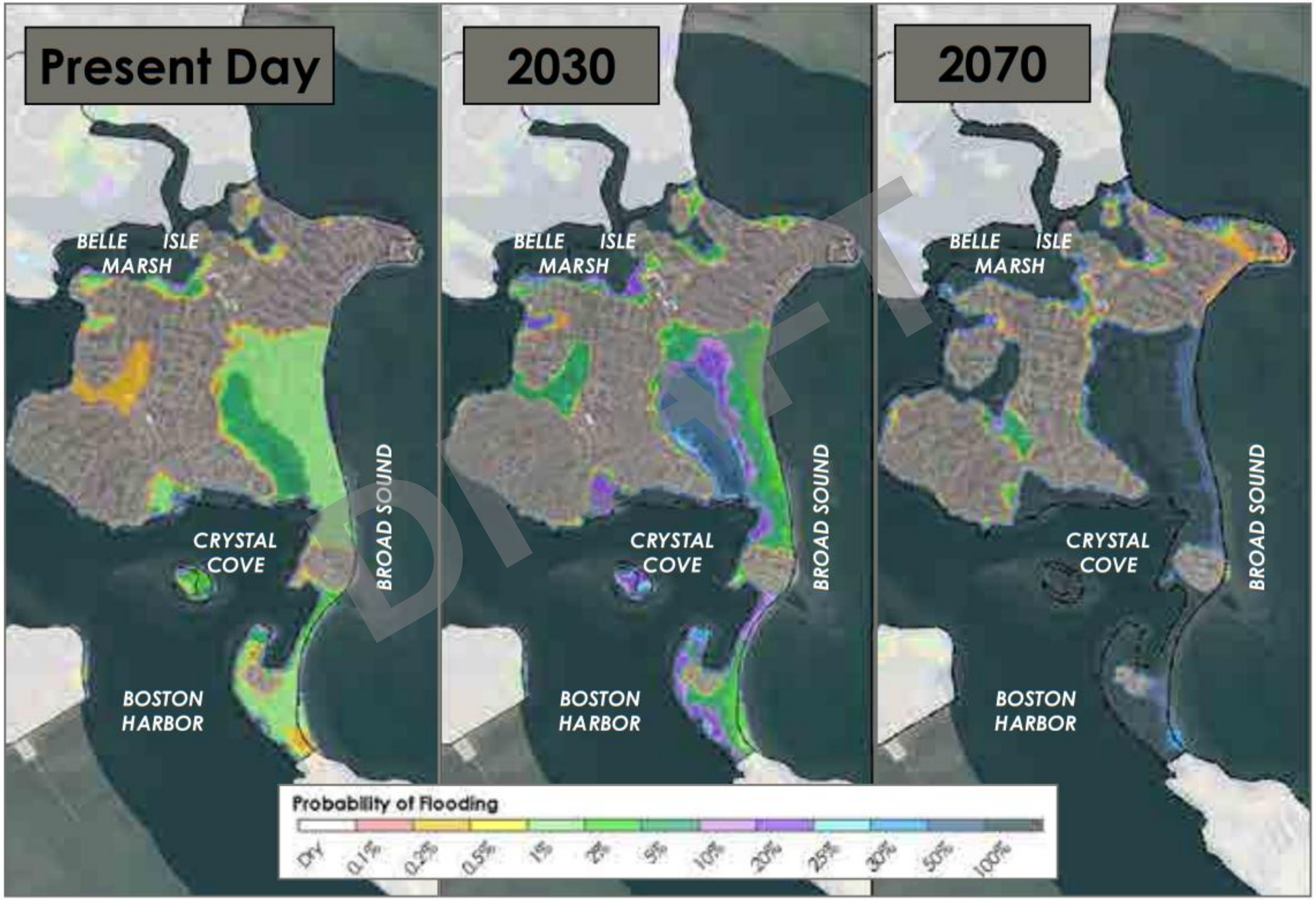


Figure 3-3 Winthrop Areas of Probable Flooding

WOODARD &CURRAN

Depth of Flooding (1% Change Water Level)

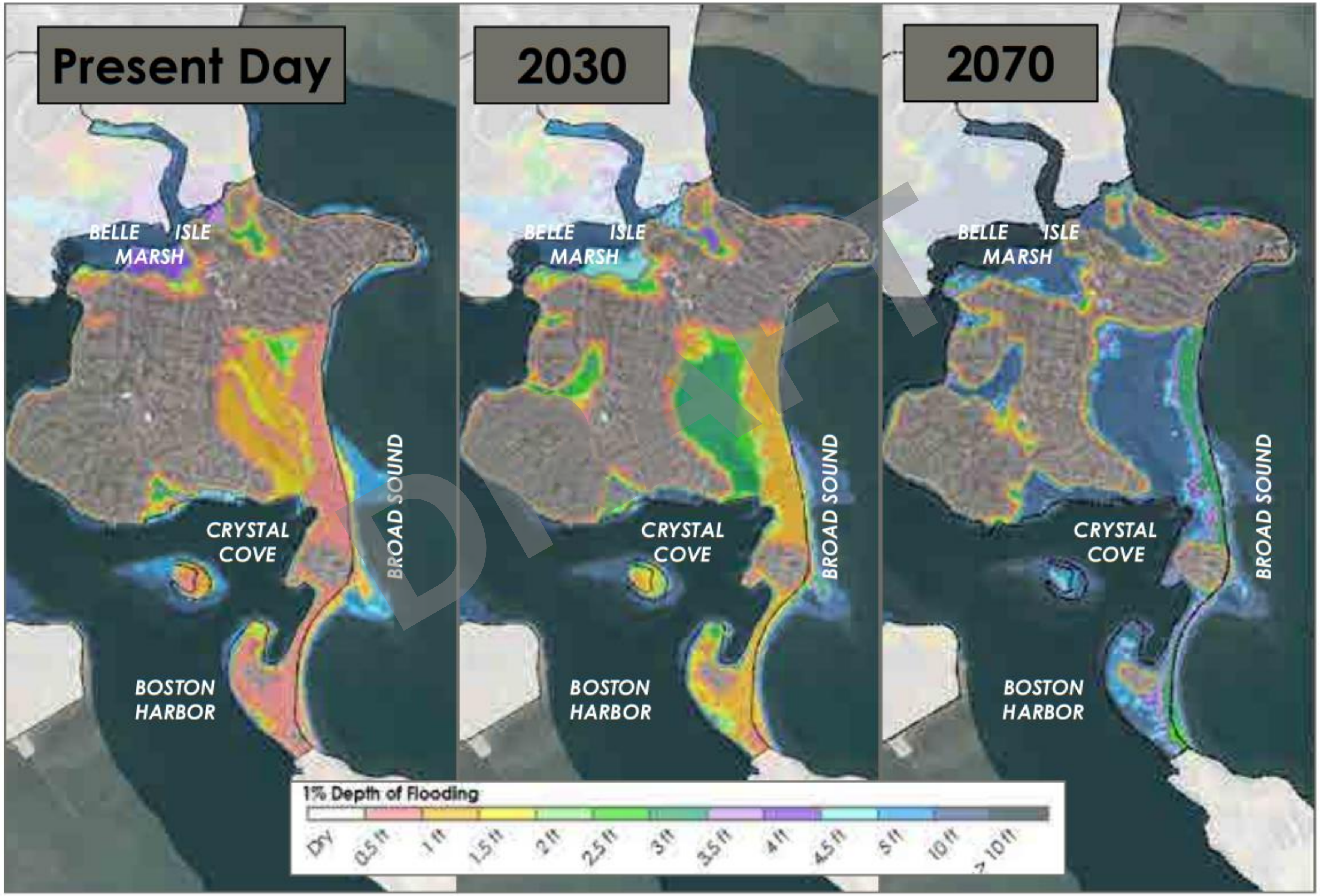
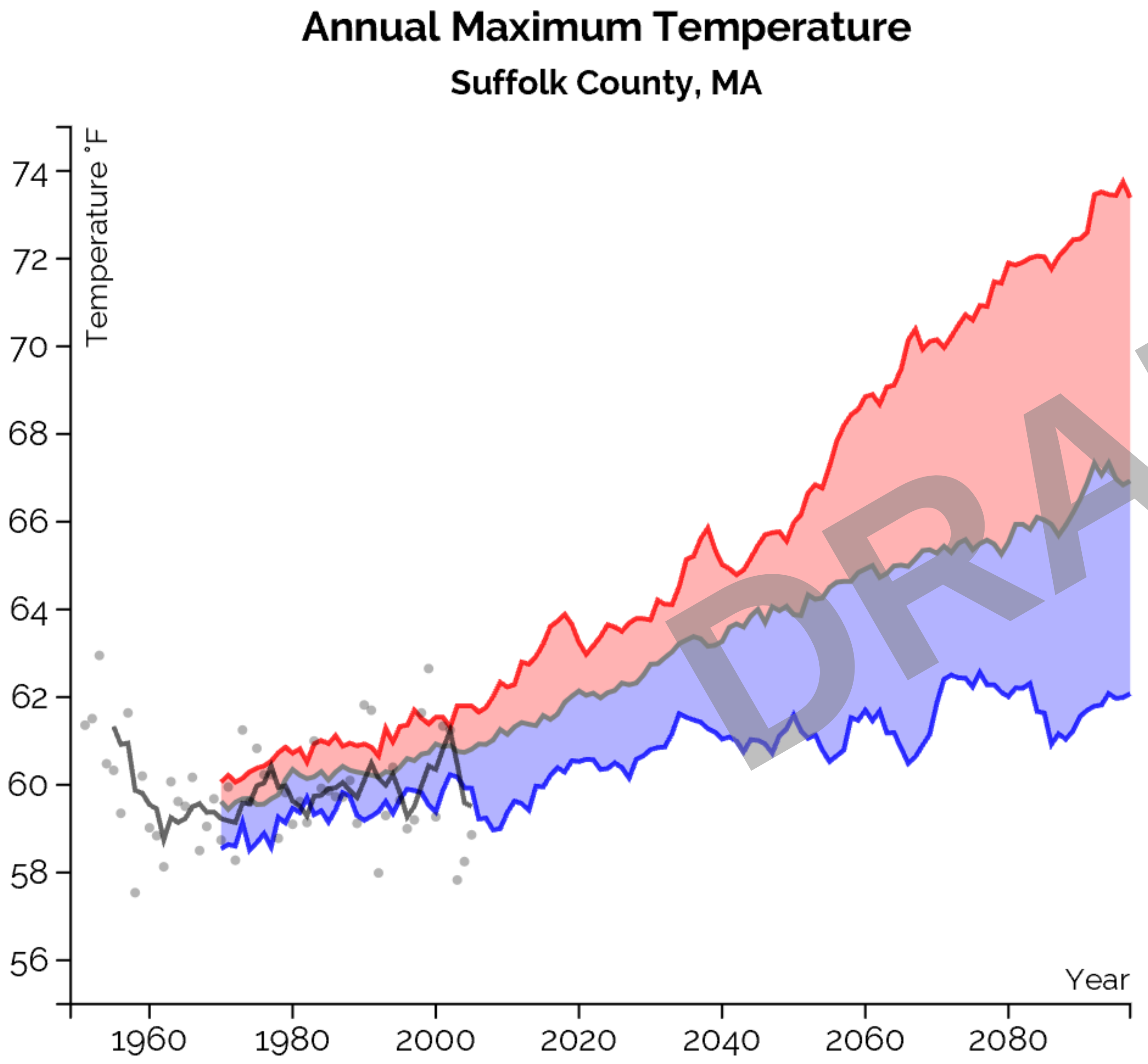


Figure 3-4 Winthrop Depth of Flooding (1% Chance water level)

WOODARD &CURRAN

Annual Maximum Temperature



Observed

°F

5-yr Mean

Modeled °F
2056–2060

Max	68.44
Median	64.64
Min	61.53

Changes from 1971-2000 for:

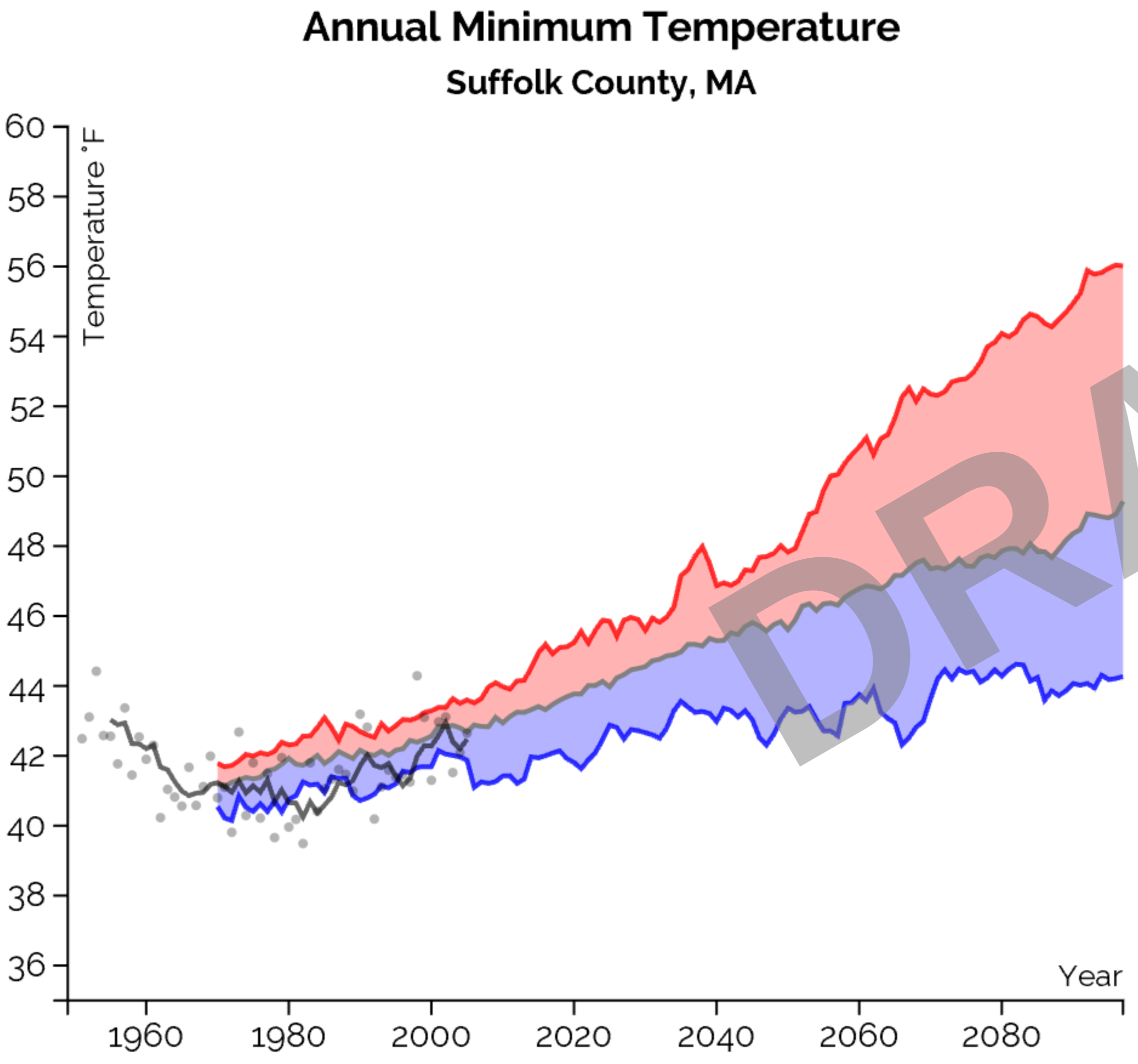
2020 - 2049	3.40° F
2040 - 2069	4.64° F
2060 - 2089	5.69° F
2080 - 2097	6.38° F

resilient MA

NE CSC Northeast Climate Science Center

WOODARD & CURRAN

Annual Minimum Temperature



Observed

	˚F
5-yr Mean	

Modeled ˚F 2066–2070

Max	52.15
Median	47.52
Min	42.82

Changes from 1971-2000 for:

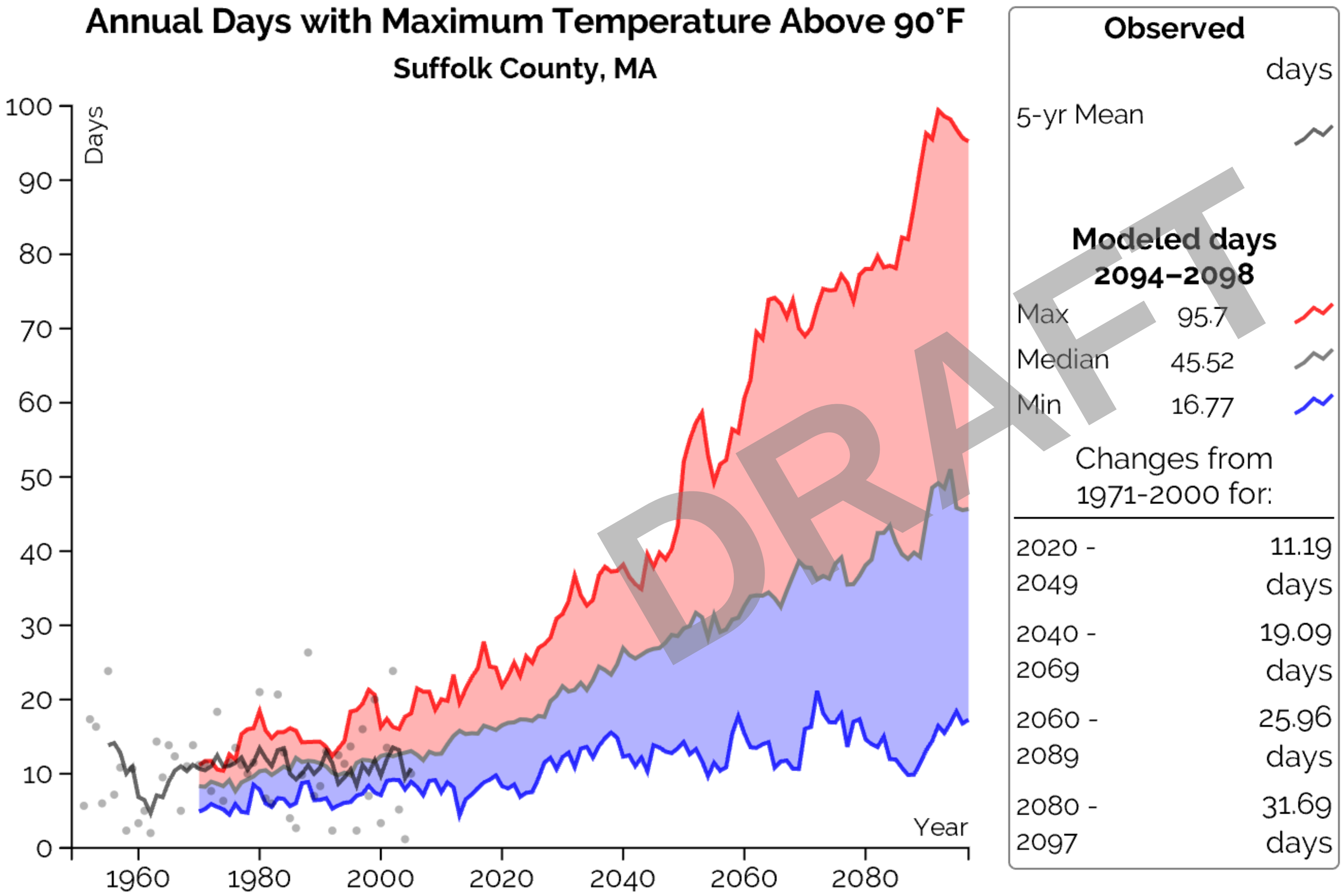
2020 - 2049	3.62˚ F
2040 - 2069	5.02˚ F
2060 - 2089	6.25˚ F
2080 - 2097	6.81˚ F

resilient MA

NE CSC Northeast Climate Science Center

WOODARD & CURRAN

Annual Days With Maximum Temperature Above 90

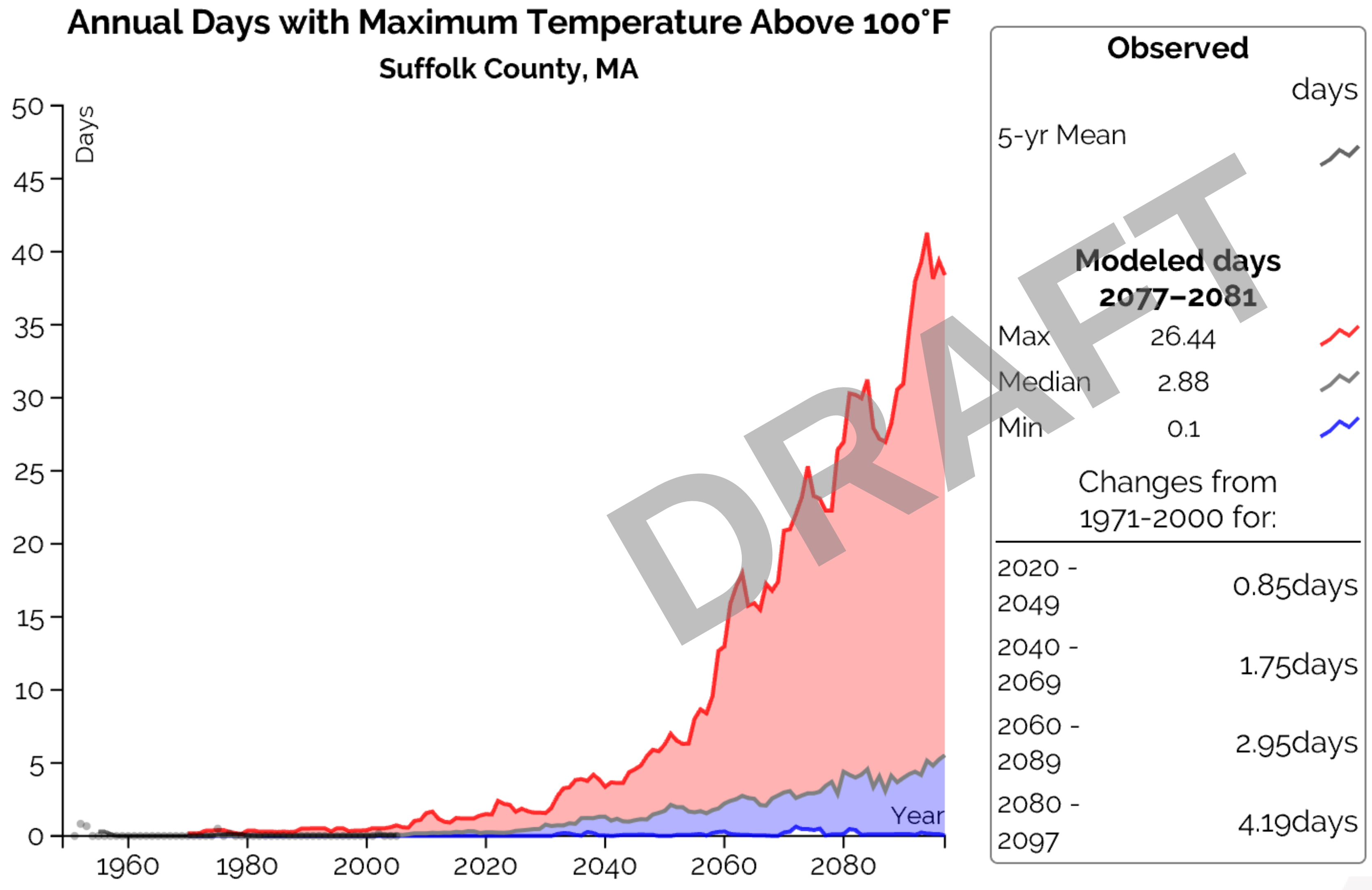


resilient MA

NE CSC
Northeast Climate Science Center

WOODARD & CURRAN

Annual Days With Maximum Temperature Above 100

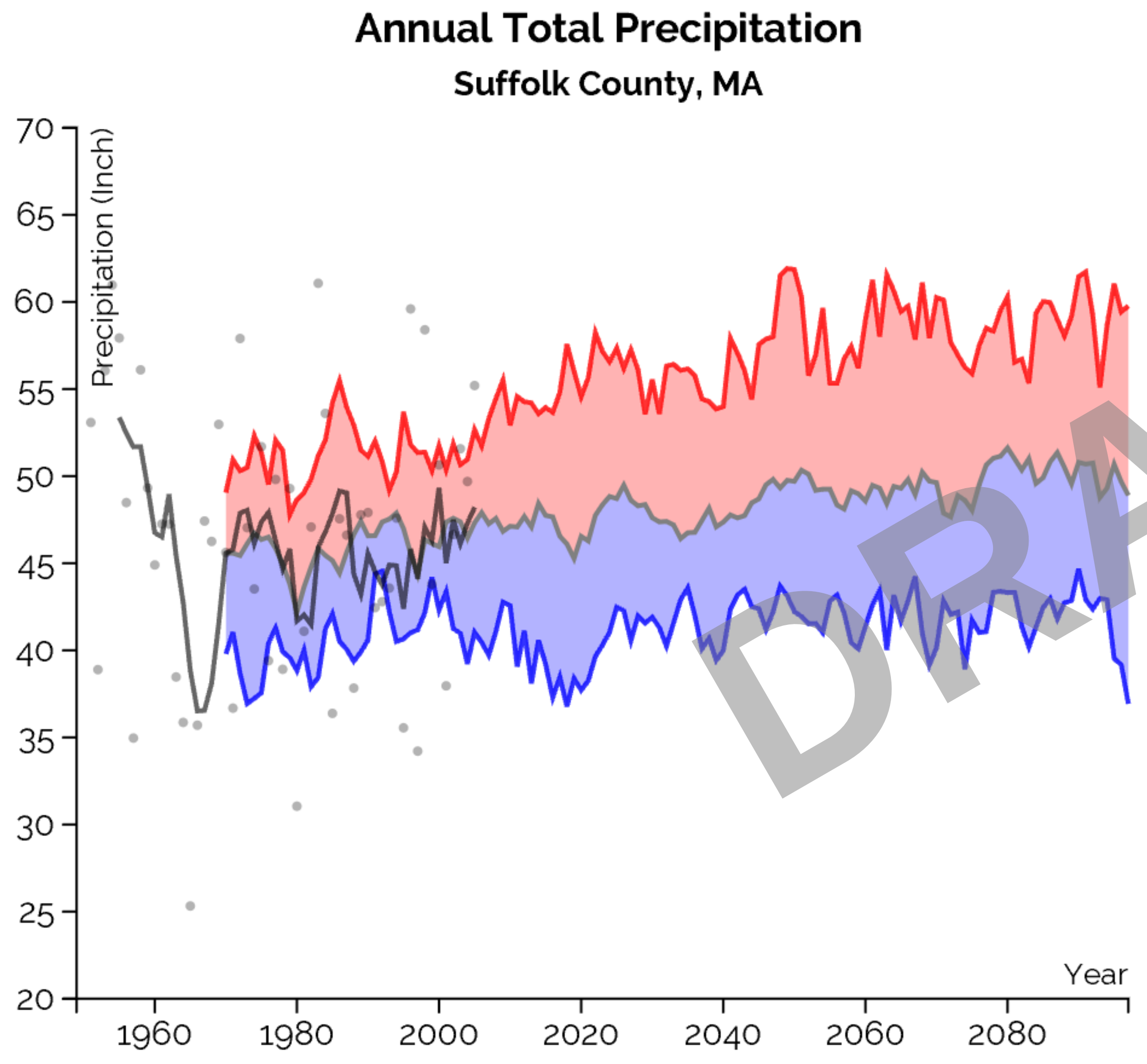


resilient MA

NE CSC
Northeast Climate Science Center

WOODARD &CURRAN

Annual Total Precipitation



Observed

Inches

5-yr Mean

Modeled Inches

Max

Median

Min

Changes from 1971-2000 for:

2020 - 2049	0.94"
2040 - 2069	2.42"
2060 - 2089	2.78"
2080 - 2097	3.77"

resilient MA

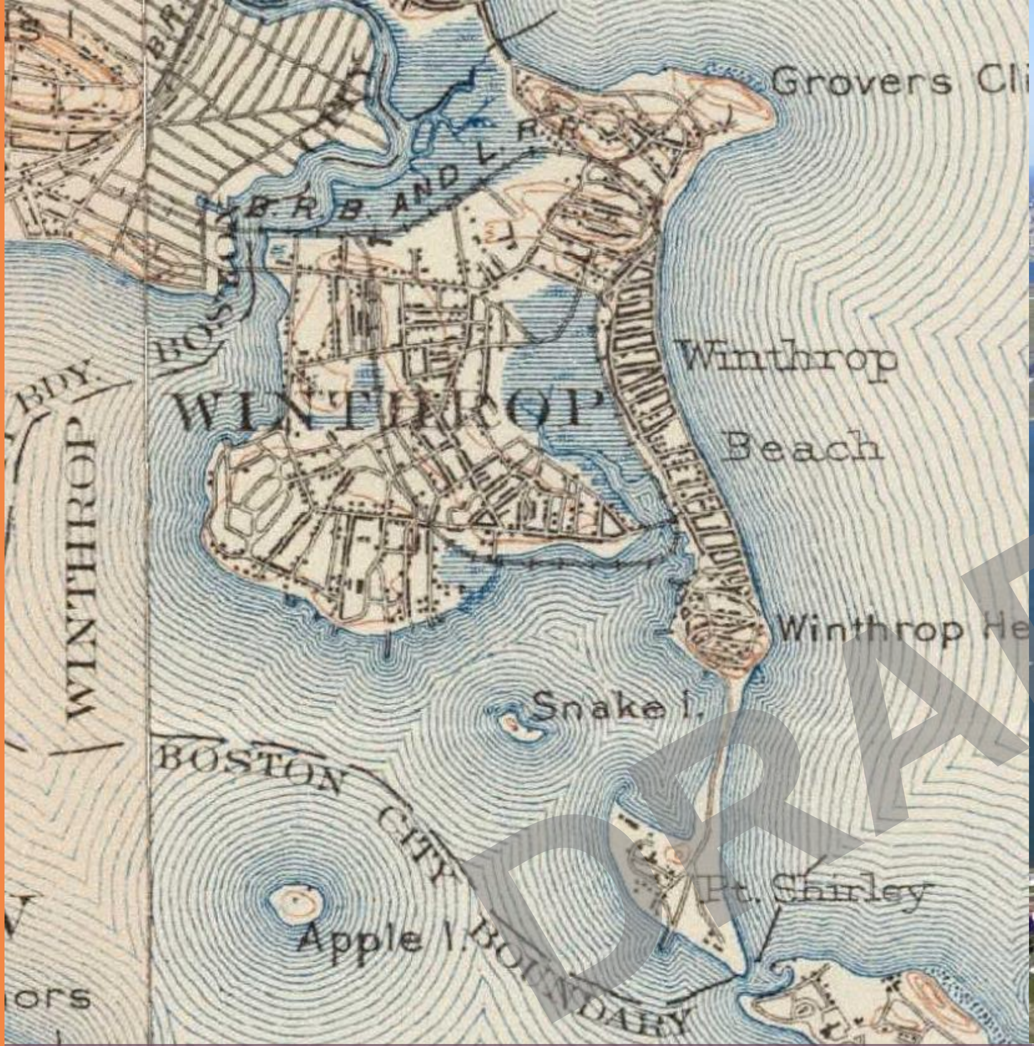
NECSC Northeast Climate Science Center

WOODARD & CURRAN

Agenda

- **7:30 – 8:00 | Registration**
- **8:00 – 8:30 | Welcome & Overview**
- **8:30 – 9:00 | CRB Workshop Why Are We Here?**
- **9:00 – 9:30 | Identify Challenges & Goals**
- **9:30 – 10:00 | Background Information About Winthrop**
- 10:00 – 10:30 | Climate Change **(Mass Audubon)**
- 10:30 – 11:00 | Characterize Natural Hazards
- 11:00 – 12:30 | Identify Community Vulnerabilities & Strengths
- **12:30 – 1:30 | LUNCH!**
- 1:30 – 2:00 | Natural Infrastructure Solutions **(The Nature Conservancy)**
- 2:00 – 3:30 | Identify & Prioritize Community Actions
- 3:30 – 4:00 | CRB Workshop Recap & Wrap Up

WOODARD
&CURRAN



Winthrop, MA

Community Resiliency Building Workshop

April 6, 2018

WOODARD & CURRAN

Community Resilience Building Risk Matrix

www.CommunityResilienceBuilding.com

H-M-L priority for action over the Short or Long term (and Ongoing)
V = Vulnerability S = Strength

Top Priority Hazards (tornado, floods, wildfire, hurricanes, earthquake, drought, sea level rise, heat wave, etc.)

Features	Location	Ownership	V or S					Priority H - M - L	Time Short Long Ongoing
Infrastructural									
Societal									
Environmental									

Climate Change in Winthrop

Daniel Brown
Climate Change Program Coordinator
dbrown@massaudubon.org

Mass Audubon

Key changes already observed in Massachusetts.

Temperature: ↑ **2.9°F** Since 1895

Growing Season: ↑ **11 Days** Since 1950

Sea Level Rise: ↑ **11 inches** Since 1922

Strong Storms: ↑ **55%** Since 1958

Source: Climate Science Special Report, 2017; NOAA NCEI nClimDiv; NOAA Ocean Service

Suffolk County Projected Changes
(2040-2069)

Annual Average Temperature — 4.9°F

Days Above 90°F — 19 Days

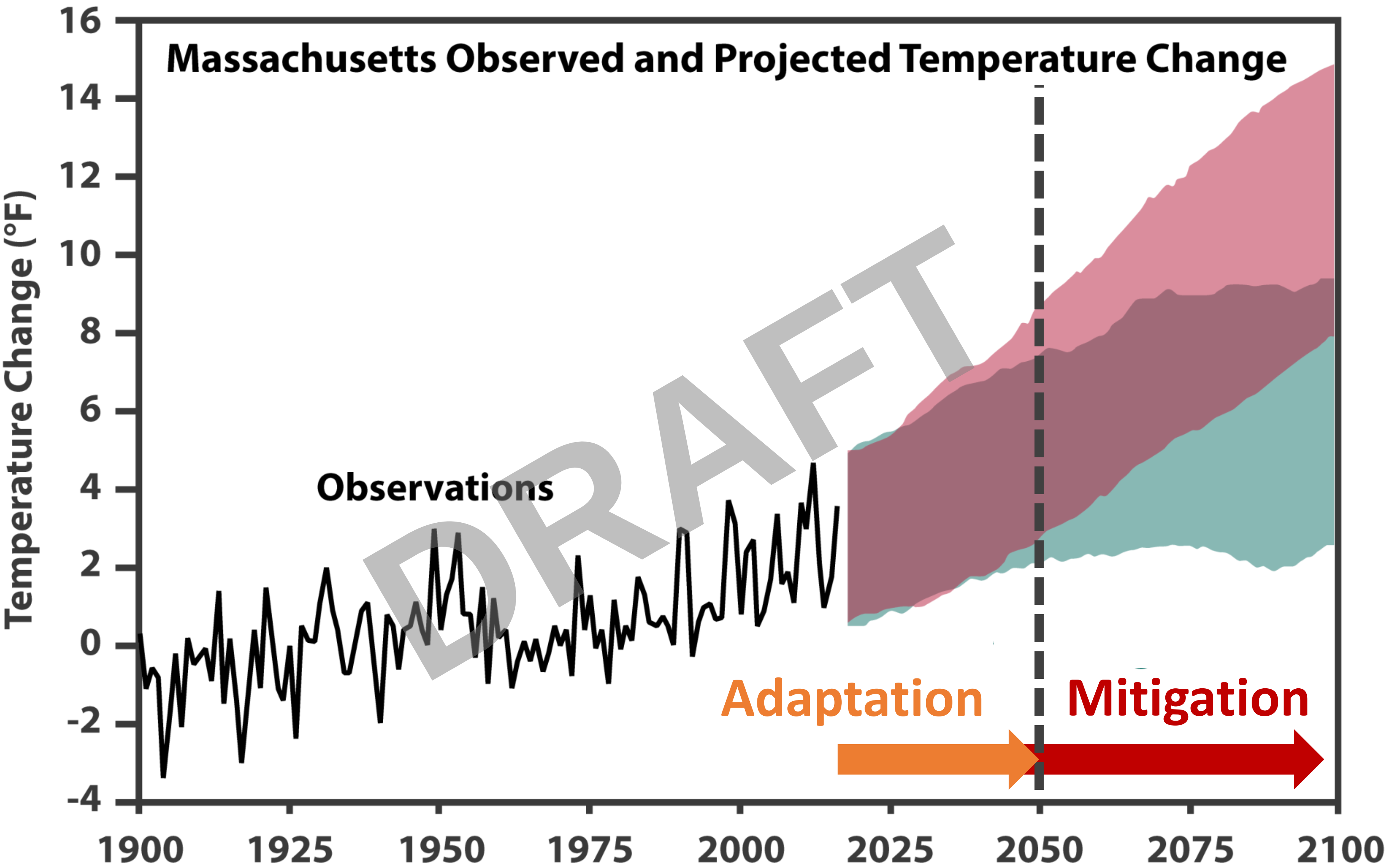
Sea Level Rise — 2.4 feet

Days with >2” Precipitation — 44%

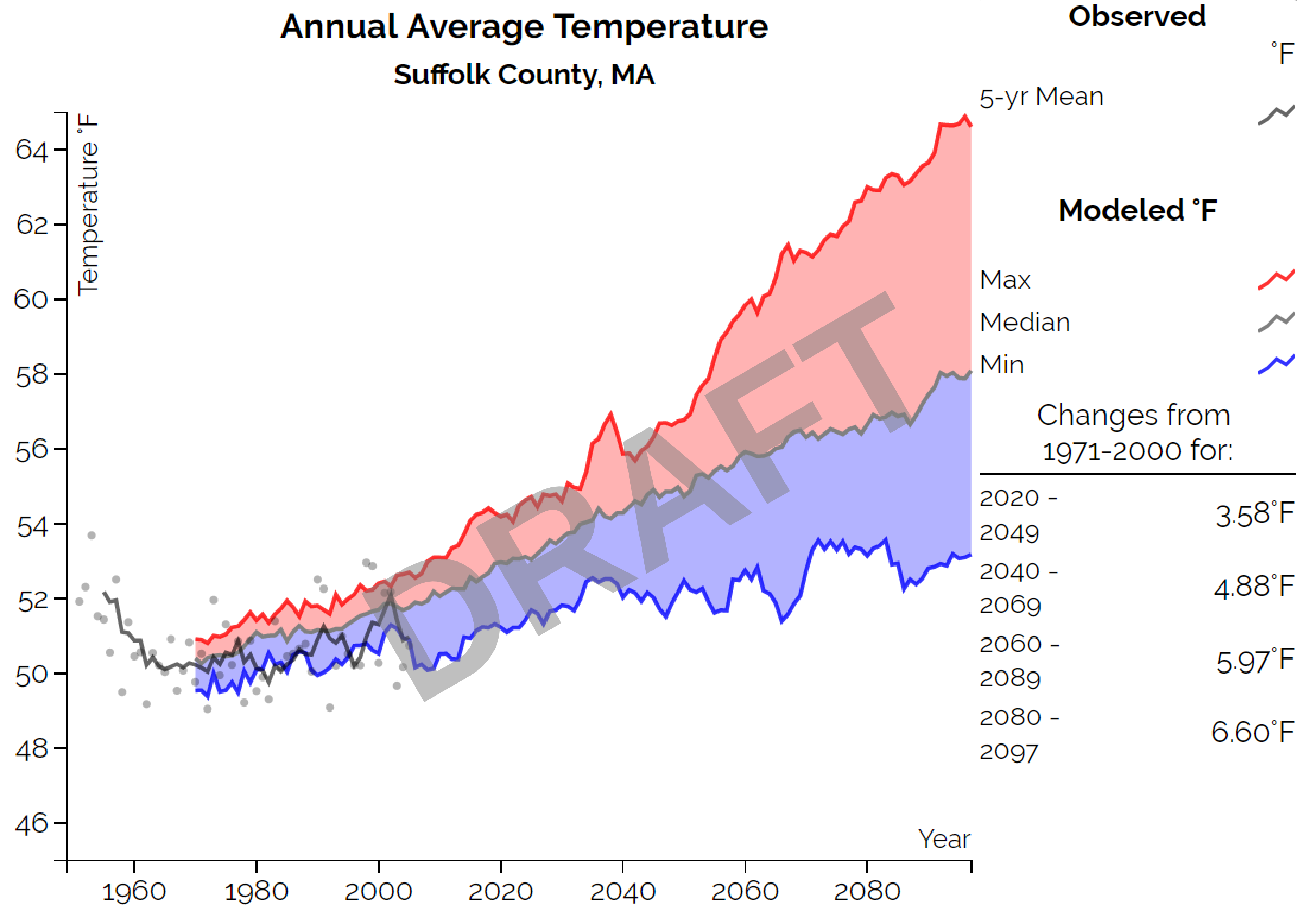
Source: Northeast Climate Science Center, MassClimateChange.org, Values shown for the Blackstone River Watershed.

What's in a degree?

During the last ice age, temperatures were 9°F cooler than today.



Source: NCICS State Climate Summaries. Observational data from NOAA nClimDiv dataset. Accessed 2017.



Source: Northeast Climate Science Center, MassClimateChange.org, accessed 2018.

Changing Energy Use and Demand

More Warm Winter Days, Less Heating Demand

(based on annual Heating Degree-Days, base 65)

11 – 24%

by the 2050s

1971-2000
6079 Heating Degree-days

More Warm Summer Days, More Cooling Demand

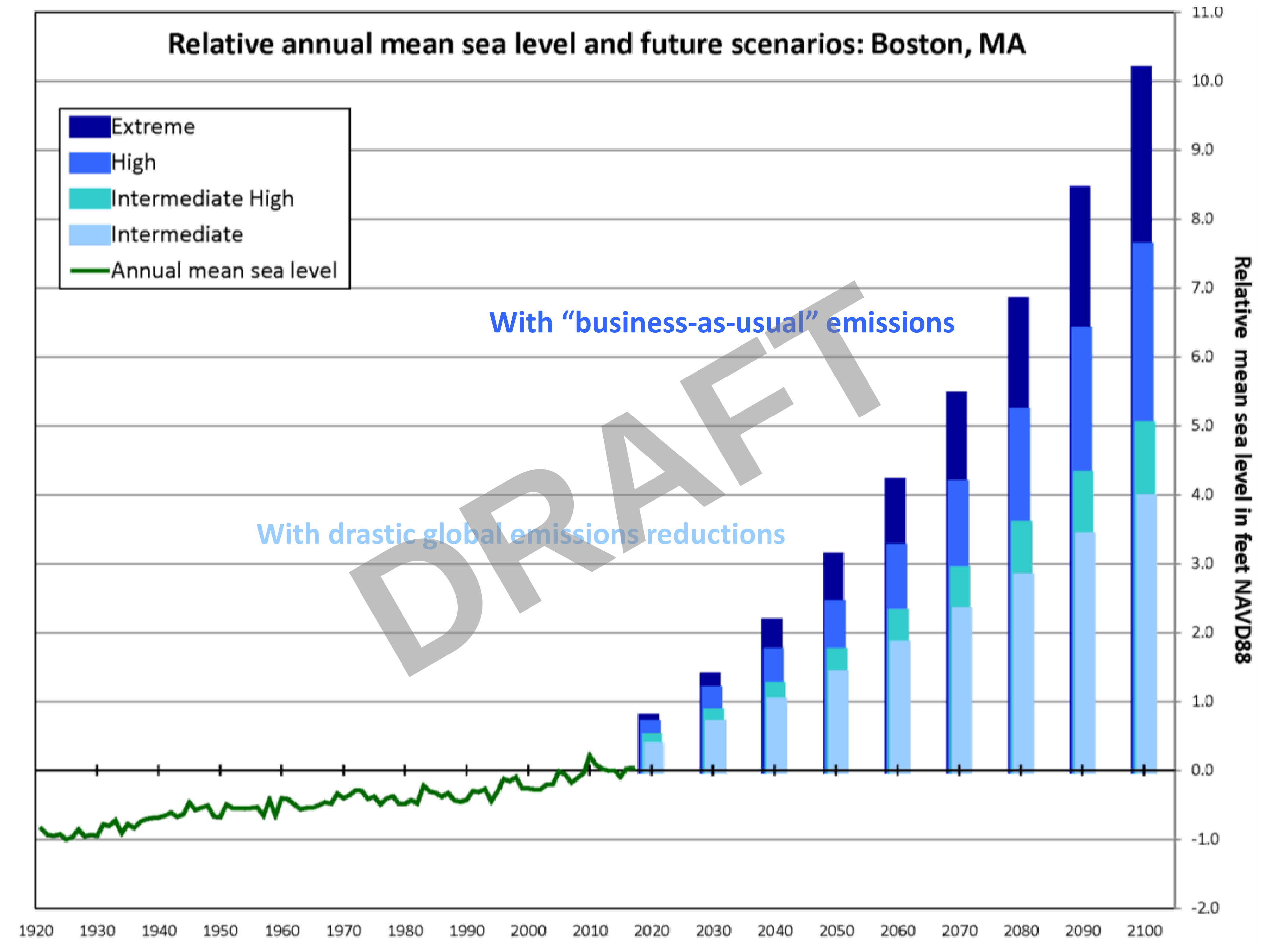
(based on annual Cooling Degree-Days, base 65)

44 – 120%

by the 2050s

1971-2000
636 Cooling Degree-days

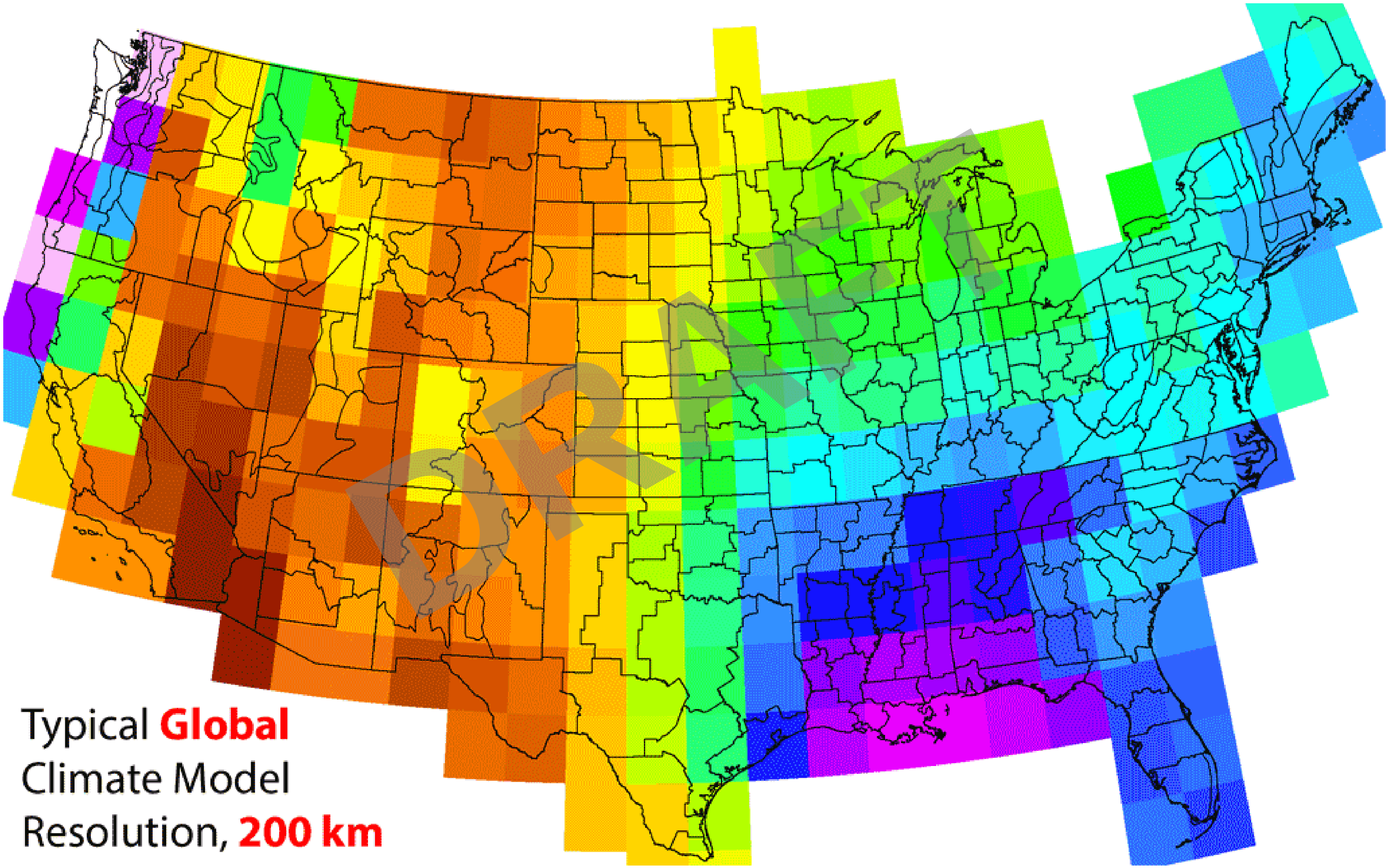
Source: Northeast Climate Science Center, MassClimateChange.org, accessed 2018.


Relative annual mean sea level and future scenarios: Boston, MA
Extreme
High
Intermediate High
Intermediate
Annual mean sea level
With "business-as-usual" emissions
With drastic global emissions reductions
DRAFT
Relative mean sea level in feet NAVD88
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100

Middlesex
Suffolk
Chelsea
Chelsea River
Suffolk Downs
Belle Isle Marsh Reservation
Belle Isle Inlet
Winthrop
East Boston
Winthrop Golf Club
Yirrell Beach
Boston Harbor
Deer Island
Massport-Marine Terminal
Economic Dev Industrial Corporation
3' SLR


Middlesex
Suffolk
Chelsea
Chelsea River
Chelsea River
Suffolk Downs
Belle Isle Marsh Reservation
Belle Isle Inlet
Winthrop
East Boston
Winthrop Golf Club
Yirrell Beach
Boston Harbor
Deer Island
Deer Island
Massport-Marine Terminal
Economic Dev Industrial Corporation
Boston Harbor
6' SLR

Typical Downscaled and Global Climate Model Resolution

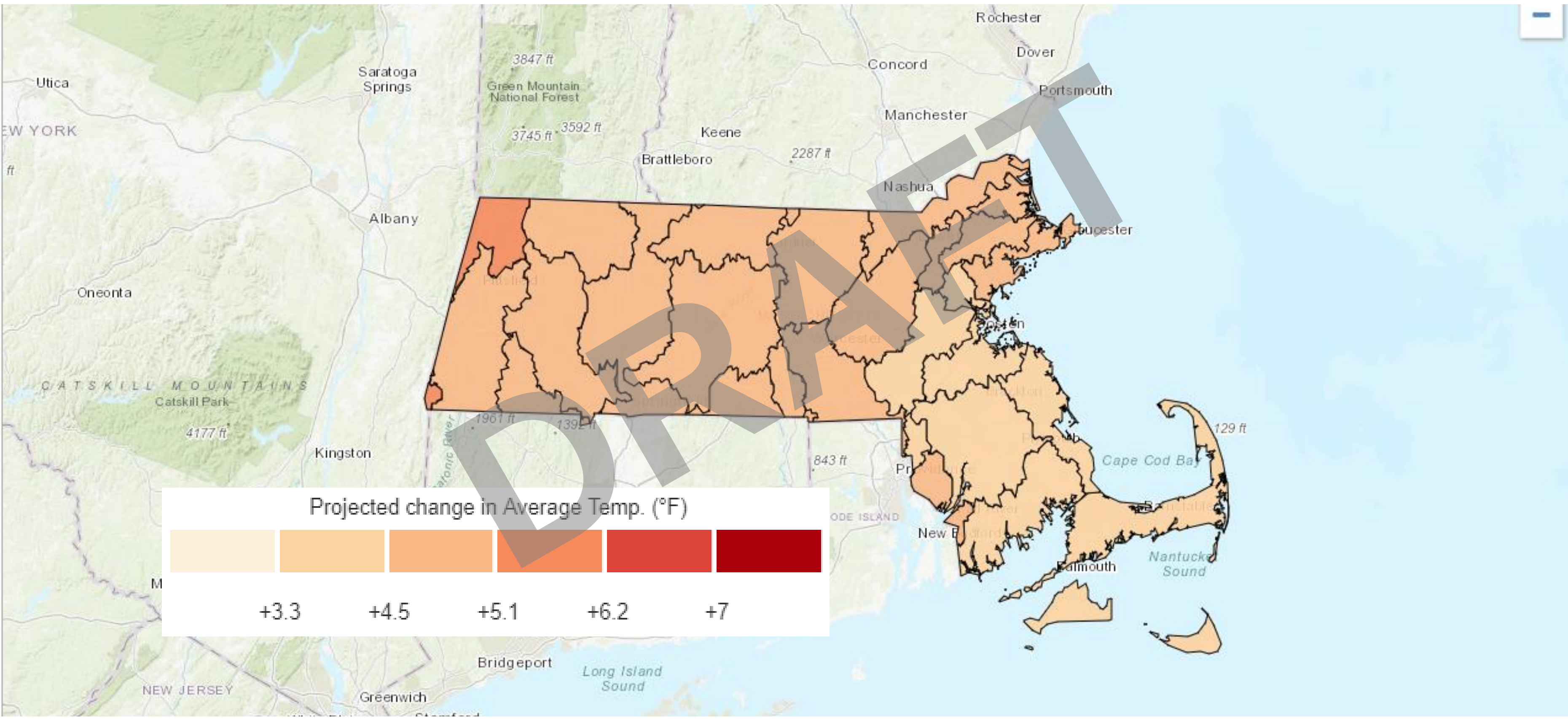


Typical **Global** Climate Model Resolution, **200 km**

Elevation data from PRISM, shown at 200 km and 24 km resolutions. Elevation profile is a key local and regional factor on climate.

Climate Change Indicators by Geographic Scale

2050s Annual Average Temperature Change



HUC-8 Watersheds

State

Climate Data and Planning

- The current and projected trajectory of many changes in climate are clear.
- Local variations are most often within the projected margin of error of climate models. Local variations are usually not practically significant.
- The resolution of climate data is not usually a limiting factor in planning. At the local scale, other factors may play a larger role.

More Precipitation

Total annual precipitation has increased by:

15%

1.2 trillion more gallons **of water equivalent falling on Massachusetts each year.**

~9,700 filled Prudential Towers

Changes are calculated from a linear regression of annual totals from 1895-2015, 1901-2000 reference period.

Source: NOAA

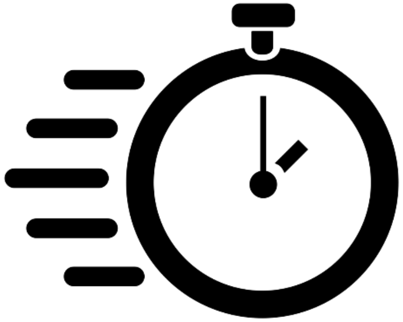
Change in 24-hour, 100-year Design Storms (inches)

	NOAA TP-40	NOAA Atlas 14	Change
Taunton	6.9”	7.7”	**12%**
Boston	6.6”	7.8”	**18%**
Worcester	6.5”	7.6”	**17%**

NOAA Atlas 14: http://hdsc.nws.noaa.gov/hdsc/pfds/

An anecdotal rule of thumb for anticipating changes in extreme precipitation…

Models often project a return period shorter by a factor of 2 to 4.



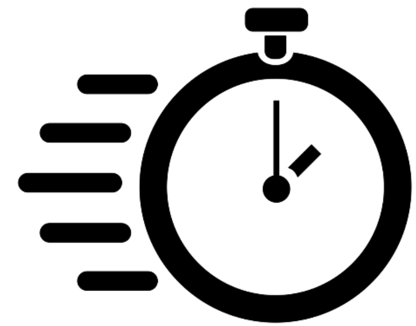
Often:

100-year storm → 25-year storm → 10-year storm

But projections vary place-to-place.

An anecdotal rule of thumb for anticipating changes in extreme precipitation…

Models often project a return period shorter by a factor of 2 to 4.



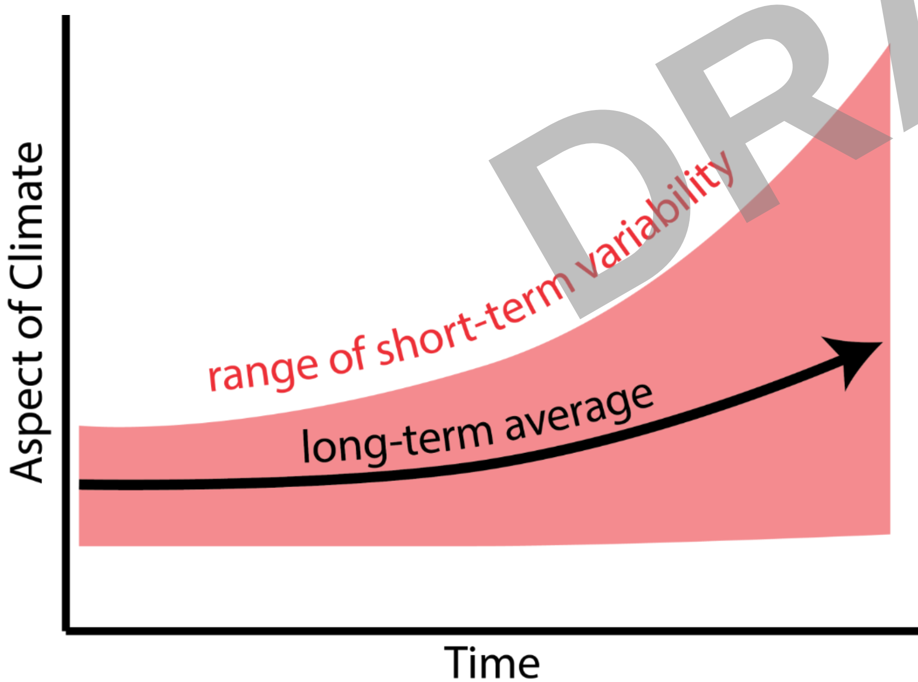
Often:

1% Annual Chance → **4%** Annual Chance → **10%** Annual Chance

But projections vary place-to-place.

Long-term change doesn't rule out shorter-term variability.

Example: Even as average temperatures warm, we will still experience winter storms.



Impact Example: Water Infrastructure
Freeze Vulnerability

Rising winter temperatures reduce spring snow cover.

+

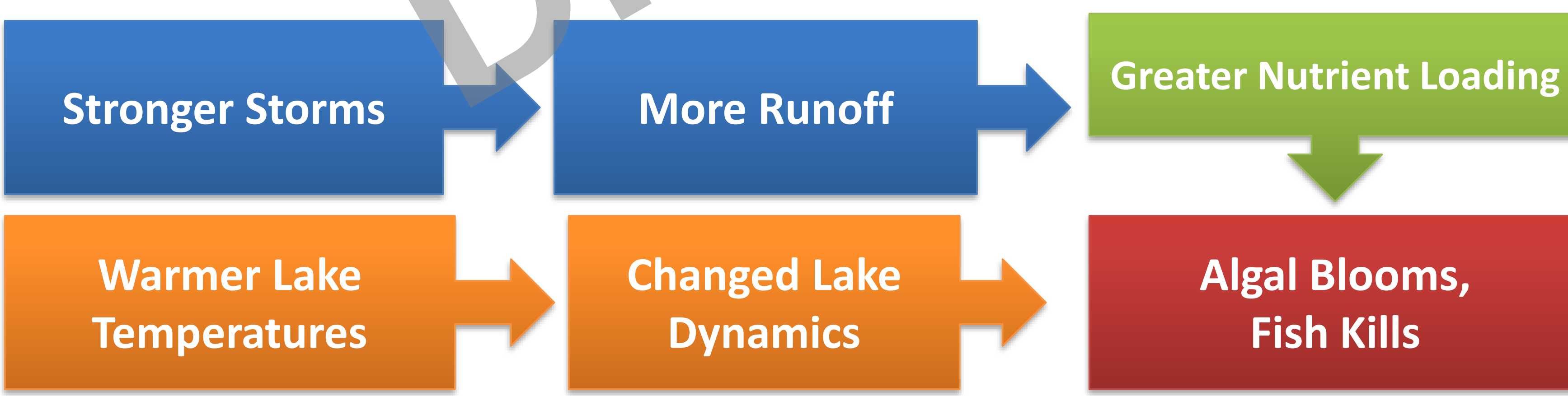
Risk of spring cold snaps remains relatively stable.

=

Increased subsurface freeze risk

Impact Example: Public Health
Algal Blooms

West Monponsett Pond, Halifax, Massachusetts



Suffolk County Projected Changes
(2040-2069)

Annual Average Temperature ↑ **4.9°F**

Days Above 90°F ↑ **19 Days**

Sea Level Rise ↑ **2.4 feet**

Days with >2" Precipitation ↑ **44%**

Source: Northeast Climate Science Center, MassClimateChange.org, Values shown for the Blackstone River Watershed.



NATURAL & NATURE-BASED SOLUTIONS FOR VULBERABILITY REDUCTION & RESILIENCE

The Nature Conservancy

Protecting nature. Preserving life.

Sara Burns

Sara.burns@tnc.org



What We've Learned Today

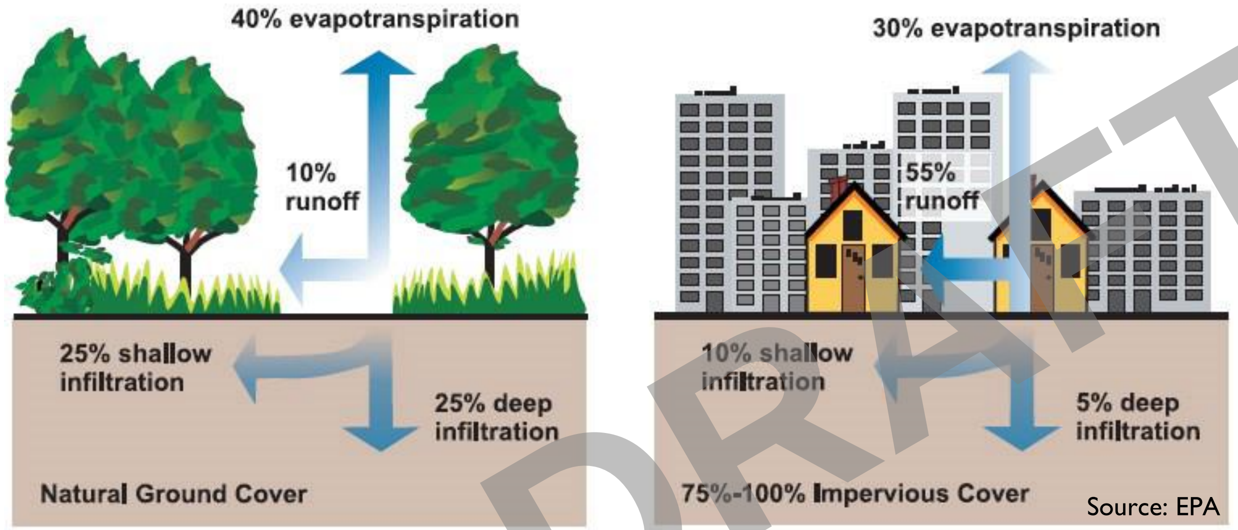
- We are all here to be proactive and find solutions!
- Climate change is already affecting how we experience storms.
- Winthrop is a great place with many strengths and coming challenges.

Key Observed Climate Changes in Suffolk County

Annual Average Temperature	4.9°F
Days Above 90°F	19 Days
Sea Level Rise	2.4 feet
Days with >2" Precipitation	44%

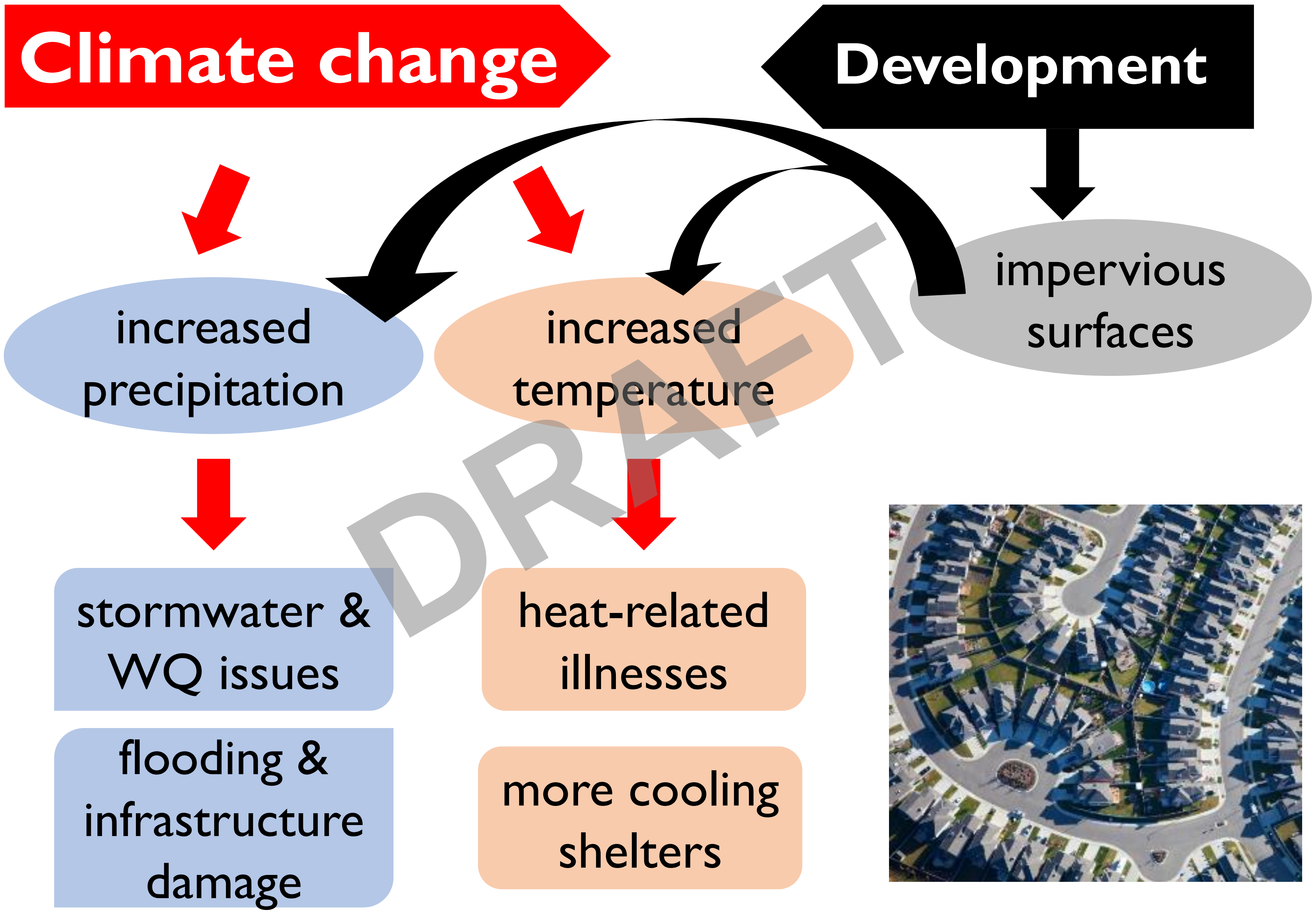
Source: Northeast Climate Science Center, MassClimateChange.org, Values shown for the Blackstone River Watershed.

What’s the problem?



Impervious surface → Runoff →

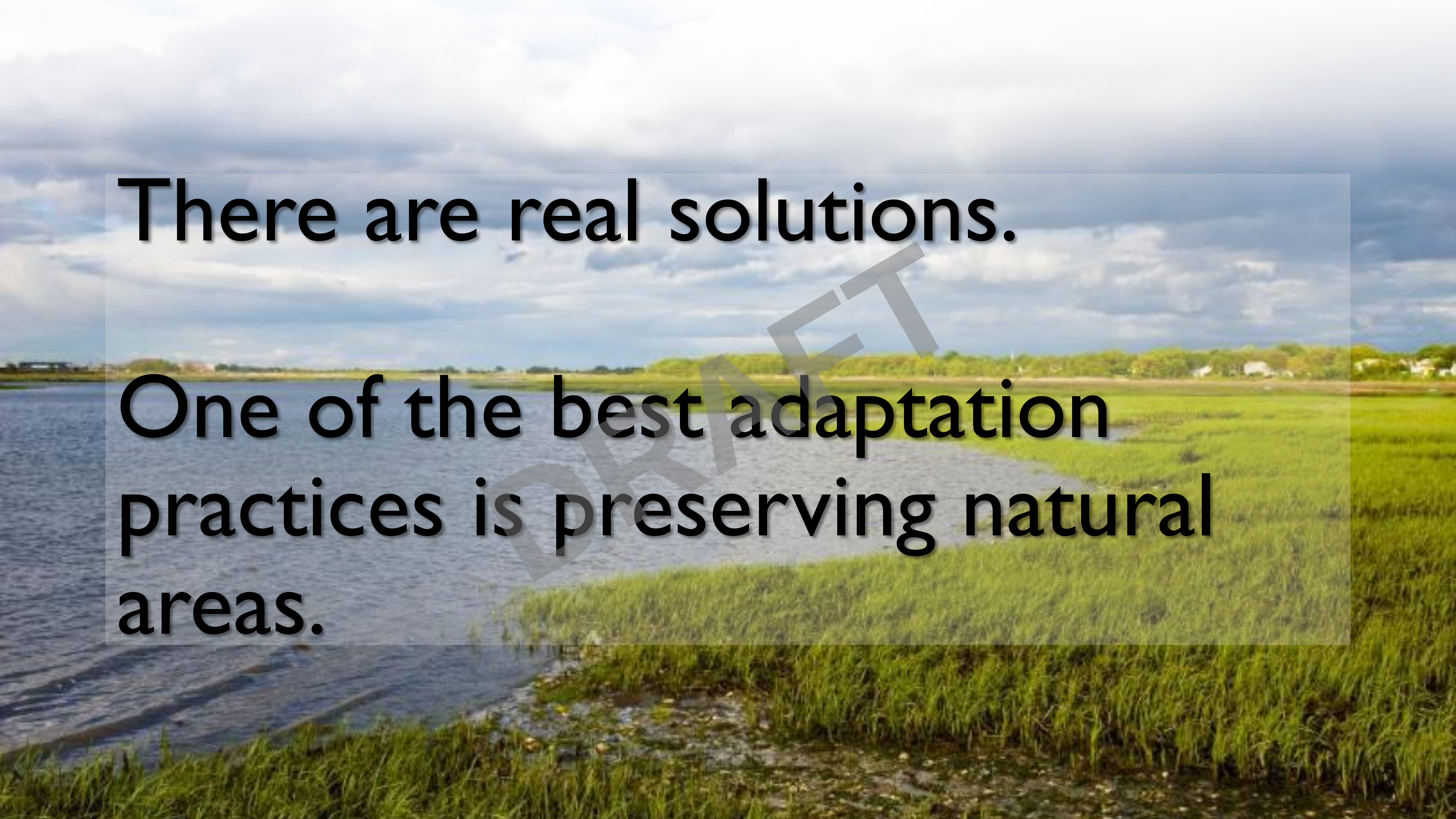
Large lawns → Fertilizer →


Climate change
Development
increased precipitation
increased temperature
impervious surfaces
stormwater & WQ issues
flooding & infrastructure damage
heat-related illnesses
more cooling shelters

Impacts: dry rivers, flooding, algae blooms, erosion, beach closures







There are real solutions.
One of the best adaptation practices is preserving natural areas.
DRAFT

Nature-Based Solutions

Nature-Based Solutions *use* natural systems, *mimic* natural processes, or *work in tandem with* traditional approaches to address natural hazards like flooding, erosion, drought, and heat islands.

Green Infrastructure

Low Impact Development (LID)

Solutions for Every Place

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure design into development

Restore the resiliency of landscapes through LID

Conserve

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure design into development

Restore the resiliency of landscapes through LID

Integrate

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure design into development

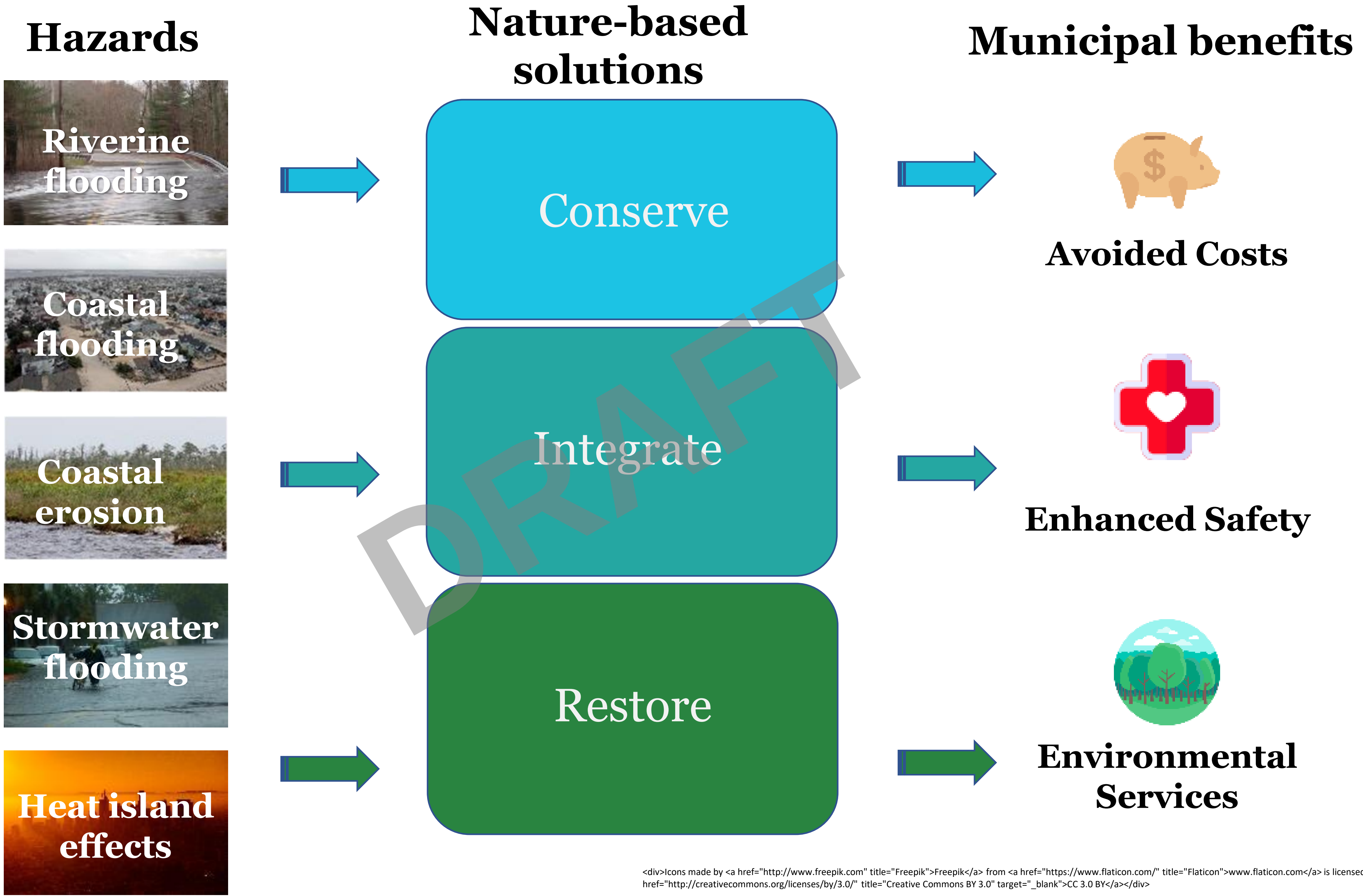
Restore the resiliency of landscapes through LID

Restore

Conserve the natural green infrastructure already providing free ecosystem services

Integrate LID and green infrastructure design into development

Restore resiliency of landscapes through nature based solutions



Hazards
Nature-based solutions
Municipal benefits
Riverine flooding
Coastal flooding
Coastal erosion
Stormwater flooding
Heat island effects
Conserve
Integrate
Restore
Avoided Costs
Enhanced Safety
Environmental Services

Co-benefits

Benefit / Practice	Reduces Stormwater Runoff											Improves Community Livability						
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding	Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO_2	Reduces Urban Heat Island	Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture	Improves Habitat	Cultivates Public Education Opportunities
Green Roofs	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Maybe	Maybe	Yes	Yes
Tree Planting	Yes	Yes	Yes	Yes	No	Maybe	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Maybe	Yes	Yes
Bioretention & Infiltration	Yes	Yes	Yes	Yes	Maybe	Maybe	No	No	Yes	Yes	Yes	Yes	Yes	Maybe	Maybe	No	Yes	Yes
Permeable Pavement	Yes	Yes	Yes	Yes	No	Maybe	Yes	Maybe	Yes	Yes	Yes	No	No	Yes	No	No	No	Yes
Water Harvesting	Yes	Yes	Yes	Yes	Yes	Maybe	No	Maybe	Maybe	Maybe	No	No	No	No	No	No	No	Yes

Yes Maybe No

Source: Center for Neighborhood Technology's The Value of Green Infrastructure

Avoided costs

Land Protection as Water Protection

- Quabbin & Wachusett Reservoirs serve 2.5 million
- Over 20 years, Massachusetts Water Resources Authority spent $130M to protect 22,000 acres of watershed lands
- Avoided ratepayer cost of $250M on a filtration plant and $4M/yr in operations

Avoided Costs

Enhance Safety: Charles River Natural Valley Storage Area. US Army Corps of Engineers

- 8,095 Acres Conserved
- From 1977 - 2016, the project has provided $11,932,000 in flood protective services
- Co-benefits include recreation and natural resource benefits

http://www.nae.usace.army.mil/Missions/Civil-W... ...k-Management/Massachusetts/Charles-River-NVS...

Environmental Services

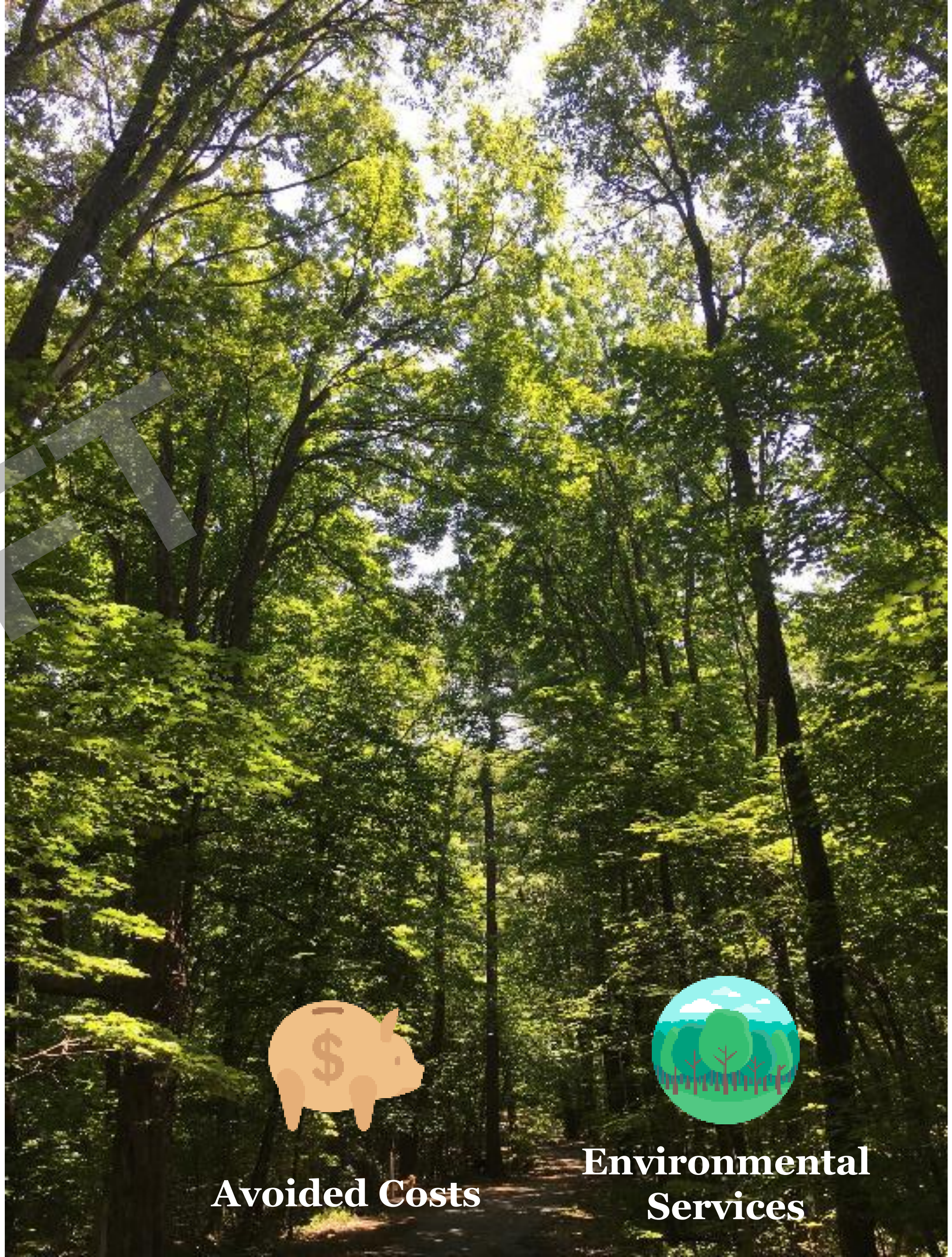
Massachusetts Forests Mitigate Climate Change

- MA forests **sequester 14%** of the state's gross annual carbon emissions
- Average acre stores **85 tons carbon**
- Capacity **increases** over time as forests mature

Environmental Services

Return on Investment Studies in MA
Trust for Public Land

- Outdoor recreation generates:
  - $10 billion in consumer spending
  - $739 million in state and local tax revenue
  - 90,000 jobs
  - $3.5 billion in annual wages and salaries
- Agriculture, forestry, commercial fishing, and related activities generate:
  - $13 billion in output
  - 147,000 MA Jobs
- **Conservation Projects Return $4 : $1 spent**



Return on Investment Studies in MA

Div. of Ecological Restoration

Division of Ecological Restoration

Invested in Nature and Community

Restoration results in

- **12.5 jobs** and
- **$1.75 Million economic output**
- “Restoration economy” in Massachusetts

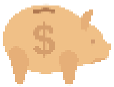
Return on Investment Studies Northeast US
Scientific Reports

- Wetlands saved $625,000,000 in direct flooding damages in New Jersey

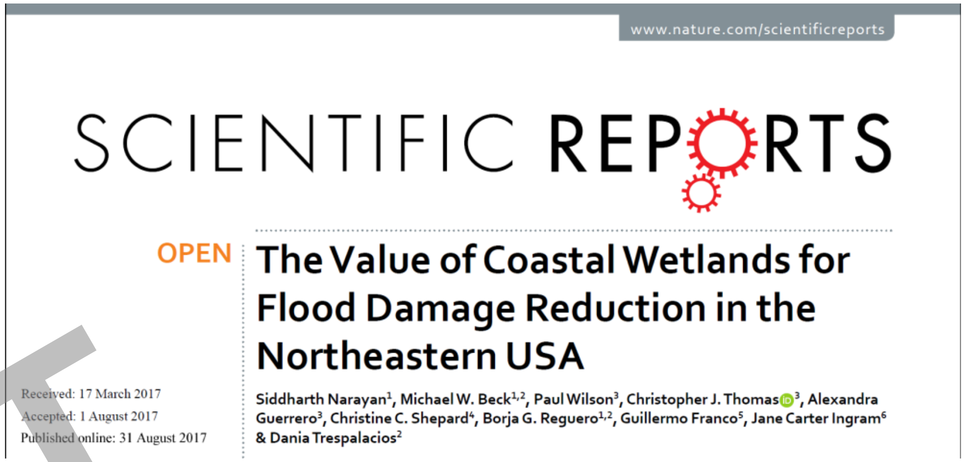
- In New England, wetlands reduce storm damage by approximately 16%

Environmental Services

Enhanced Safety



Avoided Costs



www.nature.com/scientificreports

SCIENTIFIC REPORTS

OPEN

The Value of Coastal Wetlands for Flood Damage Reduction in the Northeastern USA

Received: 17 March 2017
Accepted: 1 August 2017
Published online: 31 August 2017

Siddharth Narayan[1], Michael W. Beck[1,2], Paul Wilson[3], Christopher J. Thomas[3], Alexandra Guerrero[3], Christine C. Shepard[4], Borja G. Reguero[1,2], Guillermo Franco[5], Jane Carter Ingram[6] & Dania Trespalacios[2]

https://www.nature.com/articles/s41598-017-09269-z

Resources for Nature-Based Solutions

Guidance/Case Studies

- Naturally Resilient Communities successful project case studies from across the country to help communities learn and identify nature-based solutions
- EPA's Soak Up the Rain stormwater outreach tools, how-to guides and resources
- EPA's RAINE database of vulnerability, resilience and adaptation reports, plans and webpages at the state, regional and community level.
- Climate Action Tool explore adaptation strategies and actions to help maintain healthy, resilient wildlife communities in the face of climate change.

Mapping/Planning

- Mapping and Prioritizing Parcels for Resilience (MAPPR) ID priority parcels for protection and climate change resilience
- Living Shorelines in New England: State of the Practice and Profile Pages for Solutions are case studies, siting criteria, and regulatory challenges for coastal resilience in New England.
- Low Impact Development Fact Sheets cover valuing green infrastructure, conservation design, development techniques, regulations, urban waters, and cost calculations.

Cost/Benefit

- EPA's Green Infrastructure cost/cost-benefit/tools Database of tools for comparing solution costs
- Massachusetts Division of Ecological Restoration's economic benefits of aquatic restoration based on MA case studies

Bylaws/Ordinances

- EEA's Smart Growth Toolkit access to information on planning, zoning, subdivision, site design, and building construction techniques
- Guide for Supporting LID in Local Land Use Regulations provides a framework for communities to review their zoning, rules, and regulations for a number of factors.

Naturally RESILIENT Communities

http://nrcsolutions.org/

SOLUTIONS 14 Results | **CASE STUDIES** 0 Results

HELP ME CHOOSE

Hazard Types
- Coastal Erosion
- Tidal Flooding
- Coastal Flooding
- Riverine Erosion
- Riverine Flooding
- Stormwater Flooding

Region
- Coastal West
- Great Lakes
- Gulf of Mexico
- Mid-Atlantic
- Midwest
- Northeast
- Pacific Northwest
- Rocky Mountain West
- Southeast
- Southwest

Community Type
- Rural
- Suburban
- Urban

Scale
- Community
- Neighborhood
- Site

Cost
- $
- $$
- $$$
- $$$$

CLEAR ALL

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Coastal Marshes
Coastal wetlands occur along marine, estuarine, and freshwater coastlines and may be…

Beaches and Dunes
Beaches and dunes occur in a variety of shapes, sizes, compositions, and…

Restoring Offshore Features
Restoration is the process of establishing or reestablishing a habitat that closely…

Living Shorelines
Living shorelines are a suite of shoreline erosion control techniques that combine…

Green Roofs
A green roof is a contained vegetated space that is built on top…

Restoring Coastal Features
Natural coastlines have evolved to absorb wave energy and provide a buffer…

Open Space Preservation through Land Acquisition
This strategy focuses on the public acquisition of undeveloped land to lessen…

Moving People Out of Harm's Way: Property Buyouts
Property buyouts are a means by which communities can remove development from…

Daylighting Rivers and Streams
Daylighting rivers or streams is the process of removing obstructions (such as…

Bioswales
Bioswales are an aesthetically-pleasing alternative to concrete gutters and storm sewers, employing…

Waterfront Parks
Waterfront parks are communal recreational spaces that are intentionally designed to be…

Living Breakwaters
Breakwaters are offshore structures designed to limit wave energy by creating a…

Rain Gardens
Rain gardens are planted basins which have several key purposes including, increasing…

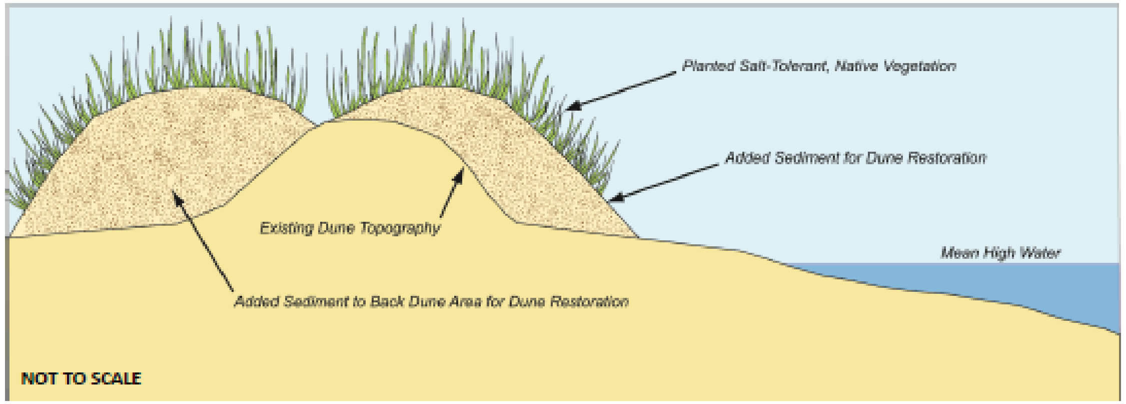
Green Parking Lots
Green parking lots incorporate permeable or semi-permeable paving and porous design techniques…

Dune - Natural

Dune building projects involve the placement of compatible sediment on an existing dune, or creation of an artificial dune by building up a mound of sediment at the back of the beach.[1] This may be a component of a beach nourishment effort or a stand alone project.

Objectives: erosion control; shoreline protection; dissipate wave energy; enhanced wildlife and shorebird habitat.

Design Schematics



Case Study

Ferry Beach, Saco, Maine

Relatively high beach and dune erosion (approximately 3 feet per year) prompted the FBPA to undertake a dune restoration project to help protect roads and homes from flooding and erosion. Given the relatively high erosion rate, it was decided that placing sediment for restoration seaward of the existing dune would be short-lived. A secondary frontal dune ridge landward of the existing dune crest was constructed instead, allowing native vegetation to establish.


Ferry Beach, Saco, ME
Photo courtesy of Peter Slovinsky

Project Proponent	Ferry Beach Park Association (FBPA)
Status	Completed 2009
Permitting Insights	Permit-by-Rule needed from Maine DEP
Construction Notes	An 800 foot long secondary dune was built to 1 foot above the effective FEMA 100-year BFE. A secondary dune was built because erosion of the front dune was considered too high (>3 feet per year) to have a successful project. 1,800 cy of dune-compatible sediment was delivered via truck from a local gravel pit. Construction and planting occurred in early spring. Volunteers planted native American Beach grass.
Maintenance Issues	Sand fencing was used to help trap sediment in the constructed dune, and to help maintain the seaward edge of the original dune. However, shoreline erosion has continued; as of May 2017 the restored dune has started to erode.
Final Cost	$29,000 and volunteer hours
Challenges	Trucking 90 dump-truck loads of sediment through the community. Construction and planting timing windows associated with piping plover nesting. Continued erosion.

Overview of Technique

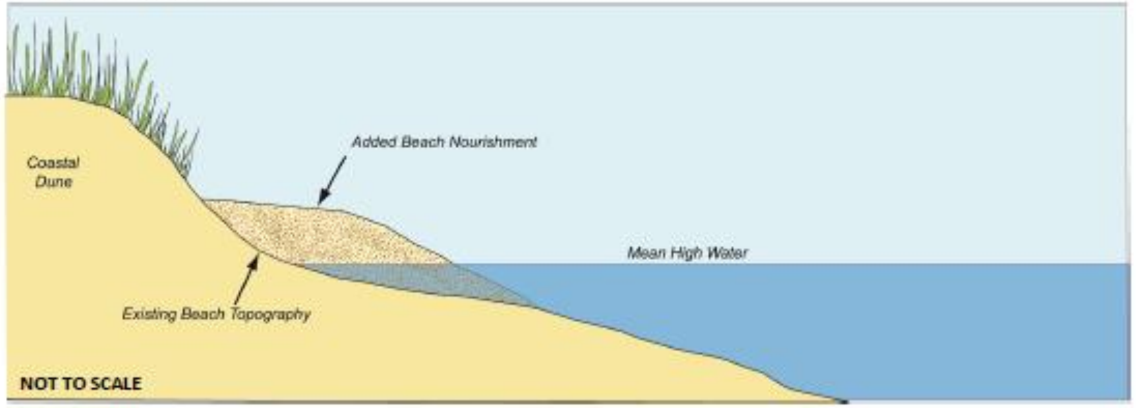
Materials	Sediment is brought in from an offsite source, such as a sand and gravel pit or coastal dredging project.[1] Planting the dune with native, salt-tolerant, erosion-control vegetation (e.g., beach grass *Ammophilia breviligulata*) with extensive root systems is highly recommended to help hold the sediments in place.[1,11] Sand fencing can also be installed to trap windblown sand to help maintain and build the volume of a dune.[1,11]
Habitat Components	Dunes planted with native beach grass can provide significant wildlife habitat.[9]
Durability and Maintenance	The height, length, and width of a dune relative to the size of the predicted storm waves and storm surge determines the level of protection the dune can provide.[1] To maintain an effective dune, sediment may need to be added regularly to keep dune's height, width, and volume at appropriate levels.[1] The seaward slope of the dune should typically be less steep than 3:1 (base:height).[1,9] Dunes with vegetation perform more efficiently, ensuring stability, greater energy dissipation, and resistance to erosion.[10] If plantings were included, plants should be replaced if they are removed by storm or die.[1]
Design Life	Dunes typically erode during storm events. In areas with no beach at high tide, dune projects will be short lived as sediments are rapidly eroded and redistributed to the nearshore.[1] Designs should consider techniques that enhance or maintain the dune (e.g. sand fencing and/or vegetation to trap wind blown sand).
Ecological Services Provided	The added sediment from dune projects supports the protective capacity of the entire beach system (i.e., dune, beach, and nearshore area). Any sand eroded from the dune during a storm, supplies a reservoir of sand to the fronting beach and nearshore area.[1,9] Dunes dissipate rather than reflect wave energy, as is the case with hard structures.[1] Dunes also act as a barrier to storm surges and flooding, protecting landward coastal resources,[9] and reducing overwash events.[10] Sand dunes provide a unique wildlife habitat.[9]
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	Shorter planting and construction window due to shorter growing season. Utilization of irrigation to establish plants quickly. Presence of sensitive species may require design (e.g. slope, plant density) and timing adjustments.

Beach Nourishment

Beach nourishment is the placement of sediment along the shoreline of an eroding beach from outside source. It widens and/or elevates the beach and usually moves the shoreline seaward, increasing the natural protection that a beach can provide against wave energy and storms. This may be a component of a dune restoration/creation effort or a stand alone project.

Objectives: erosion control; shoreline protection; enhance recreation; increased access; dissipate wave energy; enhanced wildlife and shorebird habitat.

Design Schematics



Design Overview

Design Overview	
Materials	Sediment is brought in from an offsite source, such as a sand and gravel pit or coastal dredging project.[1]
Habitat Components	Beaches nourished with compatible sediments can provide significant wildlife habitat.[5,6]
Durability and Maintenance	A coarser sand may erode more slowly than a finer sand.[6] To maintain an effective beach berm, sediment may need to be added regularly maintain the desired beach profile.[6,11] The need to replenish the beach depends upon the rate of erosion at the particular site, but is typically once every 1-5 years.[6]
Design Life	To increase erosion and flooding protection, nourished beaches are frequently built higher and wider than would occur naturally.[11] Grain size (e.g. sand, gravel, cobble) drives appropriate design slopes; gentler slopes generally perform better than steep areas. However, coarser grain sizes allow for steeper project slopes.
Ecological Services Provided	A nourishment beach can provide additional beach habitat area. Added sediment used for the nourishment can also provide a sand source for surrounding areas. The increased width and height of the beach berm can help attenuate wave energy.[10]
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	Beach nourishment sites subject to ice impacts are generally most successfully stabilized with gentler slopes (e.g., 6:1-10:1).[13] Presence of sensitive species may require design (e.g. slope, plant density) and timing adjustments.

Case Study

Winthrop, MA Beach Nourishment

Applied Coastal Research & Engineering, Inc. designed the Winthrop Beach Nourishment Program to provide storm protection to an upland urban area fronted by a seawall originally constructed in 1899. The project utilized 460,000 cy of compatible sediment to nourish approximately 4,200 linear feet and to create the equilibrated designed berm width of 100 feet. Once the beach nourishment was completed in late 2014, the high tide shoreline was pushed more than 150 feet from the seawall, with a gradual slope extending approximately 350 feet offshore.

Winthrop Shores, Winthrop, MA
Photo courtesy of Applied Coastal Research & Engineering

Project Proponent	Massachusetts Division of Conservation and Recreation (DCR)
Status	Phase 1: 2013; Phase 2: 2014
Permitting Insights	Offshore sediment source was denied by Army Corps after a 12-year permitting process. Conservation Permit required from NHESP to address potential impacts to Piping Plovers.
Construction Notes	Upland derived mix of sand, gravel and cobble to match the existing beach sediments was required, where the nourishment was provided from two sources: sand borrow (80%) and naturally rounded cobble & gravel (20%).
Maintenance Issues	Cobble berms have begun forming along the beach, which conflicts with community recreation goals, requiring additional sand for aestheitcs.
Final Cost	Permitting: $2,000,000 (including attempt to permit offshore borrow site. Construction: $22,000,000 (included work on coastal engineering structures).
Challenges	Trucking through the community: urban community with two roads in and out, as well as roadway damage and air quality impacts associated with 16,000+ truck trips. Public perception of compatible sediment.

Revere Beach, MA
Photo courtesy of MA CZM

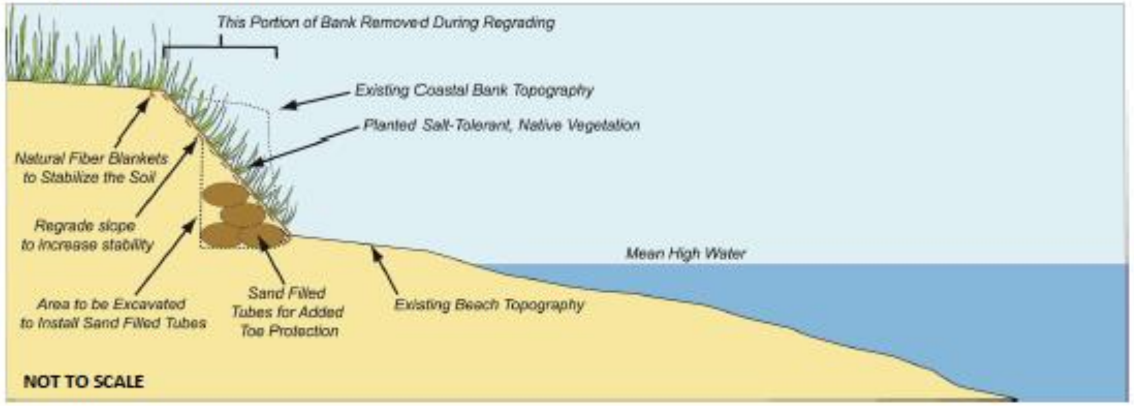
Long Beach, Barnstable, MA
Photo courtesy of MA CZM

Coastal Bank – Engineered Core

Coastal bank protection, including slope grading, terracing, and toe protection and vegetation planting will reduce the steepness and protect the toe of the bank from further erosion. Engineered cores, of sand filled tubes, provide added protection from future bank erosion.

Objectives: erosion control; shoreline protection; dissipate wave energy; enhanced wildlife habitat.

Design Schematics



Case Study

Stillhouse Cove, Cranston, RI

Stillhouse Cove is the site of a public park and a previous salt marsh restoration project that was completed in 2007. Restoration of the coastal bank was initiated after Superstorm Sandy caused extensive erosion which over-steepened the bank and washed fill and soil into the adjacent marsh. Save The Bay and EWPA, working closely with the USDA Natural Resources Conservation Service, developed a design to reinforce and protect the eroding bank by reconfiguring the slope and using natural materials and vegetation.

Construction at Stillhouse Cove, RI
Photos courtesy of Janet Freedman

Project Proponent	City of Cranston, RI, Edgewood Waterfront Preservation Association (EWPA), Save The Bay, Natural Resources Conservation Service (NRCS).
Status	Completed in 2013. Maintained in 2014 (added coir logs and plantings).
Permitting Insights	The project had several iterations but was finally permitted as a Sandy Emergency Assent. An extension was required due to challenges of securing funding within the permit time frame.
Construction Notes	A key component of this project was regrading the bank from a vertical cut to create a more gradual slope. Once the slope was regraded, sand filled coir envelopes were installed, covered with soil and planted with salt tolerant vegetation.
Maintenance Issues	3 coir logs were installed at the southern end of project and planted with warm season grasses as part of the Dept. of Interior Hurricane Sandy Relief Grant Program. The base of the bank will be more frequently inundated as sea levels rise.
Final Cost	Permitting: No permit fee for municipalities Construction: $59,006 plus volunteer labor.
Challenges	Funding and coordination with partners and volunteers.

Design Overview	
Materials	An engineered core could be constructed using coir envelopes, which are coir fabric filled with sand. Cutback/excavated material should be used to fill the coir envelopes but supplemental offsite material may be required. Anchors are necessary to secure the envelopes. Native vegetation with extensive root systems are often used in conjunction with coir envelopes to help stabilize the site. Also, natural fiber blankets can also be used to stabilize the ground surface while plants become established. (Blankets should be run up and down the slope rather than horizontally across it.)
Habitat Components	Because they are made with natural fibers and planted with vegetation, natural fiber blankets also help preserve the natural character and habitat value of the coastal environment.
Durability and Maintenance	A veneer of sand/sediment should be maintained over the sand filled tubes to prolong their lifetime. Regular maintenance, such as resetting, anchoring, replacement, or recovering, can increase the effectiveness of the project.[6] Invasive species management should be incorporated into the project. Runoff management and groundwater will also be crucial to project success.[6]
Design Life	As the sand tube material and natural fiber blankets disintegrate, typically over 5-10 years, the plants take over the job of site stabilization.
Ecological Services Provided	Upland plantings stabilize bluffs and reduce rainwater runoff.[11]
Unique Adaptations to NE Challenges (e.g. ice, winter storms, cold temps)	Shorter planting and construction window due to shorter growing season. Utilization of irrigation to establish plants quickly. Freeze and thaw processes can damage this design. Consideration should be given to the slope aspect and the implications on plant growth and microbiome from shading and sun exposure.

Completed Stillhouse Cove Project (RI)
Photo courtesy of Janet Freedman

Construction at Allin's Cove, Barrington, RI
Photo courtesy of Janet Freedman

SOLUTIONS
10 Results

CASE STUDIES
0 Results

HELP ME CHOOSE

Hazard Types
- Coastal Erosion
- Tidal Flooding
- Coastal Flooding
- Riverine Erosion
- Riverine Flooding
- Stormwater Flooding

Region
- Coastal West
- Great Lakes
- Gulf of Mexico
- Mid-Atlantic
- Midwest
- Northeast
- Pacific Northwest
- Rocky Mountain West
- Southeast
- Southwest

Community Type
- Rural
- Suburban
- Urban

Scale
- Community
- Neighborhood
- Site

Cost
- $
- $$
- $$$
- $$$$

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Regulatory and Policy Approaches to Address Hazards

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Flooding is a natural process that, in the absence of human settlements,...

Planning Approaches to Reduce Natural Hazards

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Flooding is a natural process that, in the absence of human settlements,...

Enhanced Floodplain Mapping

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Flooding is a natural process that, in the absence of human settlements,...

Bioswales

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Bioswales are an aesthetically-pleasing alternative to concrete gutters and storm sewers, employing...

Open Space Preservation through Land Acquisition

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

This strategy focuses on the public acquisition of undeveloped land to lessen...

Urban Trees + Forests

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Urban forestry is the planned installation and management of trees within an...

Rain Gardens

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Rain gardens are planted basins which have several key purposes including, increasing...

Green Roofs

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

A green roof is a contained vegetated space that is built on top...

Green Parking Lots

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Green parking lots incorporate permeable or semi-permeable paving and porous design techniques...

Daylighting Rivers and Streams

Coastal Erosion | Riverine Flooding | Riverine Erosion | Coastal Flooding | Stormwater Flooding | Tidal Flooding

Daylighting rivers or streams is the process of removing obstructions (such as...

MVP Example:
identified intersection that floods?

Bioretention bump outs & street trees can help to…

- capture & filter excess water – alleviate pressure on MS4
- improved pedestrian safety – better visibility, shorter walkway
- enhance aesthetics to encourage visitors & walking

without altering existing parking or bus stops

Environmental Services

Enhanced Safety

Funding

Certified MVP Communities Receive Priority Ranking

- MA Clean Water State Revolving Fund Program (CWSRF)
- MA Office of Coastal Zone Management (CZM)
- MA Department of Agricultural Resources (MDAR)
- MA Executive Office of Energy and Environmental Affairs (EEA)
- MA Department of Environmental Protection (DEP)
- Mass Environmental Trust (MET)

Ten things local homeowners & citizens can do

1. Divert your downspouts

2. Plant a rain garden

3. Replace impervious surfaces

4. Adopt a drain – and encourage others to

5. Don't wash your car in the driveway

6. Pick up pet waste

7. Reduce fertilizer and pesticide use

8. Replace lawn with native plants

9. Reduce lawn watering and mowing

10. Pick up leaf litter (compost/dispose of properly)

Thank you!

Questions!

The Nature Conservancy
Protecting nature. Preserving life.

Sara Burns
Sara.burns@tnc.org

DRAFT

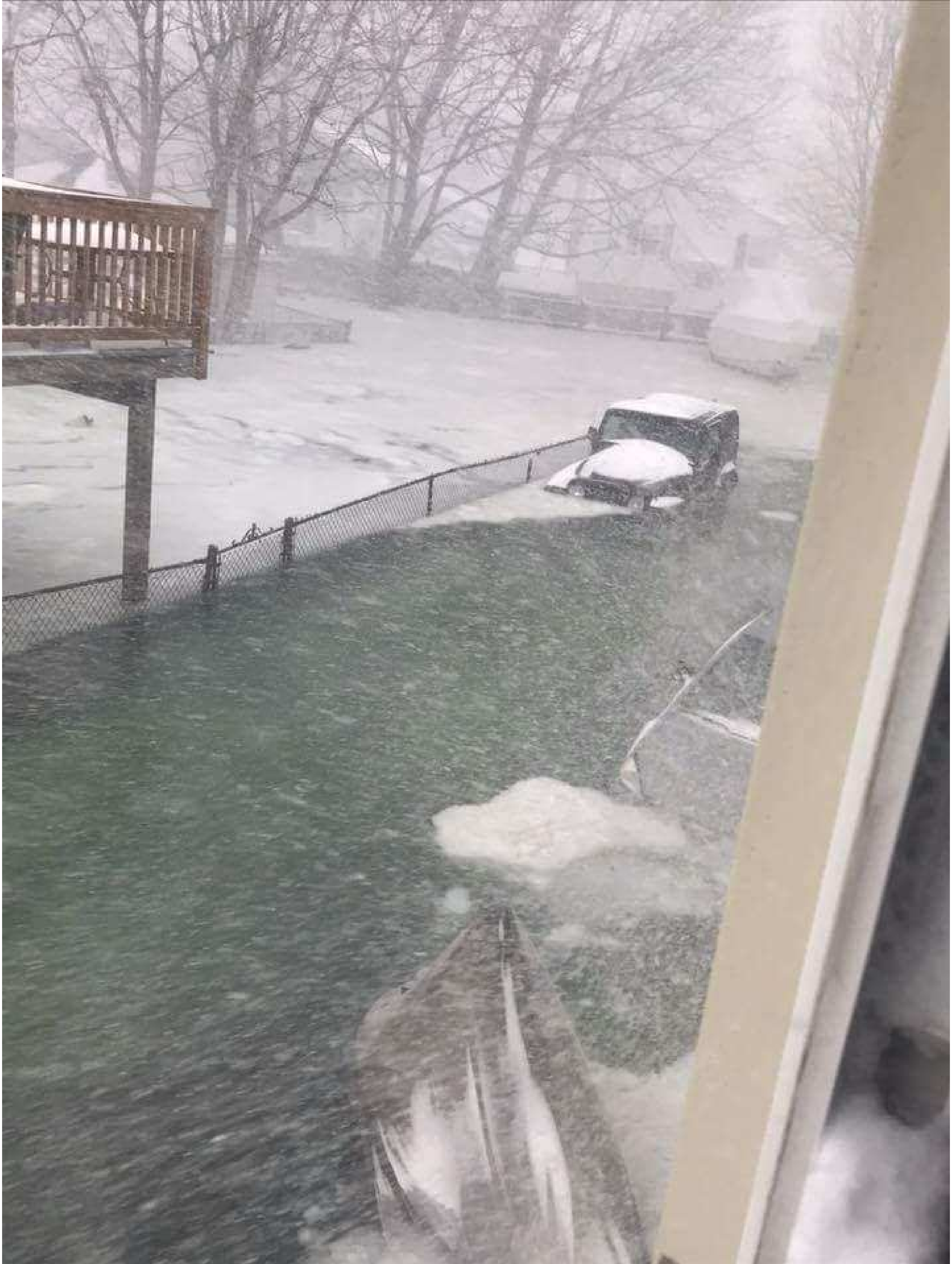
woodardcurran.com

COMMITMENT & INTEGRITY DRIVE RESULTS

ATTACHMENT D: PICTURES OF MORTON STREET DURING WINTER 2017/2018 FLOODING


WILSHIRE


WILSHIRE



ATTACHMENT E: LETTERS OF SUPPORT

The Commonwealth of Massachusetts
MASSACHUSETTS SENATE

SENATOR JOSEPH A. BONCORE
First Suffolk and Middlesex District

STATE HOUSE, ROOM 112
BOSTON, MA 02133-1053
TEL. (617) 722-1634
FAX (617) 722-1076
JOSEPH.BONCORE@MASENATE.GOV
WWW.MASENATE.GOV

Chairman
JOINT COMMITTEE ON HOUSING
AND
JOINT COMMITTEE ON TRANSPORTATION
Vice Chairman
JOINT COMMITTEE ON HEALTHCARE FINANCING

FINANCIAL SERVICES
GLOBAL WARMING AND CLIMATE CHANGE
REVENUE

May 16, 2018

Matthew Beaton
Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Subject: Winthrop MVP Grant Application for Morton Street/Belle Isle Marsh

Secretary Beaton:

Good day, I am writing to you today in support of the Town of Winthrop's application for a Municipal Vulnerability Plan Action Grant in the amount of $182,525, to support the town's efforts to address climate change impacts that are affecting the town's Morton Street neighborhood and the nearby Belle Isle Marsh Reservation.

As the largest remaining salt march in an urban environment, the Belle Isle Marsh is a critical conservation area that needs the town's protection as much as the neighboring residential area. The goal of the project is to increase the resiliency of the marsh complex and the shoreline along Morton Street, by studying the feasibility of incorporating nature based solutions that will make the Belle Isle Marsh more resilient to Climate Change and act as a buffer to the residential area adjacent to it.

The Town requires assistance to complete this project, as it has been unable to raise the funds to address the entire problem at this time. However, the awarding of this grant will allow the Town to take a step forward in increasing the resiliency of the Morton Street area; will assist the Town residents in this area by reducing the flood risk to their homes; and will also reduce costs to the Town by reducing the need to rebuild roads and repair and/or replace vital infrastructure existing in the neighborhood.

Additionally, the project offers the potential for transferability as there are many communities along the shore that have large marsh complexes that are adjacent to both private and public infrastructure. Implementation of this project will provide a guideline for those communities that have similar geomorphology. The alternatives analysis and the conceptual designs developed as part of this project will provide a road map for increasing the resiliency of similar areas around the state.

Best regards,

Joseph Boncore
State Senator
First Suffolk and Middlesex District

CC: Kathleen Theoharides, Assistant Secretary of Climate Change

Friends of Belle Isle Marsh
PO Box 575
East Boston, MA 02128

May 16, 2018

Matthew Beaton
Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Subject: Winthrop MVP Grant Application for Morton Street/Belle Isle Marsh

Dear Secretary Beaton,

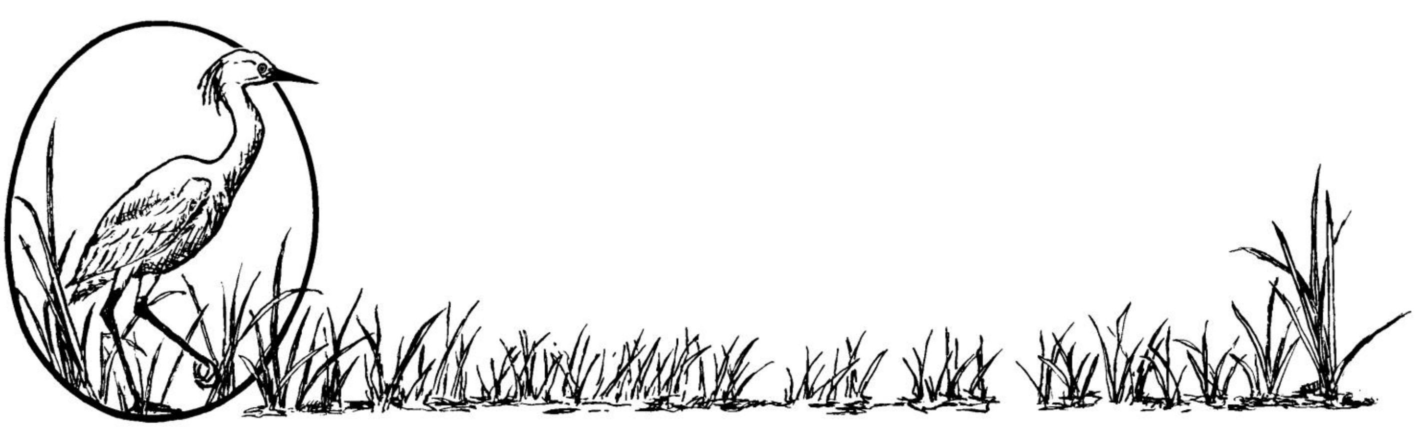
Thank you for the opportunity to express our strong support of the Town of Winthrop's application for a Municipal Vulnerability Plan Action Grant in the amount of $182,525, to support the town's efforts to address climate change impacts that are affecting the town's Morton Street neighborhood and the nearby Belle Isle Marsh Reservation.

As the largest remaining salt march in an urban environment, the Belle Isle Marsh is a critical conservation area that needs the town's protection as much as the neighboring residential area needs protection. Many homes in this neighborhood were severely damaged - for the first time - by flooding in the recent storms of January and March.

The goal of the project is to increase the resiliency of the marsh and the shoreline along Morton Street by studying the feasibility of incorporating nature-based solutions that will make Belle Isle Marsh more resilient to Climate Change and act as a protective buffer to the residential area adjacent to it.

This grant will allow the Town to increase and improve the resiliency of the Morton Street area; will assist the Town residents in this area by reducing the flood risk to their homes; and will also reduce costs to the Town by reducing the need to rebuild roads and repair and/or replace vital infrastructure existing in the neighborhood.

Additionally, the project offers the potential for transferability as there are many communities along the shore that have large marsh complexes that are adjacent to both private and public infrastructure. Implementation of this project will provide a guideline for those communities



Friends of Belle Isle Marsh
PO Box 575
East Boston, MA 02128

that have similar geomorphology. The alternatives analysis and the conceptual designs developed as part of this project will provide a road map for increasing the resiliency of similar areas around the state.

The Friends of Belle Isle Marsh strongly endorses this application and will assist in any way we can. Please contact me if you have any questions.

Sincerely,

Joanne McKenna
President

CC: Kathleen Theoharides, Assistant Secretary of Climate Change

TOWN OF WINTHROP

CONSERVATION COMMISSION

TOWN HALL
WINTHROP, MA 02152-3156
Telephone (617) 539-5821
E-mail: conservation@town.winthrop.ma.us
Web: www.town.winthrop.ma.us

May 17, 2018

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Re: Winthrop MVP Grant Application for Ingleside Park

Secretary Beaton,

I am writing to you today in support of the Town of Winthrop's application for a Municipal Vulnerability Plan Action Grant in the amount of $156,799. This grant will be used to address the vulnerability of Ingleside Park and the surrounding neighborhoods to climate change.

The impacts of climate change have become especially prevalent in this area of the Town of Winthrop. Ingleside Park was historically an area of tidal marsh; it has been filled and is now an excellent recreational asset to the town: a park. The area is also adjacent to Winthrop's Centre Business District, the most important area of economic opportunity for the Town.

Ultimately, drainage into and out of the park needs to be examined and improved. The goal is to explore different channels to divert runoff from the upland areas and/or install methods of interception.

The Town requires assistance to complete this project. This grant will enable the Town to improve the resiliency of Ingleside Park, thus reducing the severe consequences and impacts of flooding of the homes of the surrounding residents, the elementary school, and the infrastructure of the Centre Business District.

Thank you for your time and consideration of this application. If you have any questions, please feel free to contact me at (617) 539-5821 or kcampbell@town.winthrop.ma.us.

Regards,

Kara Campbell, Conservation Agent
Winthrop Conservation Commission

CC: Kathleen Theoharides, Assistant Secretary of Climate Change

TOWN OF WINTHROP

CONSERVATION COMMISSION

Mary A. Kelley, Chairperson
Stephen Machcinski
Brian Corbett
Norman P. Hyett
Karen T. Winn
Michael D. Rinaldi
John D. Trainor
Melissa B. Kaiser, Associate Member
Kara Campbell, Conservation Agent

TOWN HALL
WINTHROP, MA 02152-3156
Telephone (617) 539-5821
E-mail: conservation@town.winthrop.ma.us
Web: www.town.winthrop.ma.us

May 17, 2018

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Re: Winthrop MVP Grant Application for Morton Street/Belle Isle Marsh

Secretary Beaton,

I am writing to you today in support of the Town of Winthrop's application for a Municipal Vulnerability Plan Action Grant in the amount of $182,525. This grant will be used to address the vulnerability of the Belle Isle Marsh Reservation and the surrounding neighborhoods to climate change.

The Belle Isle Marsh is the last remaining urban salt marsh in the Boston region. It is a valuable resource and conservation area that needs to be protected. Ultimately, the resiliency of the marsh and the shoreline along Morton Street needs to be improved. Nature based solutions need to be explored and implemented, functioning as buffers to reduce the negative impacts of flooding from the marsh affecting nearby residences. These solutions will also reduce the need to rebuild roads and repair and/or replace existing vital infrastructure in the neighborhood. Additionally, the alternatives analysis and the conceptual designs developed as part of this project will provide a road map for increasing the resiliency of similar areas around the state.

The Town requires assistance to complete this project. Thank you for your time and consideration of this application. If you have any questions, please feel free to contact me at (617) 539-5821 or kcampbell@town.winthrop.ma.us.

Regards,

Kara Campbell

Kara Campbell, Conservation Agent
Winthrop Conservation Commission

CC: Kathleen Theoharides, Assistant Secretary of Climate Change