Town of Ipswich, MA

Municipal Vulnerability Preparedness Plan

Ipswich, MA. (clockwise), Pavilion Beach & Little Neck (March, 2018); dry Ipswich River streambed one mile upstream of downtown (August, 2016); Ipswich River flooding downtown (May, 2006)

Community Resilience Building Workshop Summary of Findings

March 2019
Prepared for the Town of Ipswich
by the Ipswich River Watershed Association

IPSWICH RIVER WATERSHED ASSOCIATION

Town of Ipswich Community Resiliency Building Workshop

Summary of Findings

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1. Overview

Introduction

In September 2016, Massachusetts Governor Charlie Baker signed Executive Order 569, instructing the state's government to provide assistance to cities and towns to complete climate change vulnerability assessments and resiliency action plans. The goals of the program are for each town and city across the Commonwealth to gather together a diverse group of community stakeholders to:

- Define top local natural and climate-related hazards of concern;
- Identify existing and future strengthen and vulnerabilities;
- Develop prioritized actions for the community;
- Identify immediate opportunities to collaboratively advance actions to increase resilience.

To accomplish these goals, the state's Municipal Vulnerability Preparedness Program (MVP) was launched in 2017. In 2018, the Town of Ipswich applied for and was granted a MVP Planning grant which funded a full day Community Resilience Building (CRB) Workshop on February 5, 2019. The summary of findings from this CRB Workshop and a follow-up Listening Session, held for the public on March 27, 2019, are included within this report.

Background and Need for Workshop

The Town of Ipswich is a unique coastal community along the North Shore of Massachusetts. Approximately 33 square miles in size, there are approximately 13,175 residents living in Ipswich. The Town is predominately forested (41%), while residential, commercial, and industrial development combined make up about 15%. Agriculture in Ipswich also contributes to the town's semi-rural character, and its open fields and farms represent about 10% of the town's land area. The Great Marsh, the largest contiguous salt marsh in New England, including the barrier beaches of Crane Beach and Plum Island, covers 21% of the town. Downtown Ipswich, which includes the majority of the town's infrastructure, is located along the western bank of the Ipswich River which winds through length of town leading to the

ocean at Plum Island Sound. The majority of Ipswich's land area (61%) lies within the Ipswich River Watershed, while the northern 39% of the town falls within the Parker River Watershed.

Like many North Shore communities, much of Ipswich is low-lying, leading to high exposure to sea level rise and flooding hazards. During storms and abnormally high tides, water courses through the Ipswich River, smaller streams and tidal channels, carrying flood waters inland. Culverts and bridges often act as choke points causing tidal creeks to spill out of the marsh into surrounding areas. The natural topography combined with erosion and tidal restrictions lead to chronic and widespread coastal and riverine flooding.

In 2006, the Town experienced its worst flooding in its history during the Mother's Day flood, but increased impacts from both coastal and inland flooding are becoming more and more common throughout the seasons and the years. Additionally, the Ipswich River watershed, including the Town of Ipswich, suffered its worst drought in the history of the region in 2016. The climate projections which forecast changes in precipitation patterns and an overall increase in both temperature and stretches of dry days suggest that these patterns of drought and flooding will only be more problematic for the community in the future.

To address the threats from our changing climate, the Town of Ipswich has taken numerous steps over the last several years to reduce its vulnerability and plan for resilience. Working with the National Wildlife Federation and the Ipswich River Watershed Association, the Town of Ipswich joined the five other coastal towns bordering the Great Marsh (Salisbury, Newburyport, Newbury, Rowley, and Essex) to complete the Great Marsh Resiliency Planning Project in 2015-2018. (These projects were funded by Hurricane Sandy Restoration Funds from the National Fish and Wildlife Foundation.) The final *Great Marsh Coastal Adaption Plan* (www.nwf.org/greatmarshadaptation) was completed in December 2017 and includes a town-specific Vulnerability Assessment for Ipswich, as well as specific adaptation strategies and recommendations for the town and for the region as a whole.

The Great Marsh project also included a thorough review of culverts, bridges, and dams – both coastal and inland – that are vulnerable to climate hazards. The final *Great Marsh Barriers Report*, with identification of vulnerable barriers throughout the town of Ipswich and 28 other

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communities was published by the Ipswich River Watershed Association in February, 2018 (http://www.pie-rivers.org/id_20/).

In 2017 and 2018, the Town's Local Hazard Mitigation Planning Team worked with staff from the Metropolitan Area Planning Council to complete an Update to its Hazard Mitigation Plan. This effort included discussion of where the impacts of natural hazards most affect the Town, goals for addressing these impacts, updates to the Town's existing mitigation measures, and new or revised hazard mitigation measures that would benefit the Town.

While Ipswich has already completed significant work to assess and plan for its coastal hazards, the State of Massachusetts encouraged the community to participate in the MVP program for several additional reasons:

- To use the Community Resiliency Building (CRB) process (www.communityresiliencebuilding.com), the key element of the MVP program, to engage a new and diverse set of stakeholders across the community;
- To assess and evaluate non-coastal (inland), environmental, public health, and societal vulnerabilities and hazards;
- To identify and prioritize immediate opportunities to collaboratively advance actions to increase resilience.

Workshop Planning Team and Core Partners

The Ipswich CRB Workshop Planning Team included municipal staff from the following departments: Planning, Conservation, Police/Emergency Management, Public Works, and Water/Wastewater. Regional partners who joined the planning effort included staff from the Ipswich River Watershed Association (IRWA), the Metropolitan Area Planning Council (MAPC), Mass Audubon, and 8 Towns & the Great Marsh Committee (Mass Bays). The facilitation team included staff from The Nature Conservancy (CT) and Woods Hole Group.

See Page 30 for the complete CRB Workshop Project Team.

The Workshop Process

The Town of Ipswich CRB Workshop was held on Tuesday, February 5, 2019, in Ipswich Town Hall. The day's agenda, attached as Appendix A, is more fully described below.

The Project Planning Team developed the list of invited participants in November, 2018, using local knowledge combined with the suggested CRB stakeholder groups as guidance. An invitation flyer was created and email invitations were extended by email to the selected group by Town Planner Ethan Parsons in early December, 2018. Appendix C includes the list of invited guests and workshop attendees.

Registration began at 8am on February 5th, with a formal welcome by Mr. Parsons at 8:30am. Lead facilitator Kristen Grubbs gave an overview of the workshop, and introductions were shared by all attendees with each other. Ms. Grubbs then gave a PowerPoint presentation, focusing on climate science and data relevant to the Town of Ipswich, as well as a summary of past resiliency planning efforts and outcomes, including the Great Marsh Vulnerability Assessment & Coastal Adaptation Plan mentioned earlier and the Ipswich Hazard Mitigation Plan Update dated November 28, 2018. The presentation included climate change projections and their current and potential future impacts on Ipswich. An overview of general infrastructural, social, and environmental challenges facing the Town due to climate change was provided.

Following the presentation, the full group discussed and answered general questions about the information. Attendees took a short break and then broke into five smaller discussion groups of 8-10 participants, including a small group facilitator and a scribe. Groups were pre-determined by the Planning Team to include a diversity of stakeholders and a gender balance. Following the suggested CRB process, the first task of the small groups was to confirm the Top Hazards for the community and to use a Risk Matrix to identify the vulnerabilities and strengths of the infrastructural, societal, and environmental features of the community.

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During the pre-workshop planning, Ms. Grubbs had consulted with the team of facilitators to explore how best to incorporate the extensive vulnerability planning and assessment that the Town of Ipswich had already completed as part of the Great Marsh Resiliency Planning Project and the Hazard Mitigation Planning, which had just completed in the fall of 2018. The team decided that it made sense to pre-identify the four Top Hazards.

Participants of the Ipswich Community Resiliency Building Workshop, Ipswich Town Hall. February 5, 2019

The five small groups each had multiple materials and resources at their tables to help guide their discussion of their community's vulnerabilities, including:

- Ipswich Critical Infrastructure base map (provided by Woods Hole Group)
- Set of Ipswich maps at 11x17 scale by Woods Hole Group, including: orthophoto, water & sewer infrastructure, dynamic inundation modeling maps (2030 and 2070), open space.
- Set of Ipswich 11 x 17 maps from the Ipswich Hazard Mitigation Plan 2018 Update by MAPC, including: population density, flood zones, land use, hurricanes/tornadoes, local hazard areas.
- Ipswich summary of temperature and precipitation projections from the MA Climate Clearinghouse data set;
- "The Town of Ipswich Healthy Aging Community profile" from the Tufts Health Plan Foundation;
- "Ecological Drought in the Northeast United States" compiled by the Northeast Climate Science Center;
- The Town of Ipswich Vulnerability Assessment excerpted from the *Great Marsh Coastal Adaptation Plan*; and
- Excerpts from the *Town of Ipswich Hazard Mitigation Plan Draft 2018 Update* showing the High Priority Hazard Areas.

After completing the vulnerabilities and strengths of the community's features on the Risk Matrix, the groups took a short break and then moved directly into identifying Community Actions to address the vulnerabilities and/or protect the strengths of each feature. Additional resources were used to identify actions, including:

- *"Regional Adaptation Strategies & Recommendations for the Great Marsh Region" excerpted from *the Great Marsh Coastal Adaptation Plan*;
- "Town of Ipswich Adaptation Strategies and Recommendations for Selected Areas of Concern" excerpted from *the Great Marsh Coastal Adaptation Plan*;

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- "Potential Mitigation Measures" excerpted from the *Town of Ipswich Hazard Mitigation Plan Draft 2018 Update*;
- *National Wildlife Federation's "Sample Guide to Climate Adaptation Strategies"; and
- *The Nature Conservancy's "Guide to Nature-Based Solutions".

** The asterisked items are included in Appendix D.*

After actions and strategies to address infrastructural, environmental, and societal vulnerabilities had been compiled, groups began the process of prioritizing the actions and choosing their top actions.

Following a lunch break, participants reconvened in a large group and a representative of each small group reported out to the full workshop, presenting a brief summary of their group's discussion and describing the prioritized actions. The workshop facilitators recorded each group's top actions onto posters, grouping like actions with like among the groups' conclusions.

To facilitate further prioritization, participants were then given three sticky dots and asked to "vote" on the highest priority actions by placing dots on their top choices for action. This sticky dot voting resulted in creation of a final prioritized list of actions, with the most dots determining the highest priority.

Finally, the large group discussed the results and concluded with a list of agreed-upon actions that the Town of Ipswich should embark upon to increase the resilience of the community in the face of anticipated climate change impacts. The Town Planner concluded the workshop with some remarks summarizing the recommendations and describing next steps for the community, and the workshop was adjourned.

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2. Top Hazards

To determine the Top Hazards to be considered during the CRB process, the Town of Ipswich relied heavily on the extensive previous planning it has completed over the past few years: specifically using the assessments of hazards from the *Great Marsh Coastal Adaptation Plan* (December 2017) (https://www.nwf.org/greatmarshadaptation), the *Great Marsh Barriers Report* (February 2018) (http://www.pie-rivers.org/id_20/), and *Town of Ipswich Hazard Mitigation Plan Draft 2018 Update* (insert hyperlink). These documents extensively explored the following issues:

- What hazards have impacted Ipswich in the past? Where, how often, and in what ways?
- What hazards are impacting the town currently? Where, how often, and in what ways?
- What hazards will impact the town in the future?
- What's exposed to hazards and climate threats within your community?

As described within the aforementioned documents, Ipswich is highly exposed and increasingly sensitive to several natural hazards that will be affected by climate change. As is true for most coastal communities in Massachusetts, the hazards are numerous and include coastal flooding from Nor'easters, winter storms, king tides, and sea level rise; hurricanes and heavy wind; beach and riverbank erosion; freshwater flooding caused by severe precipitation events, improperly-sized culverts, and other hydro-barriers; and extreme heat and drought that can cause brush fires, water shortage and stress, and other public health impacts.

The *2018 Ipswich Hazard Mitigation Plan* summarized the Town's highest hazards risks as flooding, Nor'easters, winter storms/blizzards, brush fires/extreme temperatures, and coastal hazards. (See Table 5 in Ipswich 2018 Hazard Mitigation Plan Update).

The Town of Ipswich Vulnerability Assessment, completed as part of the *Great Marsh Coastal Adaptation Plan*, found that approximately 27% of the town is vulnerable to coastal inundation, depending on the severity of the storm. That number climbs to 30% in 2070. That report also concluded that Ipswich has high exposure to coastal flooding, riverine flooding, and erosion due to its topography, hydrology, and geographic location. Plum Island and Crane Beach face the open ocean and are highly exposed to wind, wave action, and sea level rise – with no buffering landmass to diminish these hazards. Interior portions of Ipswich rely on these barrier beaches to buffer the worst storm effects, however the extensive number of tidal creeks

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and channels, combined with the overall low topography, can lead to widespread inland flooding – such as what occurred during the now infamous Mother's Day Flood of 2006 and the March 2010 Flood. Both floods set record high peak water flows and caused widespread damage to homes, business, and bridges in Ipswich.

The beaches in Ipswich have high exposure to erosion, particularly Plum Island (the tip of which is in Ipswich) and Crane Beach. The Trustees of Reservations' Crane Beach is one of the town's most important recreational areas and draws over 250,000 users annually—both locals and visitors. These barrier beaches are the first line of defense against storm surge and sea level rise. In their unprotected locations, the continuous impact of waves and wind has led to significant erosion. Large storms can also cause acute erosion events where large sections of beach are completely swept away. Additionally, both Clark Beach and Pavilion Beach, located on Great Neck, have high exposure to sea level rise and storm surge. The headlands of Great Neck and Little Neck are exposed to storms and have significant vulnerability to erosion. Major bank armoring occurred to Great Neck following the "No Name Storm" of 1991, and armoring occurred on Little Neck following erosion in 2013. Armoring of the coastline seems to have impacted Clark Beach and Pavilion Beach by disrupting the natural flow of sediment and by deflecting wave energy towards the beach, exacerbating existing erosion.

In Ipswich, economic sensitivity to climate hazards is intrinsically linked to the sensitivity of the town's natural systems. Ipswich is the largest shellfish producer in Massachusetts. In 2010, a total of 1.5 million pounds of shellfish were commercially produced in Ipswich. This harvest equated to about $2 million in total value and had an estimated economic impact in the area of $8 million. The shellfish industry in Ipswich is directly tied to the health of its coastal areas. For example, since the 1970s red tide has shut down the town's shellfish beds for parts of most years. Shellfishing areas in Ipswich are also known to close after most significant storm events as runoff, carrying fecal coliform and other pollutants, washes into the creeks and marshes.

Over 1,500 acres of intertidal land are contained behind Ipswich's barrier beaches. Together, these habitats make up 39% of the Parker River/Essex Bay's Area of Critical Environmental Concern (ACEC), as designated by the Massachusetts Executive Office of Environmental Affairs.270

Barrier beaches in Ipswich are becoming increasingly sensitive to climate hazards, especially erosion. Based on a recent analysis completed by the Coastal Erosion Commission and

presented by CZM, Sandy Point Reservation, located on the southern tip of Plum Island in Ipswich, had the highest erosion rates along the North Shore, with an average beach loss of 5.0 feet a year (data collected between 1970 and 2009). During this same time period, Crane Beach experienced the second highest rate of erosion with a loss of 1.4 meters (4.6 ft) a year.274 With rising seas and increased storm activity, erosion and its associated impacts are likely to worsen for this community already sensitive to climate-driven impacts.

In addition to coastal flooding, riverine and inland flooding is a concern for Ipswich. According to the Town's Hazard Mitigation Plan, flooding, caused by hurricanes, northeasters, intense rainstorms and thunderstorms, is the most prevalent and serious natural hazard in the community. Most flooding in Ipswich has historically occurred upstream of the Ipswich Mill Dam located in the Downtown area. However, over the last several decades, development throughout the upper Ipswich River Watershed has resulted in an increase in impervious surfaces. As a result, during large storm events the stormwater storage capacity throughout the Ipswich River Watershed becomes easily overwhelmed and results in more widespread flooding.

The *Great Marsh Barriers Report* assessed a total of 103 structures in Ipswich, including 5 dams, 56 non-tidal crossings, 17 tidal crossings, and 25 coastal stabilization structures. The assessment focused on culverts that are barriers to the natural flow of streams and rivers. The screening tools identified those structures that are less likely to function properly during high flows due to being undersized relative to the upstream watershed or mismatched to the natural stream bed. With climate change bringing more extreme precipitation events to the northeastern United States (more frequent storms with larger amounts of rainfall), causing higher and heavier volumes of stormwater runoff, the impact of inland flooding on infrastructure, as well as the society, will become even more significant for Ipswich.

Additionally, predictions of temperature changes resulting from climate change show that both extreme cold in the winter and extreme heat in the summer will be in Ipswich's future. The winter of 2018 brought record cold temperatures in January. Winter Storm Grayson on January 4, 2018, was one of the most intense western Atlantic winter storms in decades, clobbering the East Coast with blizzard conditions and major coastal flooding. High winds triggered power outages, white-outs, and road closures throughout the North Shore, including Ipswich.

The summer of 2016 saw "extreme drought conditions" for the first time in the Massachusetts Drought Monitor's record. Currently, the Town of Ipswich sees 6.88 days with temperatures over 90 degrees F; by the end of the century there may be as many as 11 to 55 more days over 90 degrees. In addition, the projected change in annual consecutive dry days goes from 16 to nearly 20 days (MA Climate Change Clearinghouse).

Using all of this extensive previous work and current data from the MA Climate Change Clearinghouse to identify the town's past, current, and future hazards, the Core Planning Team determined the following top hazards for the town. These Top Hazards were confirmed and endorsed by the CRB attendees during the workshop.

Top Hazards for the Town of Ipswich:

- **Coastal Storm Surge & Sea Level Rise**
- **Inland Flooding**
- **Extreme Cold/Winter Storms**
- **Heat/Drought/Fire**

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3. Top Areas of Concern

During the Ipswich Community Resiliency Building Workshop, participants overwhelmingly agreed that the top areas of concern included the following areas.

1. Water Supply & Infrastructure, including aging infrastructure; deteriorating water quality; vulnerability to sea level rise and flooding; increasing community demand; lack of drought resiliency.

The Ipswich River Watershed, which includes all or part of 22 communities in northeastern Massachusetts, has a population of approximately 160,000 people and supplies municipal water to approximately 350,000 people (EOEA, 2003). The Ipswich Basin has been studied for decades, as perennial low flow conditions in the summer both challenge the reliability of smaller, primarily groundwater, supply systems that rely on winter and spring replenishment, and also negatively impact the river and its ecosystem. The Town of Ipswich, located at the mouth of the Ipswich River, serves a population of approximately 13,200 with a combination of ground water and surface water sources. Water use in town over the past five years averages 370 million gallons/year, which is supplied by sources in both the Ipswich and Parker River Watersheds.

Over recent years, the Town of Ipswich has faced significant impacts from the persistent low flow and irregular precipitation conditions; in particular, the Town's public drinking water supply is extremely vulnerable to drought. During the Massachusetts Drought of 2016, the heart of the most extreme drought area was the northeast region, specifically, the Ipswich watershed. The Town of Ipswich declared an "Emergency" (Stage 5) drought, and the Massachusetts Department of Environment Protection (MassDEP) issued a Declaration of State of Water Supply Emergency to limit all non-essential water usage in the Town and allow for pumping of water sources in excess of permitted levels. This drought exemplified the reality that the greatest concern of drought is typically between June and September – just the same time when public water usage is highest.

Over the next 20 years, the population of the Town of Ipswich is estimated to increase by about five percent. Meanwhile, the changing climate brings the threat of more severe impacts

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in the future, which will affect water supply as well as other natural and community resources. Climate trends are likely to bring longer stretches of dry days and higher summer temperatures, thereby reducing summer flows and bringing more drought conditions. Heavier downpours falling in shorter time periods will cause more floods when it rains—even in the midst of droughts. Drought may impact both public water sources and private wells. Sea level rise may cause saltwater intrusion to private and public wells that are located in low-lying coastal areas.

Across Massachusetts, the combination of precipitation deficits and high temperatures plus water use increase and land use change has caused new record low streamflow and groundwater levels in recent years. These changes have already been documented and more changes are projected. (http://resilientma.org/sectors/water-resources)

Faced with current and future changes to climate conditions, and in order to fully accommodate future growth and development in the 14 communities that depend on Ipswich river water, it is critical that Ipswich take steps to make existing supplies more sustainable under the threats of climate change, and to reduce existing water use to the maximum extent possible, especially during periods of lower water availability.

2. Environmental Resources, especially the Great Marsh

As described in the earlier Top Hazards section, The Great Marsh is a critical component of the natural resources of the Town of Ipswich and is under significant threat from climate change, including sea level rise, coastal storm surge, erosion, and non-point source pollution. Marshes provide water filtration services, storm surge reduction, erosion control, and are home to numerous rare and threatened species. However, because this habitat is so low-lying and tidally influenced, the vast majority of critical marsh in Ipswich may become inundated under just one foot of sea level rise, and researchers have already taken notice to areas within the Great Marsh that are being degraded by standing water as a result of excessive flooding and poor drainage. Furthermore, due to coastal development at the marsh's edge, coastal ecosystems may not be able to migrate inland as sea levels rise, leading these important habitats to disappear under water. These changes will likely impact the community in many

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ways, including direct impacts on the important commercial and recreation fish populations present in the ocean, estuaries, ponds, and streams of Ipswich.

In particular, the habitat used by shellfish is quite vulnerable. Intertidal mud flats, sandy estuarine environments, and sea grass beds are all likely to suffer under the added strain of climate-driven threats. Sea level rise may permanently inundate clam flats, converting once productive harvesting areas into unsuitable habitat devoid of shellfish. Erosion also threatens to further shrink these estuarine environments so important to shellfish.

Changes in precipitation and sea level rise will also alter the balance between freshwater and saltwater in the Ipswich River and its tributaries. Development combined with an increase in severe storm activity will likely lead to an increase in surface runoff quantities and rates. Storm runoff carrying bacteria, pathogens, and nutrients can be extremely damaging to the diversity of habitats and species found within the Ipswich River Watershed. Currently shellfish harvesters lose millions of dollars annually due to stormwater contamination.

The beaches of Ipswich, including the southern tip of Plum Island, Pavilion Beach, and Crane Beach, are heavily impacted by coastal storms and other dynamic processes.

Pavilion Beach, located between Great and Little Neck, is the only public beach in Ipswich and as such is highly valued by the community. The mixed cobble and sand beach experiences frequent erosion as well as coastal flooding from storms. When tidal surges overtop the beach, the flooding can isolate Little Neck from the mainland, bringing piles of sediment along with the water. The community on Little Neck has historically consisted primarily of summer homes, but recently many of the houses have converted to year-round residences. At a three-meter storm surge, Pavilion Playground and Park, located on the north and west side of the access road to the beach (Little Neck Road) becomes beachfront: the public beach will be underwater, homes on Little Neck will have their access to the mainland cut off, and large portions of Little Neck Road will be flooded. Due to the location of Pavilion Beach, just off the southern tip of Plum Island (Sandy Point), it is likely that sand movement from Sandy Point affects sediment on Pavilion Beach – a topic that needs more study. Armoring of the coastline of both Great Neck and Little Neck seems to have impacted Clark Beach and Pavilion Beach by disrupting the natural flow of sediment and by deflecting wave energy towards the beach, exacerbating existing erosion.

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Crane Beach is a 5-mile barrier beach that stretches from the Ipswich River southeast to Essex Bay. Ipswich's significant tourism-based economy relies heavily on this beach. However several times a year, flood waters, coming around the back side of the beach through the marshes, can close Argilla Road and even flood the beach parking lot. A recent culvert upgrade was designed to alleviate some of this flooding. The beach itself provides significant flood protection to 1,500 acres of salt marsh and nearly 2,000 acres of dunes and beaches. As the beach erodes during storm events, there is reduction of its protective services of the infrastructure located behind it, including Ipswich and also the neighboring community of Essex.

Inland wetlands, streams, lakes: Ecosystem services of these important natural resources in Ipswich are being compromised by stormwater pollution from development, improperly-sized culverts, and expansive beaver activity that increases flooding and impacts infrastructure. Climate impacts including heavier and more frequent precipitation and storms will stress inland streams and wetlands, bringing scouring, erosion, and increased pollution. All aspects of the hydrology of the community, including stream flow and below-ground water supplies, will be affected by longer periods of dry days and overall drought.

3. Wastewater Infrastructure

The Town Wharf Sewage Pumping Station, the sewer interceptor and siphon, and the exposed sewer main located along the bank of the Ipswich River were identified as areas of major concern.

The pumping station is located in the parking lot of the Town Wharf, and the sewer main runs from downtown along the Riverwalk trail and the bank of the Ipswich River, behind Town Hall, and down Water Street to the pumping station. The pump station handles 100% of the wastewater in the community and is subject to 1% annual chance of flooding according to FEMA flood zones. It is also likely to be completely inundated by a modest sea level rise of 1 foot. According to the analysis using inundation modeling by Woods Hole Group, the sewage pumping station is likely to suffer significant flooding during storms – both present day and in 2070. A present day, 1% or 0.2% storm (roughly equivalent to FEMA's 100 or 500-year storm) would likely flood 63-74% of the area with between 1-20 feet of water. By 2070, a 1% or 0.2%

storm would likely flood as much as 91% of the area with between 5-20 feet of water. (See *Great Marsh Adaptation Plan* for more detail.)

Flooding of this site could cause extensive damage to the electrical equipment inside the pumping station. It would be a major health risk if the sewer main and station were to be inundated. Overflow of untreated sewage into the Ipswich River and its associated salt marsh would present an environmental risk to humans and a diversity of natural resources. In addition, workshop attendees raised concern about the location of the wastewater treatment plant outfall. Treated effluent is discharged to Greenwood Creek which is part of the Great Marsh. Increased precipitation and storms could overwhelm the system, potentially leading to contamination of the salt marsh as well as health and safety impacts to the nearby neighborhoods.

The exposed sewer interceptor and siphon are located along and beneath the river near the Choate Bridge in downtown and are. All of these issues are currently the subjects of further analysis and planning by the Ipswich Water & Wastewater Department.

4. Land Use

Ecosystem services related to the important natural resources and community features identified throughout the workshop are being compromised by current land use trends. Development and redevelopment continues at a regular pace in town, with several recent multi-unit projects before town boards. Stormwater pollution from increased impervious surfaces continues to be a concern.

To address these land use challenges, the Town of Ipswich is engaged in its own discussion of water needs, climate impacts, and resiliency. Recent discussions have extended beyond the municipal Water Department and the Board of Water Commissioners—to Select Board, Planning Board, and Zoning Board meetings, and to town social media discussion boards. Large subdivision and development proposals currently under review by the Boards are shining a light on the town-wide concern about expanding water use, with some vocal individuals advocating for a building moratorium. In 2017, the Town took an important step to address community water use by passing a water restriction bylaw, establishing restrictions on

private well usage consistent with those on the municipal supply. However, overall water usage in town is up slightly in recent years.

As the Town evaluates the limited opportunities to improve its resiliency, it recognizes that tools and regulations must be reviewed and expanded to better control water use and environmental impacts, so the community can sustain future residential growth and economic development.

5. Electricity & Communications

The town has its own municipal Electric Light Department which manages distribution lines throughout the town. However, power outages due to winter snow storms and wind events can cause widespread power outages across Ipswich and the region. The workshop discussion drew significant attention to the risks to the power grid from future severe weather events.

6. Public Safety & Transportation/Roads

Because of the fact that a significant amount of the infrastructure in Ipswich is located in low-lying areas that currently flood, transportation corridors, including roads and bridges, will be even more susceptible to flooding from storm surge, sea level rise, and increased heavy precipitation as the climate changes. Because of this reality, the safety of many areas in town was a significant topic of discussion during the workshop, including but not limited to the following specific locations.

Overall 43% of Ipswich falls within the FEMA 1% flood zone (the "100-year" flood zone), including the Ipswich downtown, the economic center which includes a major transportation corridor (Route 1A), as well as numerous businesses and restaurants. According to the USGS analysis using inundation modeling by Woods Hole Group, a significant portion of **Downtown Ipswich** may flood with between 1-20 feet of water during a present-day 1% or 0.2% storm (roughly equivalent to a FEMA 100 year and 500 year storm). By 2070, much of downtown would likely flood during a 1% or 0.2% storm; flood depths would range from 5-20 feet of water.

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As mentioned earlier, the Ipswich River emanates 35 miles to the west of the town and flows to the downtown area, where it meets the **Ipswich Mills Dam** at the head of the tidal estuary. If the dam (owned by the town) were to fail, there would be significant risk of downstream flooding and erosion. Currently the dam acts as an impoundment, contributing to upstream flooding by reducing upstream flood storage capacity. The Town is underway with the Ipswich Mills Dam Removal Feasibility Study to analyze the feasibility, cost, and effects of removing the downtown dam, including any impacts downstream. Removal of the dam may significantly reduce flooding upstream through restoration of floodplain storage capacity and reduce risk of flooding downstream in the event of dam failure.

Also near the downtown is the **Choate Bridge** which carries Route 1A/South Main Street over the Ipswich River. It is the oldest stone arch bridge in the United States, and is one of several sites in Ipswich with important historic and architectural value. The Choate Bridge carries traffic traveling to and from downtown along Route 1A, and receives an average of 17,000 cars daily. The bridge is subject to 1% annual chance of flooding according to FEMA flood zones and is highly vulnerable to increased storm activity and riverine flooding. (See *Great Marsh Adaptation Plan*.) The narrowing of the river's channel at this site exacerbates flooding around the bridge. The volume and velocity of the river during large storm events can cause significant erosion of the surrounding river bank that supports the bridge foundation.

Jeffrey's Neck Road is extremely susceptible to flooding from coastal storm surge events and white-out closures during blizzards. Closure of this road presents a major public safety concern because it isolates over 1,200 (winter) residents living on Great Neck and Little Neck. A modest increase in sea level rise of 2 feet will make these residents and nearby developments even more vulnerable to both surface water inundation and saltwater intrusion, which can contaminate private wells and underground freshwater supplies. The Town of Ipswich is already addressing some of these concerns with FEMA funding to support the design phase of raising the portion of Jeffrey's Neck Road from Island Park to Eagle Hill. The DPW staff predicts this work will reduce road flooding to one or two times a year, and even during flood events the road would likely remain passable to emergency vehicles with higher clearance. Additional guard rails or other edge markers will be included in design for safety improvements. A roadside flood gauge may also be installed as well.

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7. Vulnerable Populations

Because of the fact that a significant amount of the infrastructure in Ipswich is located in low-lying areas that currently flood, the community will be even more susceptible to flooding from storm surge and sea level rise as the climate changes. Overall 43% of Ipswich falls within the FEMA 1% flood zone (often referred to as the "100-year" flood zone), including the Ipswich downtown. The Great Marsh Adaptation Plan included an in-depth analysis of the economic and socioeconomic impacts of future climate change in Ipswich. For more detail, view the report at www.nwf.org/greatmarshadaptation . One notable fact of this analysis was that the number of Ipswich employees working in coastal-hazard zones ranges from 100 currently to 457 in 2070, representing 2% to 9%, respectively, of the 5,086 employees that presently work in the community. Additional discussion included particular concern about the residents living in coastal hazard zones who are over age 65, as well as seasonal or renter-occupied homes who may have residents unfamiliar with local services and shelters.

Participants agreed that there is a need for the community to enhance its current efforts to educate and communicate about climate-related hazards. Ongoing communications should include information on how to prepare and plan for weather-related hazards, both now and in the future, as well as information provided during an emergency. Systems and communications efforts that are in place now are helpful and important, however there will be an enhanced need for improved communications for both residents and businesses, as well as those beyond the town's borders, including tourists and visitors who are travelling to and through the community.

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4. Current Strengths and Assets

Among the discussion groups at the workshop, there was consensus about the general overall strength of the community. In recent years, Ipswich has been a leader in the region's efforts towards climate resilience and protection of natural resources, driving important regional initiatives and setting examples for its neighboring communities.

A number of specific strengths were also identified among the infrastructural, societal, and environmental assets of the town. These include:

Infrastructural: The town has taken many strides forward over the last 5-10 years to address infrastructural vulnerabilities…

The Electric Light Department (ELD) The town has its own municipal Electric Light Department which manages distribution lines throughout the town, powering the town through the procurement and distribution of electricity. Its mission is to provide reliable electric service at a reasonable price in a way sustainability way. As a community-owned, not-for-profit utility, it operates in service to its Ipswich customers and the Town. It is continuously exploring new ways to develop our position as a relevant and valued asset to the community by anticipating and adapting to future challenges including those brought by climate change.

Societal: As mentioned earlier, the Town of Ipswich has many qualities and systems in place now that are helpful and important to addressing its societal needs. Specific societal strengths identified by the Workshop participants include:

Overall Economy which thrives on the town's natural and historical assets.

Council on Aging: Strong and engaged organization to support the elderly population.

Schools: Well-supported and performing

Open Space: vibrant local farms and farming families and a robust, community-supported Open Space Program

Regional Partners: Additionally, there is a strong network of regional partners who are prepared and engaged in helping the community of Ipswich with climate resiliency initiatives,

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including but not limited to: The Trustees of Reservations, Parker-Ipswich-Essex Rivers (PIE-Rivers) Partnership, the Great Marsh Coalition, MassBays/8 Towns and the Great Marsh Committee, MA Office of Coastal Zone Management, Greenscapes North Shore Coalition, Ipswich River Watershed Association, Mass Audubon, and more.

Environmental: As mentioned earlier, the Town of Essex has many natural resource assets that define and sustain its vibrancy. These strengths include:

The Great Marsh – The Great Marsh Area of Critical Environmental Concern (ACEC), originally designated in 1979 as the Parker River/Essex Bay ACEC, includes approximately 20,000 acres of barrier beach, dunes, saltmarsh, mudflats, and water bodies, and makes up 22% of the Town's land area. The marsh provides protection to the community from storm surge by absorbing wave energy, and also traps and stores carbon. It also provides habitat for the town's economically important fish and shellfish economy. Ipswich has one of the region's most significant shellfish industries, with 930,500 pounds of landings in 2016, valued at $1,775,000 (*Ipswich Hazard Mitigation Plan 2018 Update*). Crane Beach is one of the state's most popular beaches.

Protected Open Space – Throughout the community, multiple areas are permanently protected as conservation land, including some wetland areas (both coastal and inland) which help absorb storm flooding and may allow for marsh migration as sea level rises. The town has vibrant local farms and a robust, community-supported Open Space Program.

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5. Top Recommendations to Improve Resilience (WILL BE REVISED POST-LISTENING SESSION)

The participants in the Ipswich CRB Workshop on February 5, 2019, determined these Community Actions, below, to be the top priority for the community to take in order to lessen hazard impacts and build resilience.

#1 Water Supply & Infrastructure (29 Votes)

(RED) Water Infrastructure & Supply - Actions: complete supply demand study, continue supply development, complete asset management plan, conservation education, water use mitigation

(BLUE) water conservation, water bans; increasing supply through new sources, desalination

(PURPLE) protect water supply system, reduce vulnerability regionally, advocacy with upstream communities, regional water bans

(GREEN) protect & enhance water storage, replace pipes, water conservation, outreach

(BROWN) Ipswich River Watershed strategies: water storage, reduce in peak demands, infiltrating, alternative sources, reallocation, low impact development, water flow restrictions

#2 Environment – Great Marsh (27 votes)

Multiple strategies are underway and should be continued and enhanced to restore and protect the Great Marsh and natural resources of Ipswich. These strategies may include: addressing erosion of degraded marsh banks by building mussel reefs and other strategies; studying the movement of sand and sediment throughout the region; land protection for marsh migration; invasive species removal; using green infrastructure to reduce stormwater pollution so as to keep shellfish beds open and healthy; and more.

(GREEN) Shore up existing natural resources, nourishment, vegetation, areas designated protected

(BROWN) Restore/protect barrier beach & marsh systems, coastal/wave sediment study, strategically siting dune/beach restoration, restoring marsh hydrology through ditch remediation, runnelling, & think layer deposition; improve existing dunes

(BLUE) Great Marsh/Shellfish Beds – building codes/adjust buffer zones, living shoreline, stormwater management

(PURPLE) Protect the salt marshes – modify state regulations to support adaptation,

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streamline permitting process; improve resiliency by reducing nitrogen and restoring drainage; land protection to allow salt marsh migration

#3 Wastewater (14 votes)

(GREEN) Sewers – rehab pump station, recharge water, protect Choate St & Water St lines

(RED) Actions: complete design & permitting, rehab and/or replace piping & pump station, complete asset management plan

(BLUE) Upgrade Town Wharf pump station, upgrade siphon, upgrade interceptor

#4 Regulation Changes (13 votes)

(PURPLE) Include climate change and sea level rise considerations in all local regulation, bylaws & policies, including: zoning, building, health, wetlands, stormwater management, open space, economic development, climate action plan, community development plan, and MVP/ Examples include: add a floodplain overlay district, strengthen the stormwater management bylaw to address stronger storms

#5 Electricity & Communication (8 votes):

(BROWN) Expand energy source & decentralize, loop networks for redundancy, put power lines underground where feasible, tree trimming to address transmission outages, backup radio system, improving communication procedures for emergencies

#6 Public Safety & Transportation (5 votes)

(PURPLE) Raise road or build bridge to allow continued public access to Great Neck & Little Neck; create dune behind Pavilion Beach & plant grasses

(RED) reinforce existing infrastructure and explore new alternatives & solutions for vulnerable roads, bridges, and causeways

(BROWN) raise roads, increase culvert size & connectivity

#7 Vulnerable Populations (3 votes)

(BROWN) alternating energy sources, emergency shelters & response, track elderly disabled needs, evacuations, notifications and alarm system

(BLUE) vulnerable populations and service providers, identify shelters (heating, cooling), needs assessment of vulnerable populations, develop contact lists for vulnerable populations

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6. Conclusion and Next Steps

The Town of Ipswich presented the recommendations of the MVP Workshop at a public forum held on March 27, 2019, in Ipswich Town Hall. Publicly posted and advertised, residents of Ipswich were invited to attend the meeting to learn more about coastal resilience and to learn, ask questions, and provide feedback about the February 5th MVP Workshop and the recommended highest priority actions that emerged from that workshop.

Priorities identified during the February 5, 2019 MVP Workshop will be integrated into existing and near future municipal planning efforts, including for applying for funding through the MVP Action Grants.

The Town of Ipswich will continue to improve the Town's resilience to climate change by implementing other top priority strategies in the months and years to come.

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CRB Workshop Participants

FEB 5 Ipswich CRB WORKSHOP - Invited Participants (* = attended)

Interest/Group	Organization	Name	Attended
facilitator	Woods Hole Group	Joseph Famely	*
facilitator	The Nature Conservancy	Adam Whelchel	*
facilitator	Ipswich River Watershed Association	Kristen Grubbs	*
facilitator	Metropolitan Area Planning Council	Martin Pillsbury	*
facilitator	8 Towns & Great Marsh/Mass Bays	Peter Phippen	*
facilitator	Mass Audubon	Liz Duff	*
Non-profits	Ipswich River Watershed Association	Wayne Castonguay	*
Non-profits	Greenbelt	Kate Bowditch	*
Non-profits	Mass Audubon	Amy Weidensaul	*
Non-profits	Trustees	Peter Pinciaro	
Non-profits	Trustees	Tom O'Shea	*
Non-profits	Trustees	Russ Hopping	
Non-profits	Mass Audubon	Malarie McGillivray	*
Businesses	EBSCO	Alex Lawner	*
Businesses	Realtor	Binni Hacket	*
Community leaders/champions	Agriculture	Jay Stanbury	*
Community leaders/champions		Anne Reynolds	*
Historic	Ipswich Museum	Kerry Mackin	*
Community leaders/champions	Construction	Marc Simon	*
Developers/engineers	Civil Engineer	Larry Graham	*
Elderly	Council on Aging	Lillian Riley	*
Elderly	Council on Aging	Shelia Taylor, COA director	*
Housing	Ipswich Housing Partnership	Jim Warner	*
Public Safety	MEMA	Allen Phillips	*
Schools	School Superintendent	Brian Blake	
Schools	Student	Tess Devoe	*
Schools	Teacher	Lori Lafrance	*
State Agency	MA Coastal Zone Management	Kathryn Glenn	*
Town Committee	Sustainability Committee	Mike Johnson	*
Town Committee	Open Space Committee	Andrew Brengle	*
Town Committee	Planning Board	Carolyn Britt	*
Town Committee	School	Pavica Kneedler	*
Town Committee	Open Space Dept	Beth O'Connor	*
Town Committee	Planning Board	Heidi Paek, Chair	*
Town Committee	Conservation Commission	Sissy ffolliot	*

Town Committee	Water Subcommittee	Jim Engel	*
Town Committee	Selectboard	Bill Craft	
Town Committee	Board of Health	Susan Hubbard	*
Town Govt Staff	Emergency Management	Lt. Jon Hubbard	*
Town Govt Staff	Fire	Deputy Chief Jeff French	*
Town Govt Staff	Public Works	Frank Ventimiglia	*
Town Govt Staff	Conservation Agent	Alicia Geilen	*
Town Govt Staff	Senior Planner	Ethan Parsons	*
Town Govt Staff	Shellfish Constable	Scott LaPreste	
Town Govt Staff	Town Library Director	Patty DiTullio	*

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Citation

Town of Ipswich. March 2019. Community Resiliency Building Workshop Summary of Findings. Prepared by the Ipswich River Watershed Association. Ipswich, MA.

CRB Workshop Project Team

- Town of Ipswich, Ipswich Senior Planner Ethan Parsons, Core Team Member, Project Coordinator
- Ipswich River Watershed Association, Environmental Planner Kristen Grubbs, Lead facilitator
- Town of Ipswich, Alicia Geilen, Ipswich Conservation Administrator, Core Team Member
- Town of Ipswich, Lieutenant Jonathan Hubbard, Ipswich Hazard Mitigation Officer, Core Team Member
- The Nature Conservancy (CT), CRB Founder Dr. Adam Whelchel, Facilitator
- Woods Hole Group, Senior Environmental Scientist Joseph Famely, Facilitator & Map Maker
- Metropolitan Area Planning Council, Planner Martin Pillsbury, Facilitator
- Mass Audubon, North Shore Education Coordinator Liz Duff, Facilitator
- 8 Towns & the Great Marsh/Mass Bays, Coastal Coordinator Peter Phippen*, Facilitator
- Mass Audubon, Malarie McGillivray, Scribe

Acknowledgements

Funding to support the Ipswich Municipal Vulnerability Preparedness (MVP) Program Community Resiliency Building Workshop was provided by the Massachusetts Executive Office of Energy and Environmental Affairs through a MVP Planning Grant, issued to the Town of Ipswich during the fiscal year of July 2018 through June 2019.

The Town of Ipswich contracted with the Ipswich River Watershed Association to provide MVP certified staff to support the Town in planning and facilitating the CRB Workshop.

Thanks to the Town of Ipswich for providing the Ipswich Town Hall as the workshop meeting location and for providing lunch.

Particular thanks to the Ipswich CRB Workshop Project Team and workshop contributors listed above.

Town of Ipswich, MA
Community Resilience Building Workshop

Appendix – DRAFT 3-13-19

Appendix A: CRB Workshop Agenda

Appendix B: Base Map

Appendix C: Participatory Table Maps

Appendix D: Workshop Table Materials

Appendix E: Top Priority Posters with Sticky Dot Votes

Appendix F: Presentation Slides (Insert)

Municipal Vulnerability Preparedness Workshop
Town of Ipswich, MA

Tuesday, February 5, 2019, 8:00am–3:00pm
Ipswich Town Hall
AGENDA

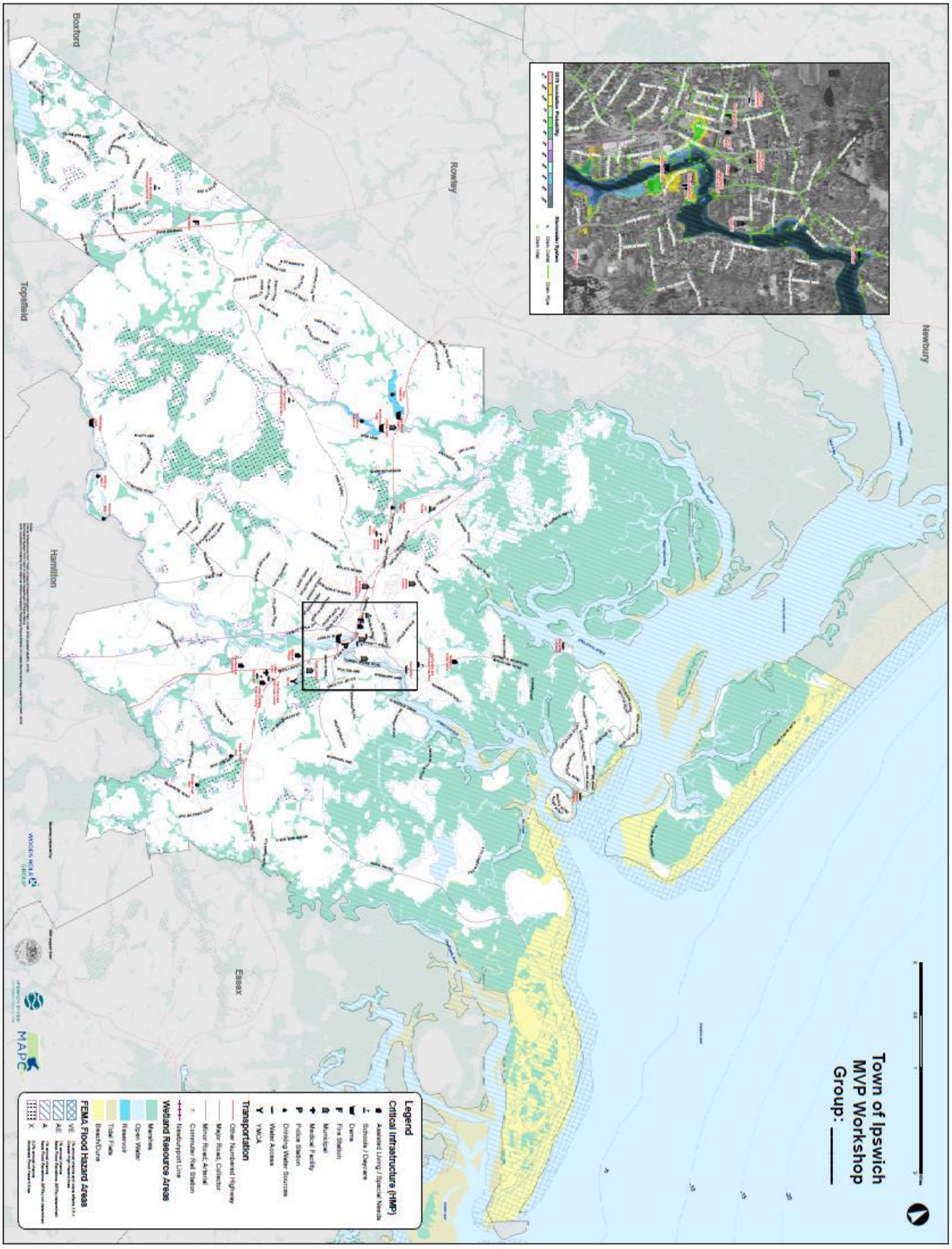
The Massachusetts **Municipal Vulnerability Preparedness Program** provides support for cities and towns in Massachusetts to plan for climate resiliency and prepare immediate action steps.

TIME	ACTIVITIES	WHO
8:00 AM	Registration and Refreshments	
8:30 AM	Welcome	Anthony Marino Ethan Parsons
8:35 AM	Overview of the Workshop Introductions	Kristen Grubbs All
9:00 AM	Presentation on Science, Resources, & Previous Planning Confirm Major Hazards	K. Grubbs
9:30 AM	Instructions for Small Group Work	
9:40 AM	Small Group Exercise #1: Review & Discuss Vulnerabilities & Strengths of Features (Infrastructure, Society, & Environment)	Small groups & facilitators
10:40 AM	10 MINUTE STRETCH	
10:50 AM	Small Group Exercise #2: Identify Actions to Address Vulnerabilities or Protect Strengths	Small groups & facilitators
11:50 AM	Small Group Exercise #3: Determine Priority (Hi, M, Lo) and Urgency (short/long-term) of Actions; Discuss & Identify Top 3 Priority Actions	Small groups & facilitators
12:00 PM	LUNCH	
12:45 PM	Small Groups Reconvene & Prepare to Report Out Write Top Priority Actions on Cards	Small groups & facilitators
1:00 PM	Small Group Report Outs: Sharing Top Priorities	Adam Whelchel Spokespersons & large group
1:30 PM	Large Group Activity & Discussion Determine Overall Priority Actions (sticky dot activity) Collectively discuss identified opportunities to reduce current and future hazard risks and improve resilience.	A. Whelchel & facilitators
2:30 PM	Closing Remarks & Next Steps How will Ipswich use the recommendations/outcomes from the MVP workshop?	K. Grubbs E. Parsons
3:00 PM	Adjourn	

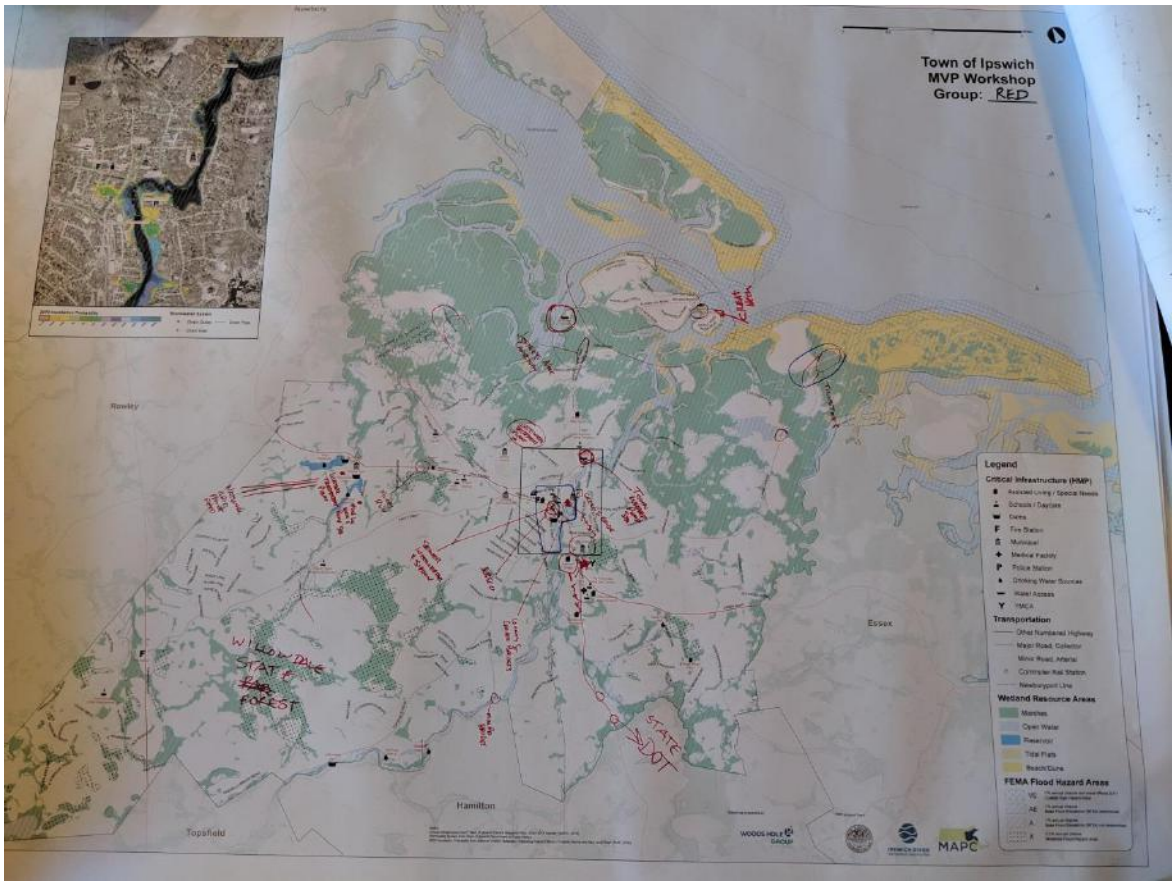
For more information about the Ipswich MVP Workshop, please contact Kristen Grubbs, Environmental Planner, Ipswich River Watershed Association (kgrubbs@ipswichriver.org, 978-412-8200)

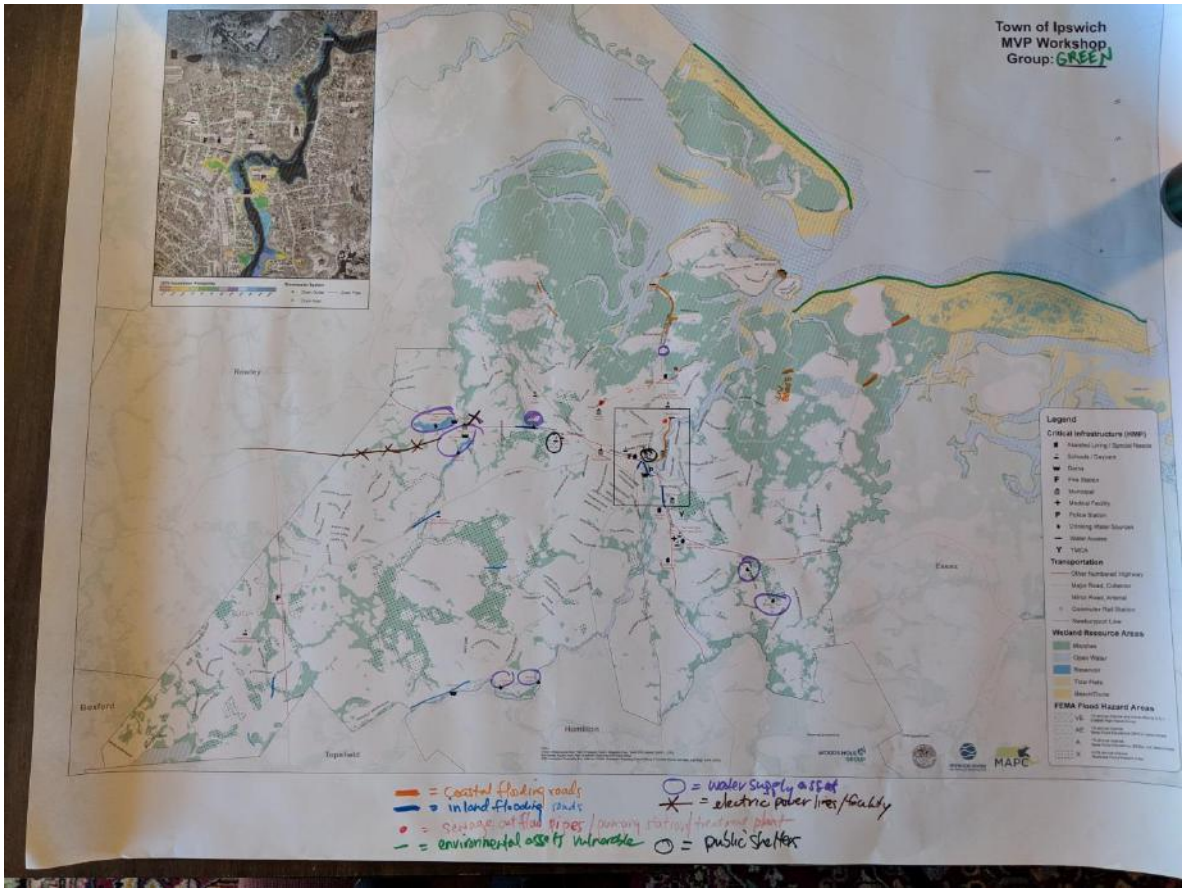
IPSWICH RIVER WATERSHED ASSOCIATION

Appendix A: CRB Workshop Agenda



Appendix B: Base Map





Appendix C: Participatory Table Maps (2 of 5 groups)

Box 4.1-1. Regional Adaptation Strategies & Recommendations for the Great Marsh Region

Best Practices *(see also page 126-130)*

- Establish and maintain a permanent Municipal Resiliency Task Force or committee
- Set clear goals for addressing existing and projected vulnerability
- Collaborate across municipal departments
- Collaborate across municipal boundaries
- Protect and enhance biodiversity
- Reduce non-climate stressors
- Evaluate effectiveness of adaptation strategies at regular intervals
- Monitor coastal hazards and maintain strong research initiatives
- Promote economic diversity
- Incorporate climate change adaptation planning and climate projections into all relevant local and regional plans as well as capital investment projects

Natural and Nature-Based Strategies *(see also page 130-137)*

- Ensure and restore connectivity of river and coastal systems
- Use living shorelines to stabilize shoreline edges, where appropriate
- Explore construction of offshore shellfish reefs and beds to attenuate wave energy, reduce erosion, and improve water quality
- Protect and restore barrier beaches and dunes through renourishment and revegetation
- Explore opportunities to beneficially reuse dredged material
- Restore sub-aquatic vegetation
- Restore degraded salt marshes
- Facilitate marsh migration
- Enhance land conservation efforts

Gray Infrastructure and Retrofits *(see also page 138-139)*

- Remove unnecessary dams
- Upgrade road-stream crossings
- Retrofit buildings to be more flood resilient
- Elevate roadways to prevent nuisance flooding and to withstand projected sea level rise
- Pursue retrofits and planning for Massachusetts Bay Transportation Authority (MBTA) railroad

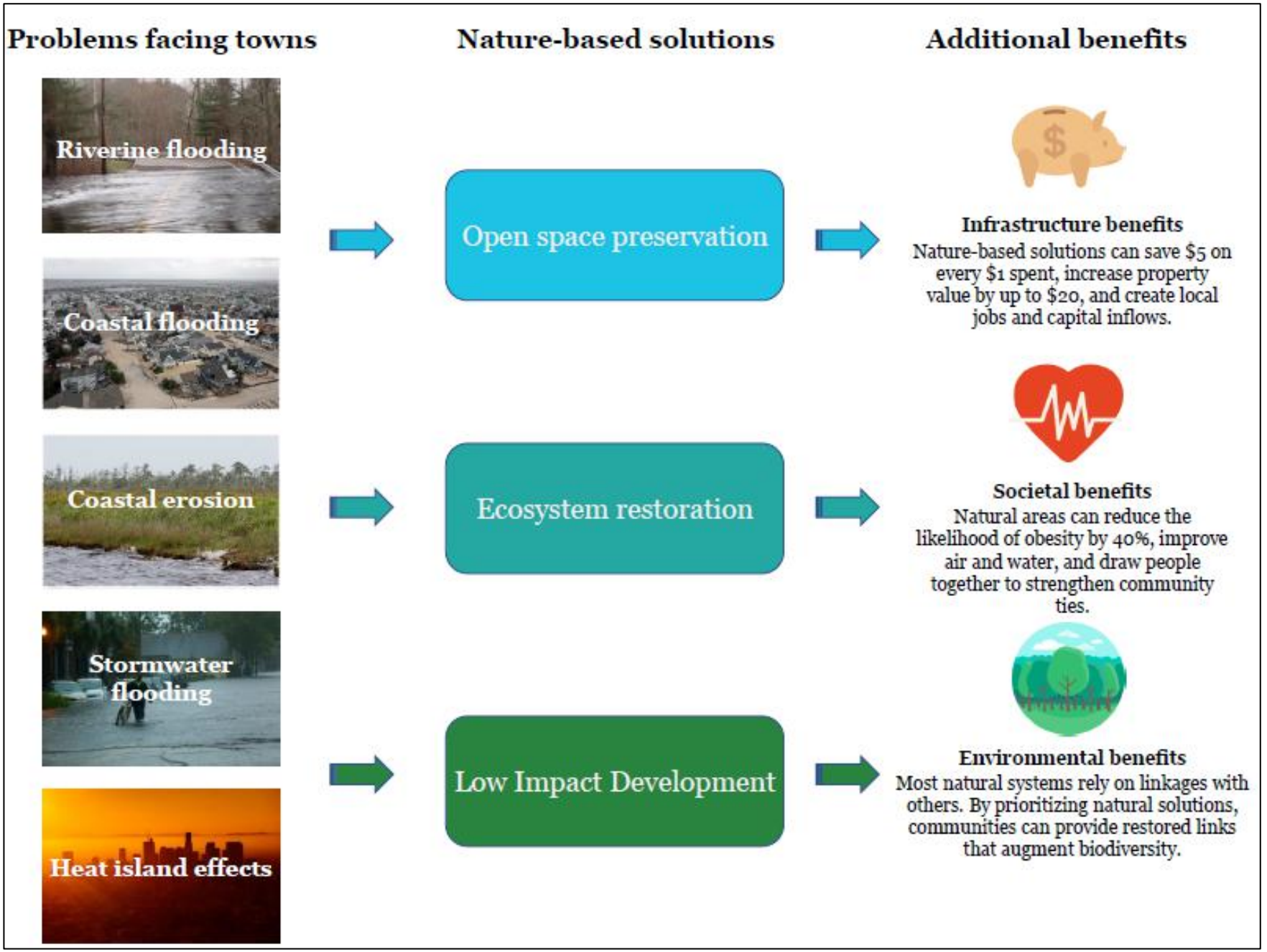
Land-use Planning and Policy *(see also page 140-144)*

- Update municipal policies
- Prioritize low-impact development (LID) practices
- Revise local wetlands protection bylaws and regulations
- Move development away from the coast and from wetlands
- Create "freeboard incentive" for residential and commercial buildings
- Use transferable development credits (TDCs) to reduce risky coastal development
- Institute comprehensive water resources management, including strategies for stormwater, waste water, and public drinking water

Outreach and Engagement *(see also page 144-146)*

- Develop municipal strategies for enhanced outreach and education
- Strengthen existing regional outreach and education programs
- Support and develop opportunities for citizen science

Appendix D: Great Marsh Coastal Adaptation Plan – Regional Strategies


Problems facing towns
Nature-based solutions
Additional benefits
Riverine flooding
Coastal flooding
Coastal erosion
Stormwater flooding
Heat island effects
Open space preservation
Ecosystem restoration
Low Impact Development
Infrastructure benefits
Nature-based solutions can save $5 on every $1 spent, increase property value by up to $20, and create local jobs and capital inflows.
Societal benefits
Natural areas can reduce the likelihood of obesity by 40%, improve air and water, and draw people together to strengthen community ties.
Environmental benefits
Most natural systems rely on linkages with others. By prioritizing natural solutions, communities can provide restored links that augment biodiversity.

Sample Guide to Climate Adaptation Strategies

What are Your Project Goals?

Flood Protection · Water Quality · Habitat Restoration · Wave Attenuation · Erosion Control · Scenic/Recreational Value

Natural Solutions

Remove Invasives

Advantages:
- Supports marsh ecosystem health & function. A healthy marsh provides storm protection, erosion control, and supports wildlife habitat.

Disadvantages
- May not be ecologically appropriate
- Requires maintenance

Vegetated Shoreline

Advantages:
- Provides shoreline stability, reduces erosion, and buffers upland areas from small waves.

Disadvantages:
- Limited flood protection depending on site features
- Plant growth not guaranteed

Land Acquisition

Advantages:
- Strategic protection of land adjacent to salt marshes can help facilitate marsh migration and reduce damage from flooding.

Disadvantages:
- Can be expensive
- Not always politically expedient

Nature-Based & Hybrid Strategies

Shellfish Reef

Advantages:
- Offshore living structures that enhance water quality, reduce erosion, and act as a submerged breakwater to reduce wave energy.

Disadvantages:
- Overtopped by major storms
- Easily damaged by debris and ice

Edging/Sills

Advantages:
- Natural vegetation combined with engineered structures parallel to coastline; reduces erosion and wave energy, and enhances wildlife habitat

Disadvantages:
- Limited storm surge reduction
- Requires more land area to implement

Thin-layer Deposition

Advantages:
- Raises the marsh platform by spraying sediment onto the marsh surface; mostly applied in sediment starved environments

Disadvantages:
- Impacts not fully understood
- Unknown utility in marshes that aren't highly degraded

Gray Infrastructure

Revetment

Advantages:
- Rocks or other material placed on a sloping shoreline to stabilize the shore and to mitigate wave energy.

Disadvantages:
- No major flood protection
- Prevents upland sediment transport to estuarine habitats

Bulkhead

Advantages:
- Vertical wall suitable in high-energy settings; stabilizes shoreline and reduces flooding.

Disadvantages:
- Can erode adjacent areas
- Prevents upland sediment transport to estuarine habitats

Road Flood Barriers

Advantages:
- Various designs exist, but all are meant to prevent flood waters from entering the roadway.

Disadvantages:
- Short-term/temporary solution
- Limited/no co-benefits

Policy Strategies

Zoning

Advantages:
- Utilizes zoning overlays to limit development in flood-prone areas (legal precedent exists in MA).

Disadvantages:
- Can impact property tax base
- May lead to legal challenges

Climate-smart Development

Advantages:
- Requires SLR to be considered in development proposals. Promotes open spaces to increase flood resiliency.

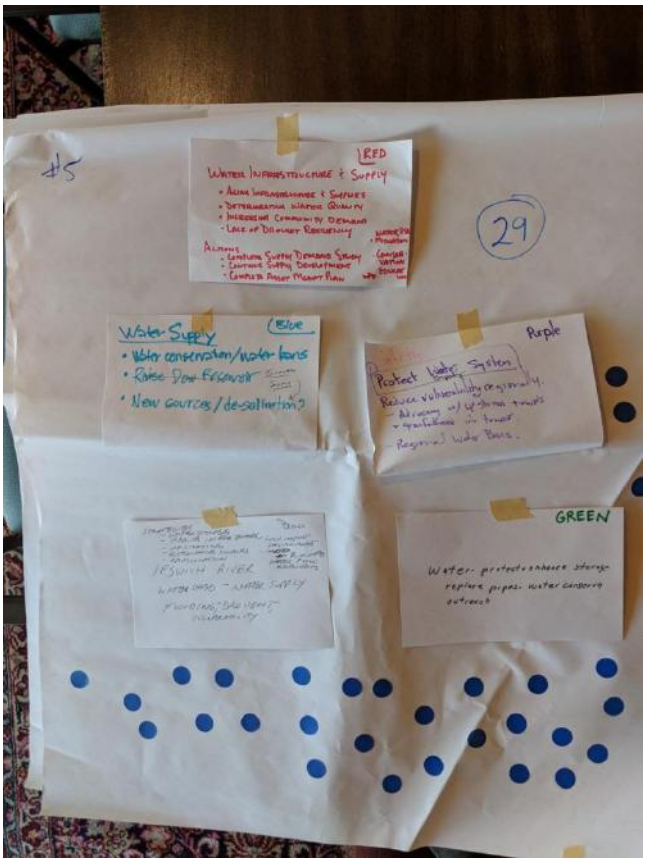
Disadvantages:
- Creates additional work for developers up front
- Doesn't require action

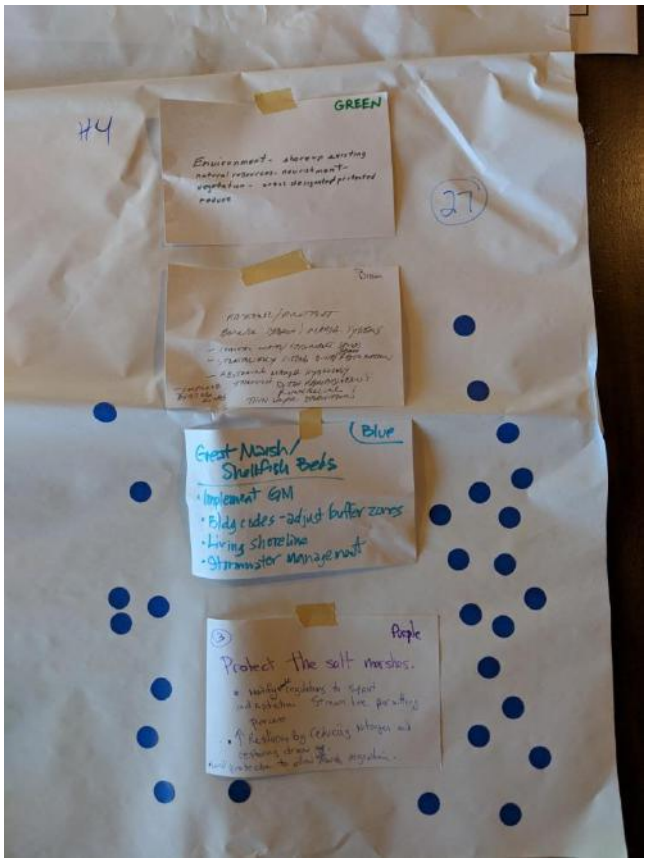
Transferable Development Credits

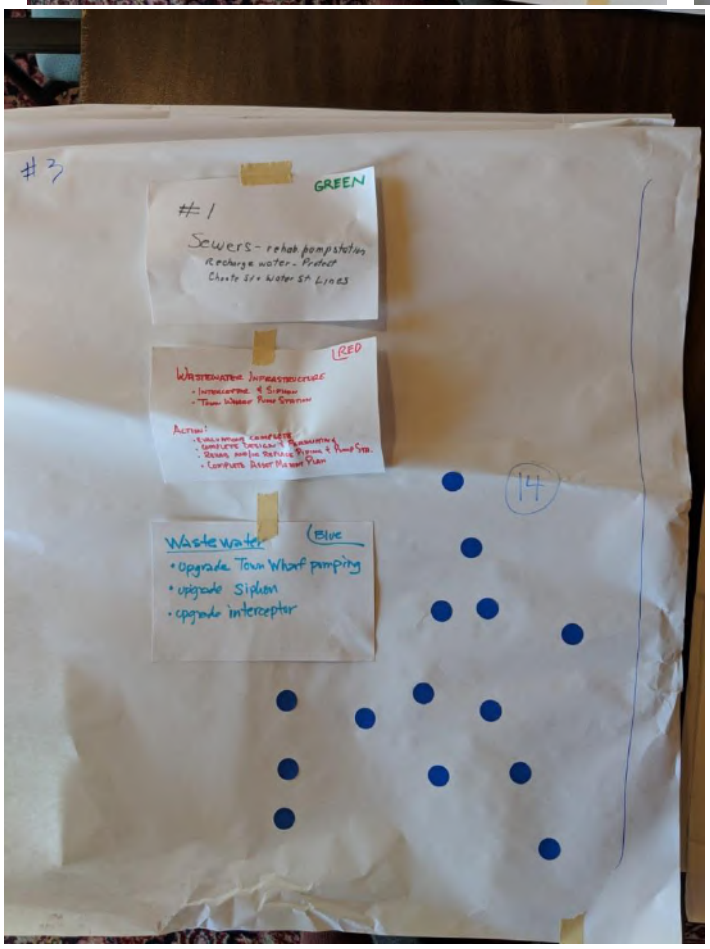
Advantages:
- Market-based approach (with existing MA guidelines) that incentivizes development away from flood prone areas.

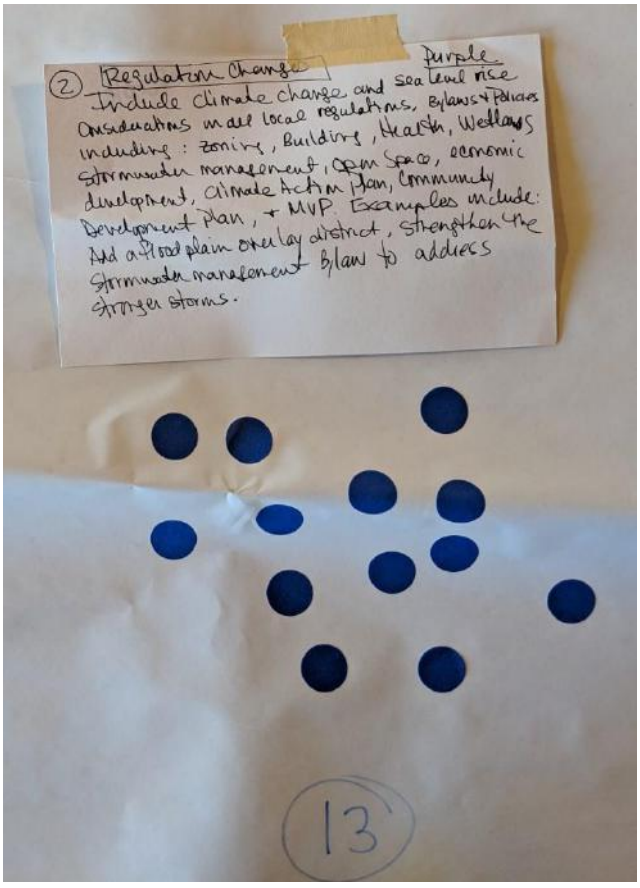
Disadvantages:
- Can be costly and complex to implement
- Requires calibrated market

Appendix E: Top Priority Posters with Sticky Dot Votes

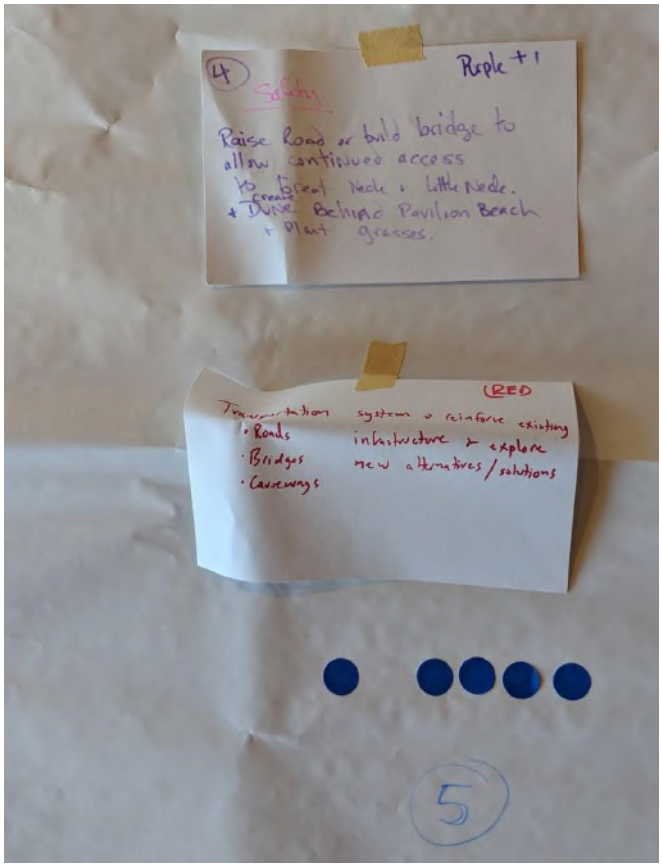


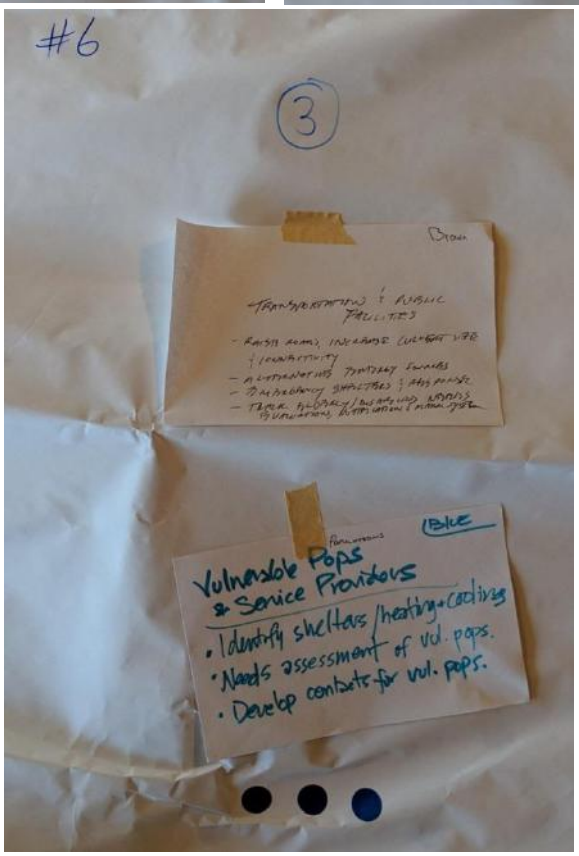







#7
Brown
ELECTRIC / COMMUNICATION
8


4
Purple +1
Safety
Raise Road or build bridge to allow continued access to Great Neck + Little Neck.
+ Dune Belmar Pavilion Beach + Plant grasses.
RED
• Roads
• Bridges
• Causeways
system + reinforce existing infrastructure + explore new alternatives / solutions
5


#6
3
Brown
Blue
Vulnerable Pops & Service Providers
• Identify shelters/heating+cooling
• Needs assessment of vul. pops.
• Develop contacts for vul. pops.