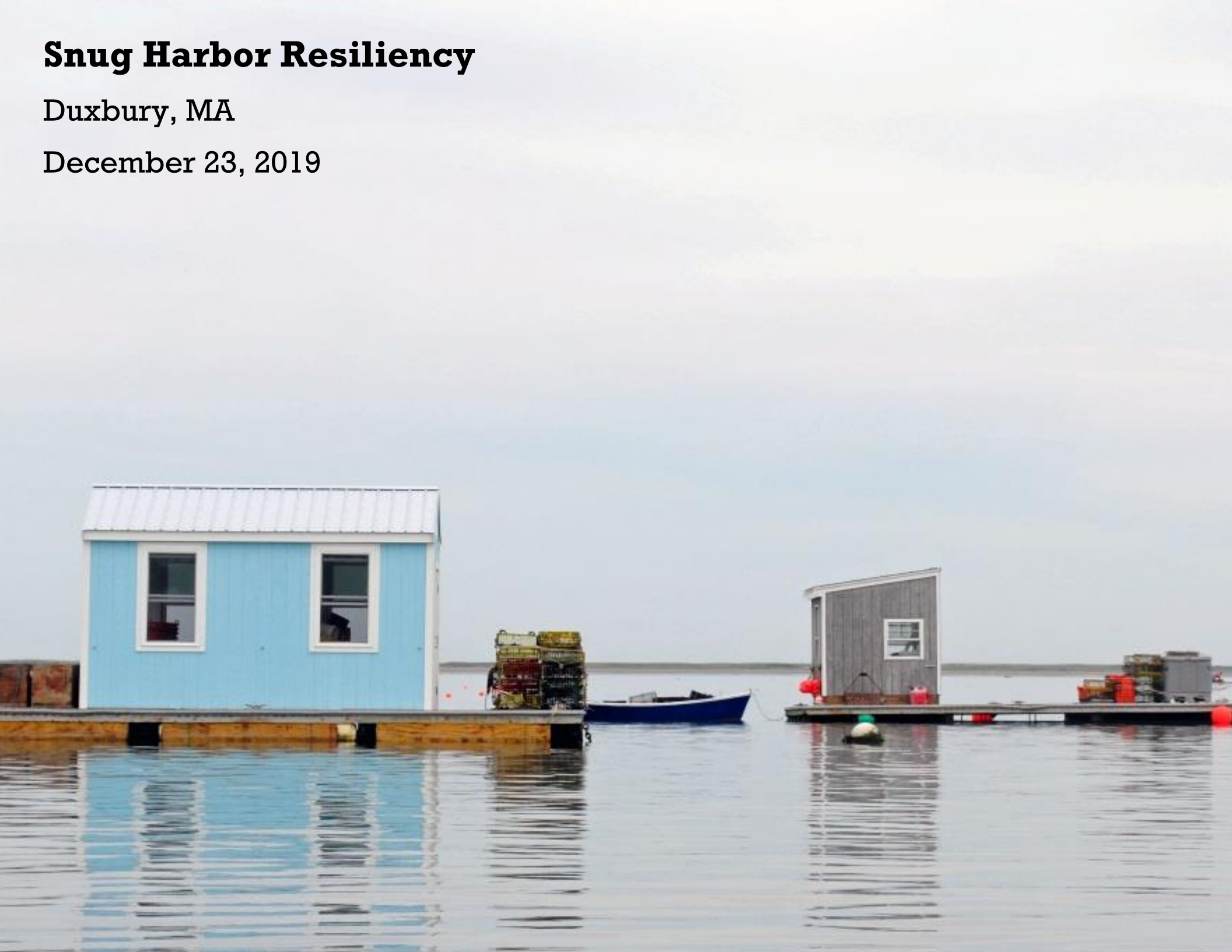
Snug Harbor Resiliency

Duxbury, MA

December 23, 2019



Acknowledgements

The project was conducted by the Metropolitan Area Planning Council (MAPC) with funding from MAPC's Accelerating Climate Resiliency Grant Program supported by the Barr Foundation. A special thanks to Duxbury Bay Maritime School for providing space for meetings and focus groups for this project.

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Snug Harbor

Snug Harbor in the Town of Duxbury is the working waterfront, water recreation, and water-based neighborhood business district in the town. It is also a popular year-round community gathering place with prominent institutions and public assets such as the Duxbury Bay Maritime School, the Duxbury Yacht Club, French Memories, the Winsor House Inn and Restaurant, Bay Side Marine, the Harbormaster, two churches, and a public boat launch. Snug Harbor also includes historic assets such as the Shipbuilders Historic District with residences over 200 years old and the historic King Caesar House, owned by the Duxbury Rural & Historical Society. The Duxbury Bay Maritime School hosts ecology, rowing, sailing, paddle sports and yoga programs to thousands of students a year. They are also building on the waterfront a state-of-the-art crew training facility and additional capacity for year-round marine ecology education programs.[1,4]

A defining public asset in Snug Harbor is the Town Pier with a public boat launch, public parking lot and entrance to the 600 hundred moorings in Duxbury Bay with a decades-long waiting list. This serves local and regional recreational boaters, including kayakers, sailors, and recreational fishermen. It also serves the robust shellfishing industry for the over 27 shellfish businesses/fishermen. In 2017, Duxbury shell fishermen harvested over 12 million shellfish on 77.5 acres with revenue of $6.8 million.[2] Snug Harbor also houses Island Creek Oysters, a prominent oyster farm and distributor selling shellfish from over 100 farms to about 700 chefs around the country.[3] Island Creek recently acquired an 11-acre campus with a deep-water launch in Snug Harbor for its headquarters, shellfish hatchery (the only of its kind in the northeast US) and newly created Raw Bar, a locally and regionally acclaimed seasonal food truck, bar, and patio behind its headquarters. Island Creek Oysters employs a local workforce of over 60 individuals during the high oyster season.[4]

45 different businesses worth $91 million

27 shellfish businesses, 12 million shellfish harvested

600 moorings

Over 40 residences

2,800 marine students

[1] Duxbury Bay Maritime School https://mailchi.mp/dbms/bc4f0t8uti-3015377
[2] MA Division of Marine Fisheries. 2017 Annual Report. https://www.mass.gov/files/documents/2018/07/30/2017%20DMF%20Annual%20Report.pdf
[3] www.islandcreekoysters.com
[4] Massard, Valerie. 2018 Snug Harbor Resiliency Study. MAPC Accelerating Climate Resiliency Mini-Grant proposal.

Overall, Snug Harbor hosts over 45 different businesses with an assessed value of over $91million.[5] The area is an important economic asset for the community and the region. It is also a hub of community gathering and celebrations, hosting weddings, festivals, and family-events, important for nurturing the community cohesion of the Town. However, the area is at risk and vulnerable to coastal flooding and sea level rise, already damaging built assets and infrastructure such as roads and utilities and interrupting business with flooding at the boat launch, Mattakeesett Court, and Washington Street. The Snug Harbor Resiliency Plan is an effort to work directly with residents and stakeholders of Snug Harbor to establish a community-based vision of resilience so Snug Harbor retains its vitality, water access, and public assets in the face of climate change.

Figure 1 Snug Harbor flooding during Winter Storm Riley, March 2018.

[5] Massard, Valerie. 2018 Snug Harbor Resiliency Study. MAPC Accelerating Climate Resiliency Mini-Grant proposal.

Introduction: Climate Change and Snug Harbor

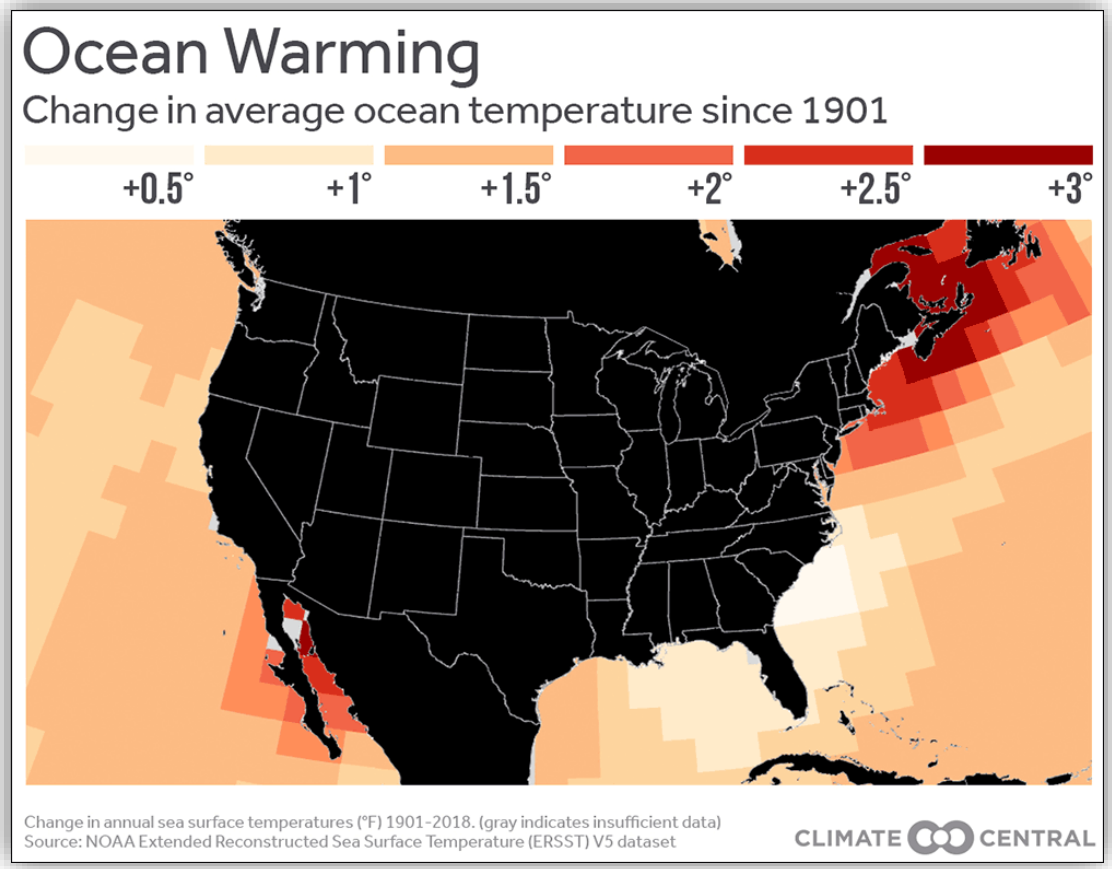
Temperature

Over the last century, the earth has warmed by nearly two degrees Fahrenheit[6] and similarly in the Northeast United States.[7] Historic temperature data indicates that the warming trend is accelerating as demonstrated by the increase and accelerated rate of increase in number of extreme heat events. Global warming and greenhouse gas emissions have important implications for climate change and the future of Snug Harbor. These include sea level rise, increased severity and frequency of coastal storms, ocean warming (Figure 2), ocean acidification, and marine species redistribution. Oceans absorb heat as well as nearly 1/3 of our carbon dioxide emissions. Ocean warming will cause marine ecosystems to shift, migrate, and/or reduce ecosystem function. Ocean acidification could reduce fish and shellfish ability to produce skeletons and shells, minimizing their reproductive potential. However, though important, these are longer-term vulnerabilities to Snug Harbor. Sea level rise, storm surge, and coastal inundation are more imminent climate change challenges in Snug Harbor.

Sea Level Rise

From 1921 to 2018 in Boston Harbor, the rate of sea level rise has occurred at approximately 2.8 mm/ year

Figure 2. The increasing trend of warming with climate change is also affecting ocean surface temperature, exacerbating sea level rise and degrading marine ecosystems. New England waters have warmed more than 2.5°F since 1901, more than any other coastal area in the US and 40% faster than anticipated.



[6] NASA https://climate.nasa.gov/evidence/
[7] Blue Hills Observatory. http://bluehill.org/climate/anntemp.gif

with a total of 0.93 feet in the last century. Sea level rise in Massachusetts is a result of a confluence of several factors, the most significant is caused by global warming through from accelerated rates of greenhouse gas emissions in our atmosphere. Global warming contributes to sea level rise in two ways: (i) thermal expansion of our oceans where the ocean warms and consumes more space and (ii) accelerated rate of glacial melting adding more water to the ocean system. Sea level rise is also caused by land subsidence along the east coast in response to the last glacial period, when pressure from the heavy ice compressed the land causing land areas around the glacier to curl upward in that time period and the coastal land to sink. Gravitational pull is also contributing to sea level rise in Massachusetts causing a disproportionate increase in the level of sea level rise in comparison to other areas around the globe.

Table 1. Total Relative Sea Level Rise projections in Boston and South Shore for the "Highest" emission scenarios.

	2030	2050	2070	2100
Boston BH_FRM [8]	8.00 in.	1.50 ft.	3.10 ft.	7.40 ft.
South Shore [9]	8.04 in.	1.85 ft.	3.39 ft.	6.52 ft.
Boston Tide Gauge[10]	0.4-0.9 ft.	2.4 ft.	4.2 ft.	7.6 ft.

Scientists anticipate that the rate of sea level rise will increase and accelerate, anticipating an additional eight inches by 2030.[11,12] Several local and state-wide sea level rise projection models indicate similar levels where Massachusetts could experience 6.5-7.5 feet of sea level rise by the end of the century (Table 1).[13] In the near term, sea level rise has exasperated the extent of coastal flooding cause by hurricanes, nor'easters, and blizzards at Snug Harbor. Since 1997, Plymouth County has experienced 49 coastal flood events totaling over $15 million in property damage.[14] Scientists have not reached consensus on the extent of increasing frequency or severity of coastal storms, though there is evidence for hurricanes. However, storm surge and inundation with sea level rise will reach greater areas causing a greater extent of damage to Snug Harbor and the vicinity. Figure 3 illustrates how sea level rise could impact Snug Harbor at mid- and late-century.

[8] Douglas, E.M., Kirshen, P.H., Bosma, K., et al. 2017. Simulating the Impacts and Assessing the Vulnerability of the Central Artery/Tunnel System to Sea level Rise and Increased Coastal Flooding. J Extreme Events 3 (4): 1650013 (28 pages).

[9] *"Sea Level Rise Study. The Towns of Marshfield, Duxbury, Scituate, MA". 2013. Kleinfelder.*

[10] Northeast Climate Science Center. UMass Amherst. "Massachusetts Climate Change Projections". December 2017

[11] U.S. Environmental Protection Agency. 2016. Climate Change Indicators in the United States, 2016. Fourth meditation. EPA 430-R-16-004. www.epa/gov/climate-indicators.

[12] Climate Ready Boston, "The Boston Research Advisory Group Report: Climate Change and Sea Level Rise Projections for Boston," June 2016

[13] MAPC. 2018. Duxbury Climate Vulnerability Assessment and Action Plan. Pp.15-16

[14]NOAA. National Centers for Environmental Information. Storm Events.

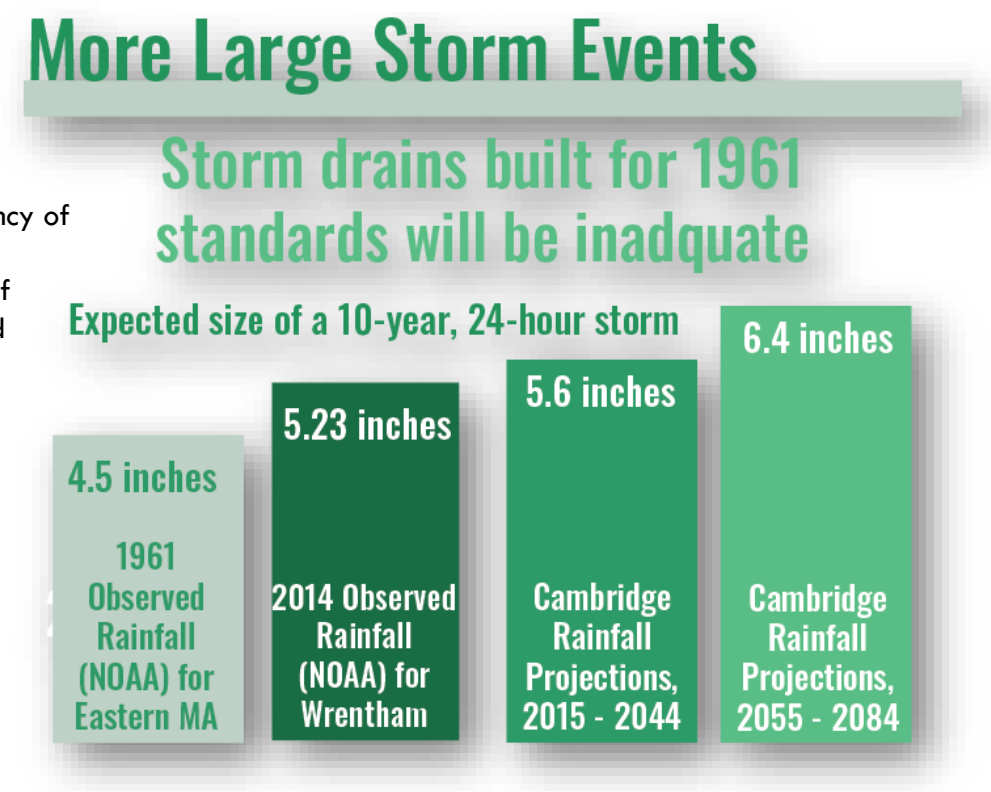
Figure 3 Snug Harbor present day and with sea level rise at 2070 (top right) and sea level rise at 2100 (bottom right).

Precipitation

For the last fifty years, precipitation has increased 70% in the Northeast in the amount of rain that falls in the top 1% of storm events.[15] November and fall of 2018 is the wettest November and fall on record since 1891 and third wettest year on record.[16] Due to several stormy periods during the year, annual precipitation was very high and totaled 67.20 inches, which was more than 18 inches wetter than the long-term mean and nearly 14 inches more than the 30-year normal.

Projections for future precipitation suggest an increase in total precipitation, changes in precipitation patterns, and increased frequency of extreme storms such as hurricanes and nor'easters. For example, a 100-year storm is defined as a storm that would have a 1% chance of occurring in any given year or consecutive years. Historically this could create 8.9 inches of rain, but that could increase to 10 inches of rain by 2044 and 11.7 inches of rain by 2084 (Figure 4).[17] This increased precipitation has the potential to exacerbate existing stormwater runoff issues and pollution of existing impaired waters. Excess stormwater can cause flushing of pollutants into nearby waters diminishing water quality, impairing marine ecosystem and fish habitat and degrading salt marshes. Duxbury Bay is already susceptible fecal coliform contamination. The Town manages compliance with the Clean Water Act for Duxbury Bay and achieved its Total Maximum Daily Load in 2016.

Figure 4. Future Precipitation Projections for Design Storms. Source: Cambridge Climate Vulnerability Assessment.



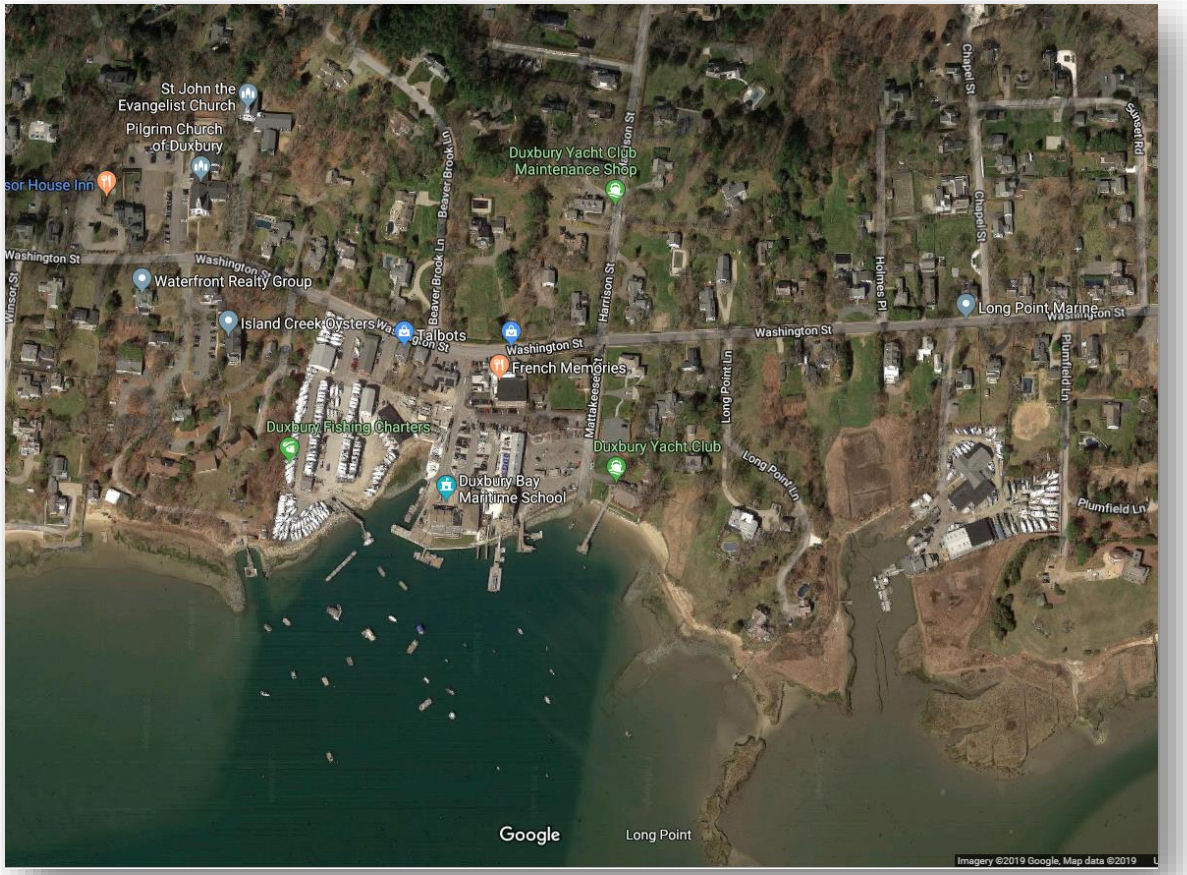
[15] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA. doi: 10.7930/NCA4.2018.
[16] Blue Hill Observatory & Science Center. 2019. http://bluehill.org/observatory/2018/02/2018-precipitation/
[17] City of Cambridge, Climate Change Vulnerability Assessment, (City of Cambridge, 2015), Temperature and Precipitation Projections (http://www.cambridgema.gov/CDD/Projects/Climate/~/media/A9D382B8C49F4944BF64776F88B68D7A.ashx)

Methodology: Community –Based Planning Approach

Since 2010, Duxbury has worked to prepare for the impacts of sea level rise and climate change through various planning efforts. These include:

- *South Shore Coastal Hazards Adaptation Study* performed by MAPC in 2011
- *Sea Level Rise Study for the Towns of Marshfield, Scituate, and Duxbury, MA* performed by Kleinfelder in 2013
- *Coastal Processes Study and Resiliency Recommendations for Duxbury Beach and Bay* performed by Woods Hole Group in 2016
- *The Town of Duxbury Climate Vulnerability Assessment and Action Plan* performed by MAPC in 2018
- *Duxbury Natural Hazard Mitigation Plan* performed by MAPC in 2018
- *Envision Duxbury* Comprehensive Master Plan performed by MAPC in 2019

Figure 5 Snug Harbor Resilience Study Area



This planning work has highlighted climate change risks including sea level rise and storm surge projections and the impacts of these risks to Duxbury's infrastructure, natural resources, economy, and people. These studies have also highlighted specific action items and recommendations on adaptive strategies to coastal flooding, infrastructure improvements for resilience, and mitigation strategies to reduce risk to natural hazards such as coastal storms, blizzards, and nor'easters. The Snug Harbor Resiliency Plan is implementation of action recommendations from both the *Town of Duxbury Climate Vulnerability Assessment and Action Plan* as well as *Envision Duxbury*. Specifically, Strategy 3.1 which states" Engage in a community-led district resilience planning and development effort of Snug Harbor that includes resilience zoning, development, migration (where applicable), and resilience project prioritization." Figure 5 illustrates the study area.

Small businesses, institutions, commercial fishermen, and nearby residents, the "Stakeholders", are at greatest risk to the damage caused by coastal flooding at Snug Harbor. Residents of Duxbury, tourists, and visitors to Snug Harbor, the "Public", are critical users of the area, supporting the livelihoods of the Stakeholders and creating community cohesion and Town spirit. Further, the public and stakeholders are the ones who will be asked to support resilience infrastructure and improvements. Hence, this planning effort was designed to provide an in-depth engagement and visioning strategy with the Stakeholders and Public to define the future resilience of Snug Harbor.

Engagement Strategy

MAPC staff, Town staff, and the Task Force worked together to develop a community engagement strategy for the Snug Harbor Resiliency Plan. The purpose of the community engagement strategy for this project was twofold:

- **Exchange** knowledge between the harbor's business owners, residents, landowners, and other stakeholders and MAPC and town planning staff regarding the nature of the relationship stakeholders have with the harbor.
- **Engage** stakeholders in crafting a vision, with recommendations, for the area's long-term future by exploring common challenges, identifying shared values, and contending with potential trade-offs.

In addition, the project team mentioned above developed several goals for the engagement process:

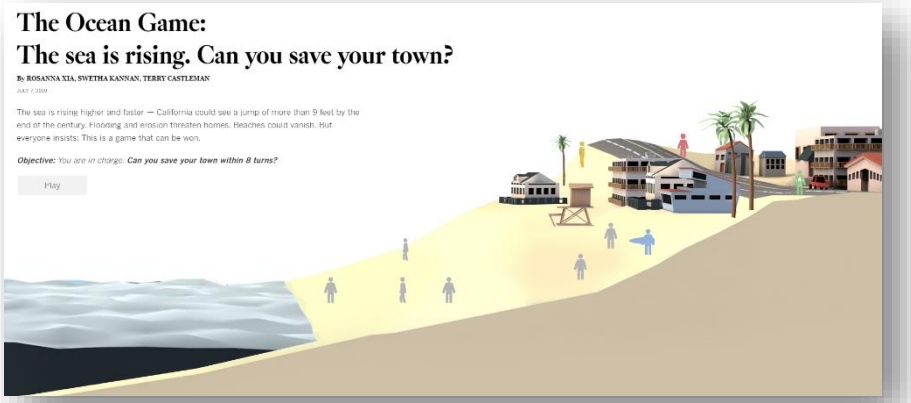
- Stakeholders develop a deep understanding of the harbor's current and future challenges so that they can provide meaningful feedback about what interventions/changes they want to prioritize.
- Planning staff develop a rich understanding of the current relationship stakeholders have with the harbor.
- All participants develop a shared understanding of the Resiliency Plan and support the creation of recommendations that address the immediate need for improved resiliency in Snug Harbor while ensuring the area continues to be economically vibrant.
-

Engagement Activities

During the course of the project, MAPC staff designed and facilitated several different engagement activities in support of the purpose and goals outlined above. These included focus groups, a community survey, and a public meeting. A full description of this project's Engagement Strategy can be found in Appendix A**.**

Outreach

Potential stakeholders and members of the public were contacted using a variety of methods depending out which engagement activity they participated in.



Focus Groups

MAPC staff conducted three focus groups with specific groups of stakeholders in the study area: Residents, Water-based Businesses and Organizations, and Non-water-based Businesses and Organizations. Any organization or individual who owned or operated a business or institution in the study area was invited to participate in the applicable focus group. MAPC staff identified relevant stakeholders and contact information through a combination of referrals, online research, and assessor database research. Once non-water-based and water-based focus group participants were identified, MAPC staff recruited them through email, phone outreach, and one-on-one conversations. Resident focus group participants were additionally recruited via an invitation mailed to every address in the focus group area.

At each focus group participants were first given a summary of the Resiliency Plan's scope and goals as well as an introduction to the issues currently facing snug harbor and an overview of the current research regarding sea level rise, flooding, and coastal storms. Participants then collectively played the Los Angeles Times' "The Ocean Game". Finally, MAPC staff led participants through a series of facilitated exercises aimed at gathering their experiences in Snug Harbor, defining the problem, framing solutions, and generating ideas for discussion. The Focus Group presentation is attached in Appendix B.

Survey

Following the focus groups, MAPC staff designed a survey aimed at gathering similar feedback from the general public. Questions were designed to be interactive and fun and to replicate the types of questions asked in the focus groups in order to ensure consistent data. Feedback gathered from the survey results further refined the conclusions of this project. The survey was shared with approximately 1,000 individuals, including all identified focus group participants and public meeting attendees; participants in

Envision Duxbury, a process that MAPC also completed; and applicants on the Town's Mooring List. In total, 147 participants completed the survey in its entirety.

Public Forum

MAPC staff facilitated one public forum, which had approximately 40 participants. Outreach for the public forum included flyers posted around Town by Town Staff, traditional public notice, press releases sent to local media outlets, and emails sent to all the individuals listed above. Attendees were given an overview of the project and a summary and description of the possible resiliency solutions. During the presentation, participant feedback was solicited via Poll Everywhere, an online tool that enables participants to text responses to questions live during a presentation. Paper copies of the in-presentation questions were distributed as well. After the presentation, attendees were invited to vote on their preferred solutions by placing a colored pin corresponding to a particular solution on a map of Snug Harbor (Figure 6). This activity was designed to solicit place-based solutions voting from attendees so that MAPC and Town Staff could asses how and where the most preferred solutions could be located.

Community Participants

Focus Groups	**Residents: 14** **Water-based: 6** **Non-water-based: 7**
Survey	147 completed responses Note: there were 282 responses to the survey, but only 147 were 100% completed responses.
Public Forum	~40 attendees

Survey Demographics: Answers to the demographic questions in the survey were voluntary. As a result, the number of respondents who chose to fill out these questions (130) is less than the total number of 147 responses.

- **Income**: Most respondents had an income of over $140,000 per year (66%). Less than 16% had an income $85,000.
- **Residency**: Almost 85% of respondents were year-round residents of Duxbury. The next most common residency type was Seasonal. Only 13 respondents (9%) lived outside of Duxbury, however the majority of those worked or owned property in

Figure 6 Public Forum Posters where participants were asked to place color-coded resilient solution pins onto the map both indicating solution preference and geographic location.

Snug Harbor **Resiliency Plan**

Help define appropriate resilience solutions for Snug Harbor

Follow the 3 steps to share your priorities:

Step 1 Review potential resilience strategies below and pick your top (3) strategies for improved resilience in Snug Harbor

Step 2 Pick the (3) pins that correspond to the color of your top (3) strategies

Potential Solutions Inventory

Category	Strategy	Description	Example	Pin Color
Open Ocean Adaptation				
A	**Fortification** *Fortification structures in the open ocean at the outer edge of the harbor, mouth of the harbor, or inner harbor.*	*A major man-made structure that places a fortification or barrier at a location in the water that would reduce wave action and storm surge.*	*A stone jetty, hurricane barrier or hurricane gate such as the New Bedford Hurricane Protection Barrier (shown in image) or the Fox Point Hurricane Barrier in Providence.*	(red)
B	**Attenuation** *Floating structures in the open ocean at the outer edge of the harbor, mouth of the harbor, or inner harbor.*	*A system of objects or structures that reduce or weaken wave action and storm surge by disrupting the wave energy.*	*Floating breakwaters are buoyant objects typically consisting of box, pontoon, mat, tethered float, or other shape (shown in image).*	(darker blue)
Coastal/Harbor Adaptation				
C	**Fortification** *Fortification structures at the coastal edge between the harbor and the land.*	*A variety of coastal edge structures including rip-rap, boulders, armor stone walls, revetments, sea walls, sheet piling that protect against rising sea levels and waves.*	*A variety of coastal fortifications are employed at Snug Harbor properties today such as boulders, sea walls. A sculptural seawall is shown in the image.*	(orange)
D	**Attenuation** *Artificial or natural systems at or near the shoreline.*	*A variety of man-made systems or support for natural systems that reduce or weaken wave action and storm surge by disrupting the wave energy.*	*Man-made systems may include living shoreline systems, or break waters. Natural systems may include beach nourishment, salt marshes, artificial dunes,or oyster reefs.*	(lighter blue)
E	**Elevated** *Raising the elevation of the coastal edge, typically on the immediate land side of that edge.*	*A variety of approaches to raise the elevation where water enters the district that protect against rising sea levels and waves.*	*Elevated stone walls, earthen berms, man-made topographical features, increased elevations integrated with new parks, playgrounds, or improved harborwalk.*	(green/cyan)
Land Adaptation				
F	**Fortification** *Fortification structures on land within the district that provide a barrier to flood waters.*	*Permanent or temporary barriers at buildings, streets, walkways, or other potential pathways for floods that can protect against rising sea levels and waves.*	*Removable, deployable, or retractable flood barriers that are connected to other permanent barriers or buildings or at building entries to prevent water entry.*	(yellow)
G	**Elevated** *Raising the elevation of the building to increase the height of occupied space above projected flood levels.*	*Increasing the height of the building with piles or columns to allow water to flow beneath the building during a flood event.*	*Elevating occupied building levels, moving critical building infrastructure to the roof, elevating other infrastructure and utility components.*	(pink)
H	**Accommodate** *Design parks, streets, buildings, and other infrastructure to flood without extensive damage.*	*Make permanent changes to locations and design of infrastructure, utilities, and equipment to allow flood waters to enter or divert flooding to specific locations.*	*Buildings and infrastructure that are designed and occupied strategically to be floodable, flood diversions that give flood waters room.*	(purple)
I	**Migrate** *The strategic and managed relocation of high risk or high sensitivity functions away from flood risk.*	*Defining where uses could be intentionally relocated and creating opportunities for long term migration of those uses.*	*Incentives for relocation, zoning changes that allow migration of the business zone, property voluntary buyout program.*	(black)

Looking for something else?

If nothing fits with what your thinking, put a white pin at the location with a note about your idea. (white)

Snug Harbor **Resiliency Plan**

Prioritize the most important locations for your top (3) strategies

Follow the 3 steps to share your priorities:

Step 3 Place the (3) pins you selected in "Step 2" in the highest priority locations where the strategies would be appropriate in Snug Harbor

Duxbury, 5 (3.5%) and 3 (2%) respectively. Of those respondents who live in Duxbury, the majority live in either Precinct 1 or Precinct 2.

- **Gender:** The majority of the respondents identified as men: 63% of the respondents selected "male" and 34% selected "female."

Relationship to Snug Harbor: The survey also asked residents to describe their relationship to Snug Harbor and indicate what kinds of activities they and their family members enjoyed when they visited.

The most commonly selected options were "recreational user" and "resident", by 38% and 30% respectively. Eighteen percent of respondents indicated that they were business patrons. The remaining categories, business owner, employee, or "other", were all under 7%. Respondents were able to select any of the options that applied to them.

- Individuals were most likely to go to Snug Harbor to dine out (18%), participate in water recreation activities (17.5%), or go fishing or shellfishing (13.5%)
- Families were most likely to participate in water recreation activities (19.5%), dine out (18.5%), or go fishing or shellfishing (14%).

Visiting Snug Harbor: Based on the survey responses, many of the respondents visit Snug Harbor on at least a weekly basis all year round, though there were some differences between the summer months and the rest of the year:

- During the Summer, the overwhelming majority of respondents (91%) indicated that they visited Snug Harbor at least weekly: Daily (48%), Weekly (43%)
- During the other seasons, the majority of respondents (70%) again indicated that they visited Snug Harbor at least weekly. However, the number of residents who visited Snug Harbor only Monthly jumped to 6% to 25%.

Results: Community Response

Snug Harbor Strengths

Snug Harbor is the area identified by the community as a unique combination of scenic beauty, historic value, and cultural and community activity. Noted by participants as the heart of Duxbury, a community gathering space, and an economic asset to the Town and region, Snug Harbor is highly revered by residents and visitors alike. Participants were asked to identify the Snug Harbor's strengths or what is working well today in Snug Harbor.

There are several assets that were repeatedly noted and beloved by participants in the study. The most frequent responses were Duxbury Bay Maritime School (DBMS) with 14% response rate, retail shops at 6% response rate, Duxbury Yacht Club at 4%, French Memories at 3% and the quaint atmosphere of the area at 3%. The remaining 73% of responses covered a wide variety and Figure 7 solution preference and geographic location.

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Figure 7. Word Cloud summarizing the assets and strengths of Snug Harbor as reported by all participants in the study. Larger words indicate a greater frequency of response.

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Figure 7 summarizes responses by the task force, stakeholders, public forum and online survey. Some participants noted that Snug Harbor's strengths are the tides; they ebb and flow every day, a critical process that ensures a vibrant oyster industry, and indeed, oysters, the oyster industry and Island Creek Oysters were prominent assets and strengths identified at Snug Harbor. Overall, the small businesses and beauty of the area were also a frequently described asset to Snug Harbor.

Snug Harbor Challenges

Resilience strategies may involve major capital improvements as well incremental investments to minimize or prevent coastal flooding. In order to create the most comprehensive resilience vision, the study asked participants to define the problem or challenges at Snug Harbor. Whereas resilience strategies may require major capital improvements, defining the problems outside of climate change and sea level rise are an important system-based approach to resilience.

Participants were asked to identify challenges or what does not work in Snug Harbor today. There was a wide range in response where 44% of the responses were not unique values, however, there were several trends revealed. Twenty-seven percent of respondents reported parking was a challenge and traffic, traffic flow or congestion was another top challenge at 11%. Bicycle and pedestrian safety were frequently reported at 4% and 3% respectively. Finally, flood control at 7% and competition for space between commercial and recreational boaters (6%) were the other identified major issues. Figure 8 summarizes all the responses to challenges in Snug Harbor and the most frequent challenges are described in more detail below.

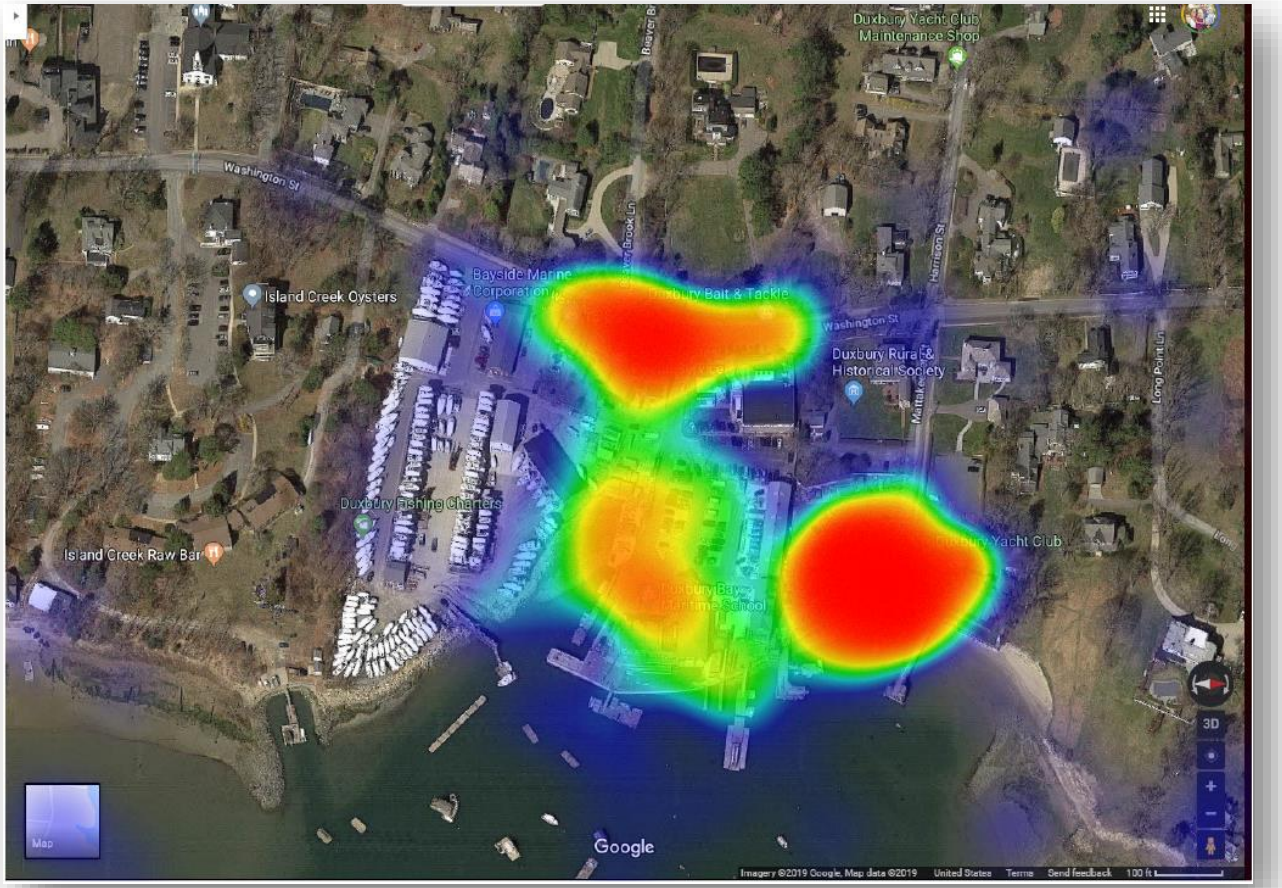
Coastal Flooding

Today, Snug Harbor businesses, residences, Harbormaster, and Town Pier/parking lot are all susceptible to frequent coastal flooding with blizzards, hurricanes, tropical and winter storms, and nor'easters. Greater wave energy has been observed in the area causing more infrastructure damage and stone-throw. With sea level rise, an astronomical high tide with 30 mile per hour winds can cause flooding on to Mattakeesett and other areas in Snug

Figure 8 Participant responses to current challenges at Snug Harbor or what is not working today. The larger words indicate greater frequency of response.

Harbor.[18] The winter of 2018 presented some of the highest sea levels since 1825 and astronomical high tides, hurricane strength winds, near record-breaking storm surge and sea level rise caused widespread and dangerous coastal flooding. During Winter Storm Riley in March 2018, Snug Harbor experienced widespread flooding, causing closure of Washington Street and businesses as well as requiring evacuation. Lower elevation buildings and residences experienced flood damage (*Figure 1*)[19] and the Art Gallery, which had 1.5 feet of water in its gallery, opted to permanently close after the extent of damage from the storm.[20] Finally, the Harbormaster office was completely submerged during Winter Storm Riley. Staff were required to work out of their vehicles during a critical emergency management time.[21]

Figure 9 "Heat" map of Snug Harbor study area indicating frequency of responses to the location of flooding by stakeholders and the public. Areas in red indicating a greater

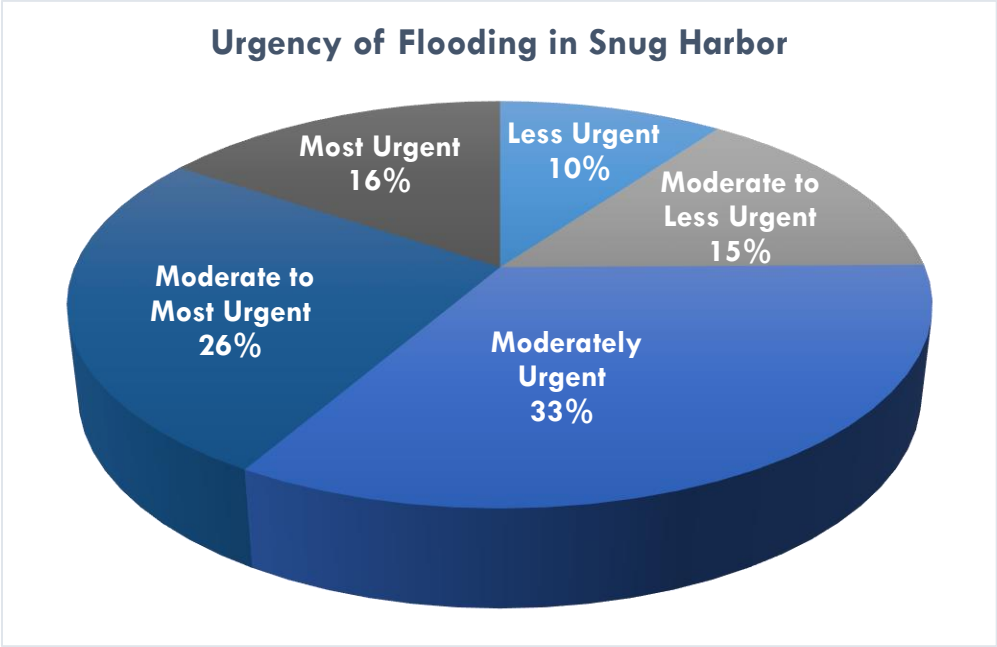


[18] Massard, Valerie. 2018 Snug Harbor Resiliency Study. MAPC Accelerating Climate Resiliency Mini-Grant proposal.
[19] Massard, Valerie. 2018 Snug Harbor Resiliency Study. MAPC Accelerating Climate Resiliency Mini-Grant proposal.
[20] Personal Communication. Snug Harbor Resiliency Task Force Meeting #1. June 26, 2019
[21] Personal Communication. Snug Harbor Resiliency Task Force Meeting #1. June 26, 2019

Figure 9 illustrates where stakeholders and public residents indicated flood areas at Snug Harbor where Long Point Marine and Washington Street are the areas (the "hot spots") where respondents reported flooding most frequently.

Because coastal flooding was one of the challenges reported by participants, the study inquired on the urgency of the matter of coastal flooding at Snug Harbor. The most frequent response to the urgency was "Moderately Urgent" at 33%, however, 59% percent believe that flooding is "Most Urgent" or "Moderate to Most Urgent" (Figure 10). In comparing stakeholder to public responses, stakeholders, reported greater urgency to flooding than the public at large where 40% of stakeholder participants believed flooding was moderately to most and most urgent in comparison to and 29% of the public responses. None of the stakeholders responded that flooding was less urgent.

Figure 10 Stakeholder and public participants' response to the urgency of coastal flooding at Snug Harbor.



Infrastructure Challenges

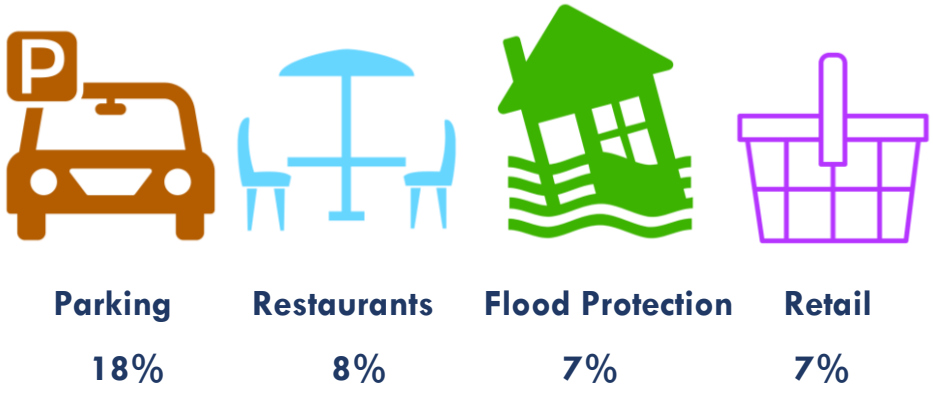
In addition to the climate change vulnerabilities at Snug Harbor, the community has identified additional challenges to the existing infrastructure in the area. First, the Town Pier was built in 1991 and requires maintenance and upgrades to continue to serve the public. Second, the Harbormaster building is insufficient to perform staff operations, too small, located in a vulnerable location on the Town Pier, and outdated. Third, private marinas with deep boat launches are important assets for hauling boats prior to coastal storms. The Town does not own enough facilities to enable quick evacuation of boats during storm events. Coordination and protection of these facilities is critically important. Fourth, stakeholders have reported that there are not sufficient restrooms to support the public use of the area, particularly during festivals and events. For example, the visitors to the outdoor seating at French Memories and Snug Harbor Fish Company are using the DBMS's facilities or the Town Pier facilities because none exist to serve those patrons. Finally, stormwater infrastructure has been identified as being insufficient during periods of heavy precipitation events and coastal storms, where water is bubbling out of the storm drain at DBMS.

Transportation

Parking has been identified as one of the most significant challenges in Snug Harbor. The Town Pier and public boat launch has a public parking lot on Mattakeesett Court containing approximately 60 parking spaces. However, at peak demand, during high-tide on a summer weekend day or during local event and festivals, the parking exceeds the supply. There is competition for parking with a variety of existing users including shell fishermen, kayakers/paddle boarders, recreational boaters, and tourists patronizing Snug Harbor businesses. Importantly, the study has identified an urgent need for creating a space or separate boat launch for commercial fisherman.

The Duxbury Yacht Club, Duxbury Historical Society, and the Duxbury Bay Maritime School host events drawing additional visitors to the area. Overflow parking occurs on Washington Street, Mattakeesett, at the area churches and Island Creek Oysters; however during festivals, Sundays (during church services), and high tide, the limited parking and overflow has created dangerous conditions, particularly to pedestrians walking from overflow street parking to the Town Pier or businesses at Snug Harbor. Residents in both the 1999 and 2019 Comprehensive Plans have identified a desire to create a walking and biking corridor that connects to Halls Corner, the Middle School/High School in addition to safety modifications at key intersections to maximize pedestrian and bicycle use and mitigate vehicular traffic.[22] Resilient designs strategies will consider these transportation challenges and opportunities for a safe walkable and bike able neighborhood as well as supporting transportation alternatives such as the GATRA Bus.

Figure 11 Participants' response for what needs to be in Snug Harbor in the future.



[22] MAPC.2019. *Envision Duxbury Comprehensive Master Plan.*

Snug Harbor's Future

Participants were asked what must be a part of Snug Harbor in the future, or what is most important to protect as we investigate resilience strategies. There was a wide range in response from retreat to development to more open space; however, the inquiry revealed several community-valued trends. The most frequent responses include better parking, more restaurants including harbor-side and outdoor dining, pedestrian safety and sidewalks, flood protection and public access to the waterfront (Figure 11). Other important and frequently mentioned components were creating a commercial boat launch or better space for commercial operations so that recreational and commercial interests are not competing with each other. Improving traffic flow, bicycle and pedestrian safety, and connectivity to assets for walking and biking were frequent responses and requests for consideration for the future. Duxbury Beach as a critical barrier resource was an important asset for the future encouraging its projection and elevation. Finally, many respondents wanted to retain the historic and natural features of the area, with living shorelines and elevating existing buildings (Figure 12).

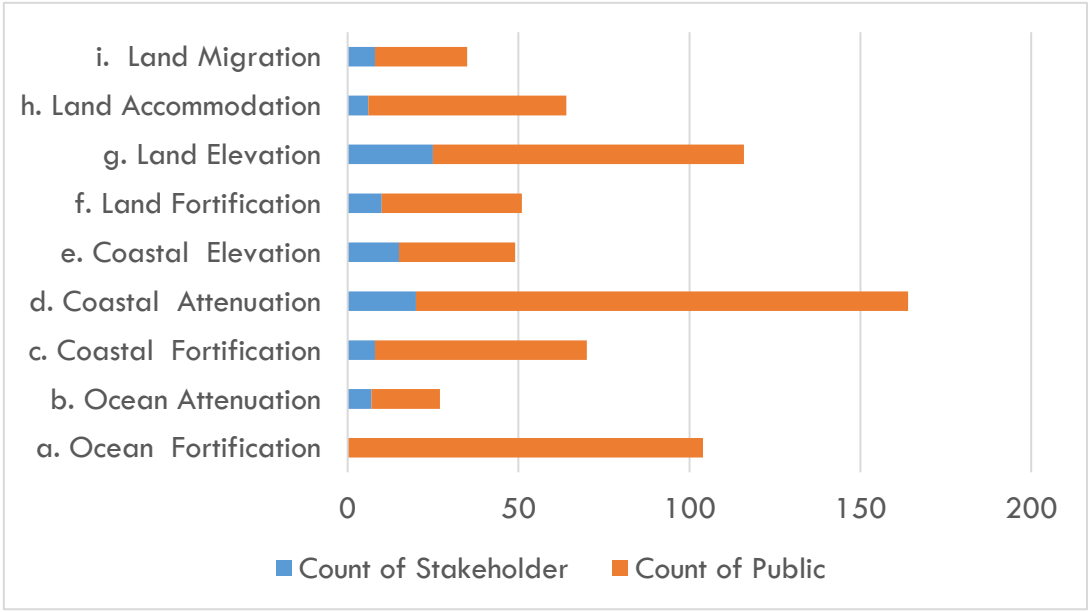
Resilience Solutions Preferences

Resilient strategies for protecting against sea level rise, storm surge and coastal flooding take various forms including infrastructure improvements, changes in land use, regulation, zoning, incentives, and nature-based solutions. Each strategy has a cost, both financial and environmental, and sometimes multiple benefits. For example, living shorelines are relatively low cost solutions that dissipate wave energy and enhance commercial fish habitat; however, living shorelines are susceptible to degradation and do not protect against sea level rise. The likely best resilience approach to Snug Harbor is designing some combination of the aforementioned strategies based upon function, community-interest, and willingness and/or availability of financing. Prioritizing long-range capital planning and decision-making in the best interest of protecting Snug Harbor's vitality requires critical input from the stakeholders, residents, and public whose livelihoods, homes, or businesses at stake.

Figure 12 Word Cloud from participants' responses on what needs to be here in the future in Snug Harbor?

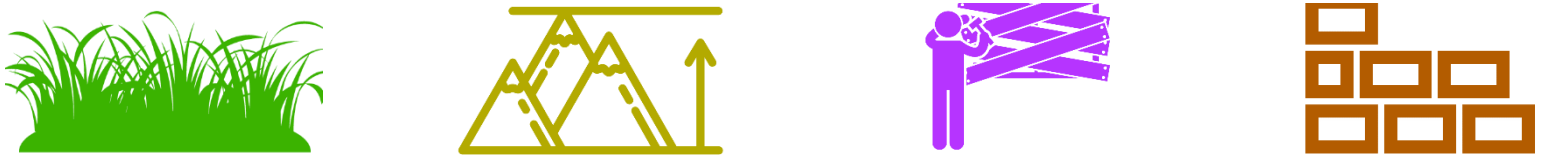
This planning effort presented resilience solutions to participants based upon geographic location (inland, coastal/harbor, and open ocean) as well as function (fortification, attenuation, elevation, accommodation, and migration). Relative costs and benefits in relation to expense and environment were presented to individuals to consider (Appendix B). Participants chose their preference for their three top resilience strategies that would protect against coastal flooding while considering Snug Harbor's assets and multiple functions. This exercise served to refine and prioritize the resilience approach and ascertain the geographic and function preference as well as willingness to finance.

Figure 13 Stakeholder and Public resilience solutions preference, count of responses by engagement group.



Overall, the most preferred resilience solutions included (i) coastal attenuation such as beach nourishment, living shorelines, oyster reefs, and break waters and (ii)land elevation such as elevated structures, roadways, and utilities. The stakeholders responded most frequently (93%) to land elevation whereas the majority of responses from the public (52%) were a preference for coastal attenuation (Figure 13). Ocean attenuation and land migration were the least preferred strategies at 38% and 40% respectively, and none of the stakeholders preferred ocean fortification such harbor barriers or hurricane gates. This differs

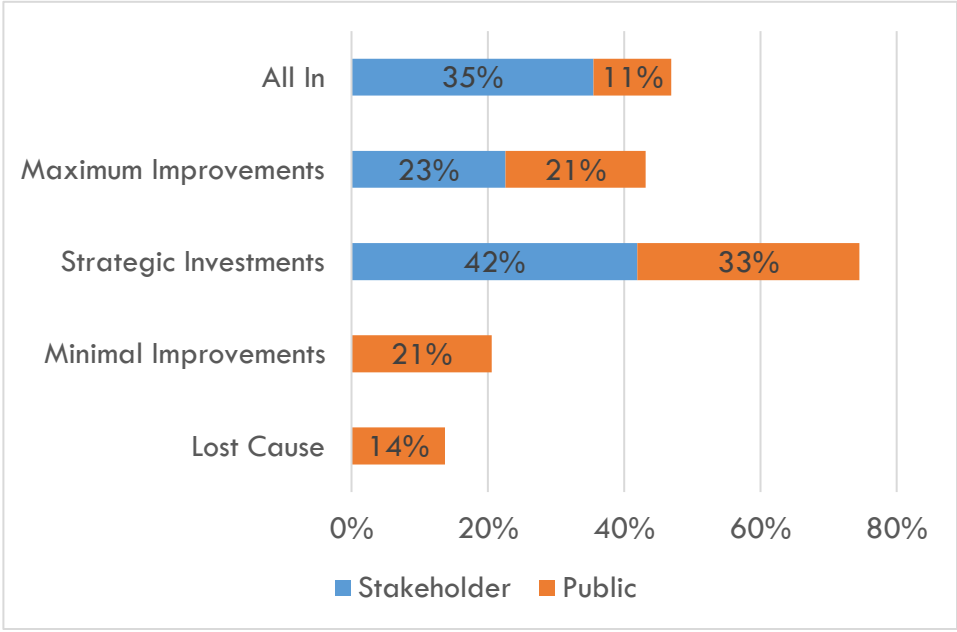
Figure 14 Resilience solutions categories most frequently preferred by participant.



significantly from the public response to ocean fortification at 38%. Further, stakeholders had a greater preference for land migration (30% of responses) than the public (10% of responses). The median of response frequency is 30% for stakeholders and 21% for the public. The median can provide an indicator of the range of resilience strategies the participants might be willing to support.

Resilience solutions will require an investment, both public and private and a variation thereof. Major capital improvements that include resilience designs could require a significant public investment. Public funds could include federal, state, and/or local funding. Private funds could be from an individual's willingness to pay for improvements or philanthropic support for resilience. For example, coastal attenuation resilience strategies would likely involve public funding whereas many land elevation strategies might require an individual's investment. This study sought to ascertain stakeholder's and public's willingness to pay for resilient solutions collectively as a determination on how the Town pusing public funds, private grants, Town Meeting support or regulations or incentives that require an individual to pay for resilience.

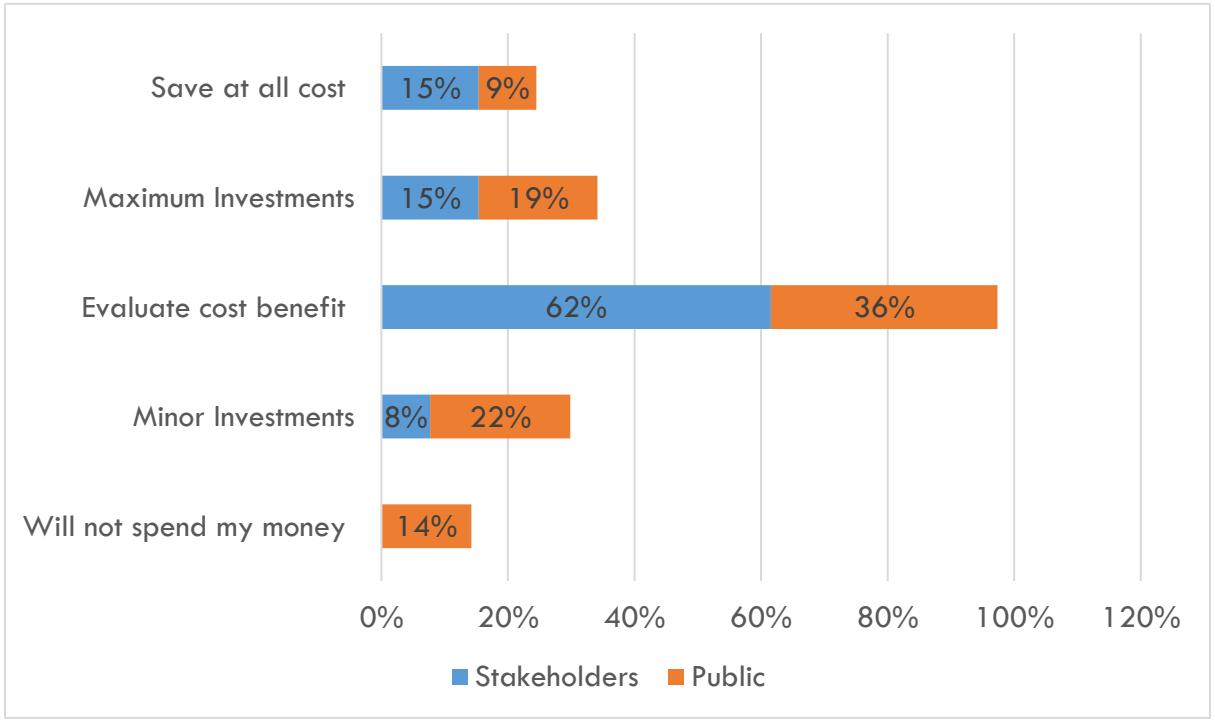
Figure 15 Stakeholder and Public willingness to finance resilience collectively, such as public funding or as a community. Percentages the proportion of each population total rather than the total population of both groups.



Overall, the most frequent response by both stakeholders (42%) and the public (33%) were a willingness to pursue strategic investments- evaluating new technology and information in relation to climate change over time and ones that worked to solve multiple problems. Fourteen percent of the public believe that Snug Harbor is a lost cause and not worth investment whereas none of the stakeholders responded lost cause or minimal improvements, and 35% of stakeholder's response were to pursue investment all in (Figure 15).

Participants responded similarly to a collectively investment as their own willingness to spend their own money on building resilience. Both stakeholders (62%) and the public (36%) responded midlevel, evaluate cost benefit, on their willingness to pay as an individual. Fourteen percent of the public would not invest any of their own money and 9% of the public would save Snug Harbor at all cost. Fifteen percent of stakeholders would save Snug Harbor at all cost. Overall, there was a general willingness to invest their own funds and overall general support for pursuing incremental investments toward Snug Harbor resilience.

Figure 16 Stakeholder and Public willingness to spend their own funds to protect Snug Harbor. Percent are totals of each population rather than the total population of both groups.



Snug Harbor Resilient Vision

The following Resilient Vision is based on the results of the community-based process undertaken in Snug Harbor to strengthen resilience of the coastal neighborhood business district. The Resilient Vision is comprised of recommendations that provide a set of coordinated activities that can be undertaken through public and private actions and investments to bring about incremental resilience improvements. The Snug Harbor recommendations are focused on how to create a more flood resilient district, in the short and long term, that preserves the quaint character of the area; aids in parking, traffic, and congestion; creates better safety for walkability and bike-ability; improves boat launch and water access; and reinforces the economic and community vitality of the neighborhood business district. The core strengths of the district (Duxbury Bay Maritime School, quaint retail and local businesses, the Duxbury Yacht Club) are complemented by this the recommendations outlined in this vision for the district. The core challenges (traffic, parking, flood control, access) are directly confronted and the focus of the major changes through the recommendations outlined in this vision. The recommendations respond to the most preferred resilience solutions articulated by the community and include a focus on coastal attenuation and land elevation as the most preferred resilience solutions. These solutions look at ways to strengthen the natural systems of resilience for the district and effective and manageable ways to elevate the district's assets above potential flood levels.

The recommendations are divided into two sets of linked, but separate approaches to future improvements:

- **Policy/Program Recommendations –** This type of recommendation involves a change to a the regulation, management, or operation of the Snug Harbor and would typically involve a more easily attainable resilience adaptation as most would not require a major funding resource to make happen, but would instead require focused and supported efforts by the Town staff and leadership.

- **Infrastructure Recommendations –** This type of recommendation is focused on adapting the physical composition of Snug Harbor to incrementally invest in improvements that will strengthen resilience to flooding and improve the functionality of the neighborhood business district for a variety of users. This set of recommendations will require investment by public and private entities that would be occurring both on public and private parcels in the district.

Policy/Program Recommendations

Oyster Reef Breakwater Program

Duxbury Bay is home to a vibrant and thriving shellfish industry. Other communities have implemented artificial breakwater installations that are also deployed as oyster beds. The combination of these two features could provide an interesting resilience solution for Snug Harbor. This type of resilience solution, natural coastal attenuation, was the most preferred by community members. This type of resilience solution would provide protection against wave energy and storm surge. While the barrier beach of Duxbury Beach provides this type of protection today, a second breakwater installed near the Snug Harbor coast would provide a second redundant system if the barrier beach were to breach in the future with sea level rise. This type of solution would not be designed to provide protection against rising sea levels, however it can minimize coastal erosion of salt marshes and minimize the impact on hardened shoreline infrastructure, adding longevity to its functioning life. The specifics of this type of program would need to be evaluated and planned to be consistent with the Duxbury Aquaculture Management Plan and the operations of the shellfish growers in the bay, but as a concept this type of solutions seems well aligned with the assets of Snug Harbor. The approach typically involves submerging artificial structures in more shallow waters near the coast line. These structures then dissipate wave energy away from the shore and provide an artificial habitat for marine life. A detailed site analysis would be required to determine where this type of living shoreline would be most advantageous for Snug Harbor. The analysis would consider navigation channels, coastal erosion rates, elevation, wave energy, prevailing wind and wave direction, vegetation and soil types along the coastal edges.

Resilient Zoning Recommendations

The community vision included a desire to see more restaurants and destinations in Snug Harbor, including harbor-side and outdoor dining. The zoning in the district could be refined to support this vision while requiring the inclusion of resilient features in future investments in the district. Currently, parcels in Snug Harbor are in the Neighborhood Business District 1 (NB1), Neighborhood Business District 2 (NB2), Residential Compatibility District (RC),

Case Study: The Billion Dollar Oyster Project

Oyster Reef Barriers are being installed all over the world to protect shorelines from coastal storms where the reef acts as a natural breakwater, dissipating wave energy before it reaches the shore and minimizing coastal and marsh erosion. Oyster reef barriers also improve water quality, enhance the commercial fishery, and improve marine habitat. The Billion Dollar Oyster Project in New York City is an excellent partnership to add one billion live oysters in around 100 acres of reefs distributed across New York Harbor by 2035. The project collects 10,000 pounds of discarded shells a week, cures the shells at Governor's Island for a year, then brings them to a hatchery with larvae. Once they have grown, New York Harbor School students, divide the shells into permeable bags which are strategically placed in reef cages throughout the harbor.

and Wetlands Protection Overlay District (WP). The RC parcels include those accessed from Mattakeeset Court and parcels with frontage on the west side of Washington Street. The NB2 parcels include the parcels on the water's edge. The NB1 parcels include the parcels with frontage on the east side of Washington Street. It may be useful to differentiate this district from other NB1, NB2, and RC districts in the town, to address the specific resilience and coastal concerns of Snug Harbor. This could be achieved through the creation of a new underlying zone.

The zoning in the Snug Harbor Neighborhood Business district should be tailored to the unique circumstances of this coastal district. In regard to the community interest in additional restaurants and destinations, currently Restaurants, Service Establishments, and Retail Business are allowed only by Special Permit. Allowing these uses by right subject to site plan approval would provide a regulatory context that is more welcoming to these types of desired uses. In regard to coastal resilience, the zoning regulations should require new buildings to design all occupiable space a minimum of 3 feet above the FEMA 1% annual chance flood elevation. If existing buildings are investing in improvements over 50% of the value of the structure, the entire structure should be raised to a minimum of 3 feet above the FEMA 1% annual chance flood elevation. Utilities and critical building infrastructure should be required to be located on an upper level or integrated as part of the roof of the structure. Building foundations, basements, or crawl space should be required to be designed as floodable areas that can withstand water inundation. These requirements may necessitate an increase in maximum height for the district. The maximum height is currently thirty (30) feet and should be increased to not penalize projects that raise the building due to flood resilience requirements. The same height the building is raised could be added to the maximum height on a sliding scale.

Parking Management

During peak times, such as high tide during the summer boating season, the parking areas at Snug Harbor experience demand that exceeds the capacity available. During these times all parking spaces are full of vehicles and the overflow parking lines along Washington Street with vehicles along the side of the street toward St. George Street. As has been shown repeatedly for issues surrounding vehicle congestion, the need to accommodate more vehicle demand, either on roadways or parking areas, cannot be accomplished through an increase in capacity alone. Other measures must be taken to help influence the patterns of peak demand and calibrate the use of this shared and valuable public resource. Parking management can provide the tools to manage the demand around the limited parking resources at Snug Harbor. Defining time limits for parking will help to manage the demand for parking and encourage an increase in the frequency of parking turnover in the district. The time limits can be associated with parking fees or parking meters that would help to reinforce the turnover of spaces. A variety of time limits should be offered to respond to the variety of uses that occur in the district. This may include 2 hour parking, 4 hour parking, and all day parking. It may also include differentiating commercial parking spaces. The parking management would require periodic enforcement to operate effectively. The fee, meter, and ticket revenues should be reinvested into the district with a particular focus on the maintenance and operation of the parking areas.

Commercial Boat Launch

Creating a commercial boat launch or better space for commercial operations were mentioned frequently by the community when articulating a vision for Snug Harbor's future. Currently, many of the boat launches for commercial or recreational boats occur at the Town's boat ramp at the end of Mattakeeset Court. The Town should explore potential partnerships that could occur with one or more of the private water access areas that are adjacent to Snug Harbor. This type of partnership could be explored at Bayside Marine, Island Creek Oysters, or Long Point Marine to provide an alternative location for commercial boat launches. Potentially an access agreement with compensation or benefit to the property owner could establish a framework for providing access for commercial vessels that would alleviate some of the pressure on the public boat launch and parking area at Mattakeeset Court.

Remote Parking with Valet Service

Even with alternative commercial boat launch locations, improvements to circulation, and increased parking capacity, it is likely that the demand for recreational and commercial boating access will continue to increase and place pressure on the public boat launch and parking area at Mattakeeset Court. One component of the difficulty associated with the high demand for water access is the storage of vehicles and trailers for patrons who are day boaters. One solution that could help to reduce this aspect of demand at Mattakeeset Court is to provide parking that is remote from the waterfront. The logistical challenges of remote parking under this circumstance make it difficult and unlikely to be used. However, it is important to alleviate this type of demand for valuable parking spaces to allow more active parking with more frequent turnover of parking spaces to occur. Hotels, restaurants, and other high volume destinations that have frequent arrivals, predictable timeframes for parking, and the need to store vehicles away from the primary point of access have successfully relied on valet parking services as a solution. This type of approach could be applied to remote parking for Snug Harbor combined with a valet parking service for vehicles with trailers once the boat is launched. The remote parking location could be a municipal property or location that is relatively nearby and may be underutilized during the peak demand periods for Snug Harbor. The parking and circulation areas at the Duxbury School complex may be well-located for this purpose and could offer a variety of options for possible locations to store the vehicles. The complex is about 1 mile away from Snug Harbor. While the remote location could be provided by the Town under an agreement, the operation of the valet service should be provided by a private entity. It may be a model of expanded service that could fit well with the services offered by a local marina.

Infrastructure Recommendations

Address Boat Ramps as Flood Entry Point

As a deliberate access point that provides a ramp down into the water, the boat ramps in the district will always be a point of flood water entry during a storm or high water event. This flood vulnerability in the district cannot be completely mitigated, but should be addressed with temporary or deployable flood barriers that can reduce the amount of water that would enter the district through these points of water access and work in conjunction with other infrastructure recommendations to create a flood barrier for the district. A deployable flood gate or barrier near could be designed to connect to other permanent flood barrier features that flank the boat ramp. One example of this type of solution is a deployable flood gate that could work for this application is a water-gate water dam.

This type of solution is portable, self-inflating, and reusable. This type of solution would be used to close the opening in district flood defenses that may remain if other recommendations for flood mitigation are implemented.

Another more costly approach to the potential flood pathways that boat ramps represent would be to regrade the boat ramp and access area to increase the elevation at the top of the ramp. This regarding could reduce the likelihood that boat ramps will flood during high water events. In Snug Harbor the most critical boat ramps are the public boat ramp at the end of Mattakeeset Court, the boat ramp at the Duxbury Bay Maritime School (DBMS) and the boat ramp at Bayside Marina.

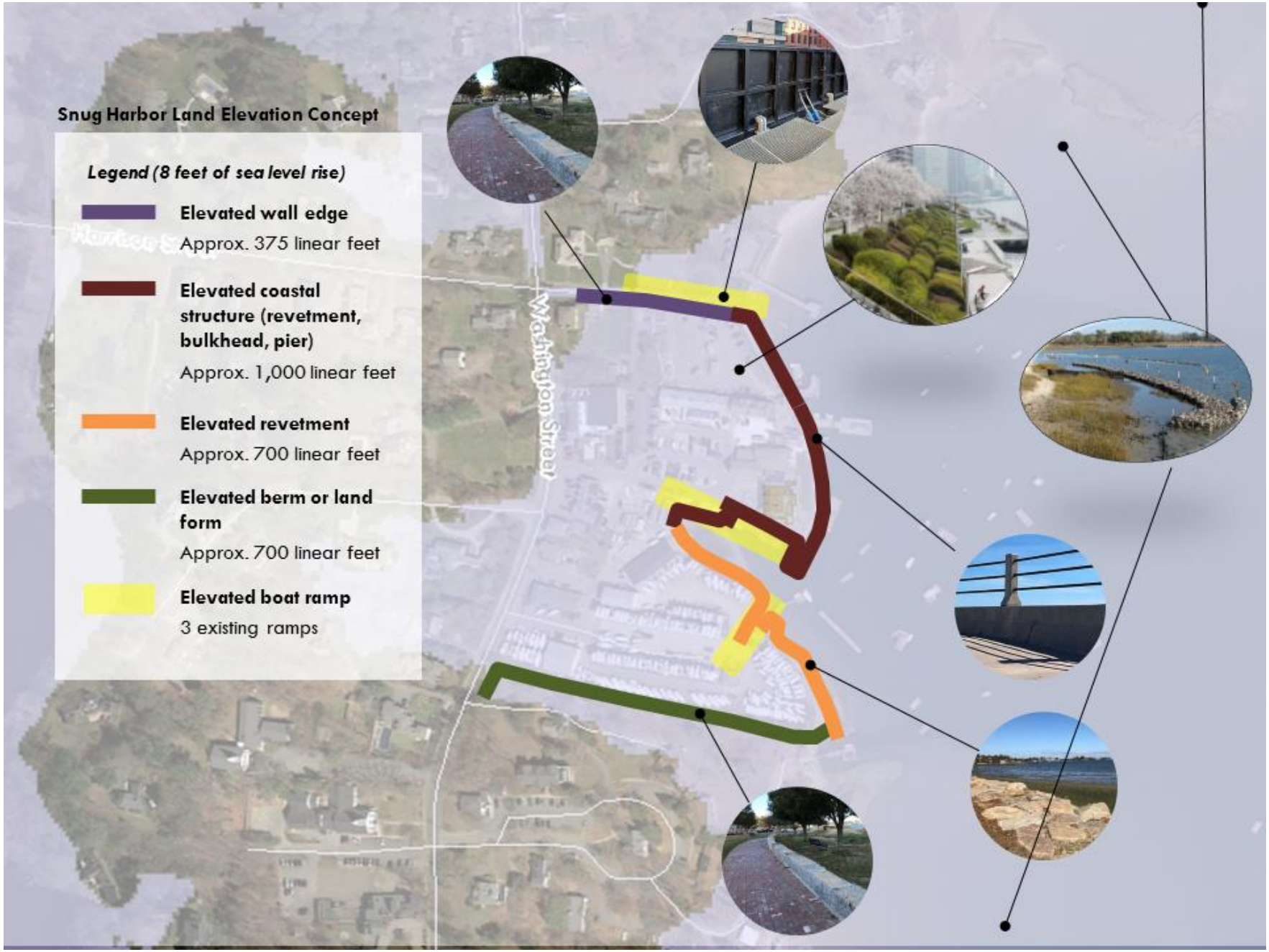
Incrementally Lift Coastal Edge

Land elevation was the second most preferred approach to improve resilience in the district among the inventory of resilience approaches that were presented. The specific solution that responds to this preference of elevation is focused on the elevation of the coastal edge as an approach that is would be effective in a district that includes a variety of existing buildings and site improvements. By elevating the land at the edge of the district the resilience to rising water levels is increased and the current buildings and sites require less intense reconfigurations. The land elevation approach can also be combined with other district improvements or maintenance efforts. For example, the Town Pier was built in 1991 and is in need of maintenance and upgrades which could be integrated with investments that raise the elevation of the bulkhead edge at the Town Landing. The land elevation would require coordination and protection of public and private land, particularly private marinas with deep boat launches that are important for retaining capacity of boat access to the water, and that would be a critical part of this elevated coastal land barrier. The elevated land edge could be combined with a continuous harborwalk path, exterior plaza spaces, an expanded Harbormaster facility, and more resilient boat ramp configurations to improve the resilience and public amenity of Snug Harbor.

The land elevation would combine several different approaches depending on the existing context and coastal conditions. The solutions would wrap the coast at Snug Harbor and would require elevation of district edges at the north along Mattakeeset Court and at the southern edge of the district that would bring elevation measures back to the Washington Street edge in order to protect the area from the flood along all vulnerable edges. About five specific land elevation approaches would be used along these edges. At Mattakeeset Court a stone wall could be added to improved pedestrian access to provide a continuous flood barrier along that edge. This newly designed barrier could be integrated with an elevated boat ramp or a boat ramp redesigned with flood gates or that uses temporary flood barriers during storm events. The existing hardened edge along the town parking area and Duxbury Bay Maritime School would be elevated with a new bulkhead edge with increase height and railings. This elevated edge could be integrated with an elevated harborwalk, open space amenities, or other new features at the coastal edge with steps, seats, or other terraced design elements that would take advantage of the increased height. Other coastal edges that are not currently hardened would be elevated with a reconstructed stone revetment to increase the height. The landscaped buffer between Bayside Marina and the Island Creek property could be elevated with a similar stone wall combined with a new coastal walkway or it could be the land could be filled and elevated with a berm.

Figure 17 shows the general extent of the different approaches for this land elevation concept. The background graphic shows the extent of potential flooding with 8 feet of water level above the local high tide line (mean higher high water). As outlined in the Climate Change and Snug Harbor introduction of this report, sea level rise projections for the "highest" emission scenarios and other local and state-wide sea level rise projection models indicate that Massachusetts could experience between 6.5 and 7.5 feet by the end of the century. The diagram showing the extents of 8 feet approximates a worst -case scenario for frequent flooding extents by the end of the century. The flood extents reinforce the need for land elevation to occur in a rotated "W" shape that would extend to Washington Street. Thumbnail examples of each potential type of solution are included in the diagram. The approximate length of each type of solution is also noted in the color-coded legend.

Figure 17 Resilient Vision Recommendations for Land Elevation with Sea Level Rise at eight feet (NOAA).



Beach Nourishment

Outside of district, the barrier beach of Duxbury Beach provides significant coastal protection to Snug Harbor and other portions of the Duxbury and Plymouth coastline. The most preferred resilience solution from the community's perspective was through coastal attenuation efforts such as beach nourishment, living shorelines, oyster reefs and break waters. These strategies to strengthen the natural systems of resilience already in place should be supported and would complement and directly benefit the other resilient solutions that are a part of the vision for Snug Harbor. While these approaches provide direct benefit to the district dissipating wave energy and significant impacts of coastal storms and storm surge, they do not protect against sea level rise. The other strategies outlined as part of this vision are necessary and complementary components to address sea level rise.

Redefine More Public Amenity at Waterfront

Snug Harbor provides water access for a large proportion of commercial and recreation needs in Duxbury. In addition to getting out onto the water, many people enjoy just being near the water and finding a place to enjoy the views and activity associated with the waterfront. One of the clear articulated desires of the community was to take advantage of the ambience of the waterfront with more restaurants including harbor-side and outdoor dining. This desire could be generalized to a desire to increase public amenity and open space that is publicly accessible in the district. Today, the amenities are clustered on the Duxbury Bay Maritime School property with pleasant plaza, lawn and deck spaces that are directly on the water's edge. These spaces are often filled with tents for events and are used as venues for weddings and other significant events. Other amenity spaces that exist today are away from the waterfront and oriented to Washington Street with outdoor eating and patio areas that are associated with the French Memories Bakery, Snug Harbor Wine, and Snug Harbor Fish Company.

Expanding this type of waterfront public amenity to other parts of the Snug Harbor would expand the options to enjoy the district. A particular focus could be given to the waterfront edge of the parking area at Mattakeeset Court and the area around the Duxbury Harbormaster. If these areas were improved and expanded as a publicly accessible waterfront open space it would create continuity at the water's edge and provide a more welcoming and accessible waterfront for all patrons.

Harbormaster Facility and Public Restrooms

The Harbormaster building is insufficient to perform staff operations and its location on the Town Pier is vulnerable to flooding. The specific design requirements of a new Harbormaster Facility were not developed as a part of this study. A detailed assessment of the building needs and program for the Harbormaster should be performed to determine the feasibility of replacing the current structure in approximately its current location. It would depend on the size and needs of the facility. Potentially, with a reconfigured water's edge and parking area, a new Harbormaster facility could be placed in a similar location and combined with a new public restroom facility. The new facility should be elevated out of the projected flood elevations as per the zoning recommendations and designed with critical infrastructure and utilities placed on or near the roof. Currently, the equipment in the building must be removed to protect it from storm

events and operations must be performed out of a vehicle during those events. The new Harbormaster facility should be considered as a component that is contributing to more public amenity at the waterfront.

Connect a Pedestrian Harborwalk

Creating a connected and continuous pedestrian harborwalk is difficult due to the distinct interests of the private owners of properties that would either need to reconfigure portions of their property or may be impacted by the route of the pedestrian walkway and amenity. This vision is intended as an initial concept that can open conversations about this type of amenity in Snug Harbor. The concept would require the support and agreement of the property owners involved. Improving the pedestrian safety and sidewalks was an important feature of the community's vision for Snug Harbor. The connected Harborwalk path would provide a convenient and attractive walking connection to all parts of the district and along the water's edge while improving public access to the waterfront. The harborwalk could be designed to connect to sidewalks on the west side of Washington Street. Starting from the north, turning the corner from Washington Street to Mattakeeset Court with a new sidewalk on the south side of the street leading east toward the water. This new sidewalk would require sensitive design and integration with the historic features and frontage of the Duxbury Rural & Historical Society property. The improvements would recreate historic features at the sidewalk edge and integrate them with a flood resilience stone wall along this side of the property. The new sidewalk would turn south along the reconfigured parking areas to the rear of the Sweetser's Building. This would connect to a new sidewalk along the edge of the reconfigured parking area that aligns with the new Duxbury Bay Maritime School (DBMS) rowing facility, connecting a future improved Harbormaster facility and a continuous walk along the water's edge. The plazas and waterfront lawns of DBMS would be part of this continuous connection and would then connect to a pedestrian path that is marked on the sidewalk west to the Post Office and back to the existing crosswalk at Washington Street. This type of

Case Study: Creating a Harborwalk on Private Land

The Boston Harborwalk is an approximate 40-mile waterfront public walkway along all of Boston's shoreline neighborhoods, from Charlestown at Chelsea Creek to the Neponset River. It was conceived through the 1984 Boston Harborpark Plan and developed through a collaborative partnership among the City, State agencies, residents, and advocacy groups. The partnership utilized Chapter 91, The Public Waterfront Act, to secure permits for public access in the required set-back areas through a Chapter 91 License. All new and re-development along the waterfront becomes another opportunity to secure another Chapter 91 license and expand the Harborwalk.

The City Planner of the seaport community Belfast, ME had a vision to enhance tourism and economic growth through its working waterfront. As part of local, state, and federally funded project, they transformed an old railroad to a harborwalk. However, some of the parcels were privately owned. The City is working to negotiate leases and easements to connect the trail. Businesses along the waterfront know that this is a major attraction for Belfast and it has enhanced more diverse restaurants, shops, and businesses in the area.

concept could be extended south, but the operations of the Bayside Marine property may pose safety risks for pedestrians that would determine the location of a potential pedestrian connection. A more direct connection between Snug Harbor businesses and destinations to Island Creek Oysters near the water would be beneficial to pedestrian circulation for the district.

Enhance Vehicular Circulation and Connections

Improving the traffic flow was one of the important and frequently mentioned aspects of the community's vision for Snug Harbor's future. The amount of vehicles that need to circulate into the Snug Harbor parking areas during peak times exceed the capacity of the parking and circulation. The vehicle and trailer valet program could help to alleviate the peak demands for parking capacity, but circulation may require additional refinement and improvement. Currently vehicular circulation is provided to the town pier parking by Mattakeesett Court and to the Duxbury Bay Maritime School parking by a single two-way entry drive. No circulation connections exist between these two primary parking supplies offered in the district. Circulation and access benefit from providing multiple routes for vehicles to flow through. Connecting the two major parking areas provides options for vehicles to circulate in and out of the district.

The current town pier parking area provides about 60 striped parking spaces with some additional areas for parked vehicles and storage of boat trailers. The adjacent Duxbury Rural & Historical property includes about 20 unstriped parking spaces in a parking area that is directly adjacent. This type of adjacent parking areas on abutting properties can often be made more efficient when the two parking areas are combined. This type of reconfiguration can often result in an increase in parking while simultaneously increasing pedestrian circulation and open space at the parking area's edges. This type of reconfiguration could be combined with several other improvements including a regrading of the boat ramp to increase its elevation and flood resilience, reconfiguring an area directly at the water's edge as a public amenity that offers a buffer to vehicles, accommodating the continuous pedestrian connection of the harborwalk, provides space for the integration of flood resilient stone walls or other elevated features, creating additional space for an expanded Harbormaster facility, and offering the potential to connect to the parking area and vehicular circulation to the rear of the Sweetser's Building. The parking area to the rear of the Sweetser's Building and the Duxbury Bay Maritime School parking area may also benefit from a reconfiguration and new parking layout to maximize capacity and efficient traffic flow.

The more efficient use of parking capacity in the district at large through these approaches could provide an opportunity to improve parking conditions and vehicular safety on Washington Street. The 90 degree nose-in parking that is provided along the Washington Street frontage could be redesigned as parallel parking spots would be consistent with other nearby parking areas on Washington Street, but would reduce the parking capacity by a few spaces in front of the shops and services there.

Stormwater Infrastructure Improvements

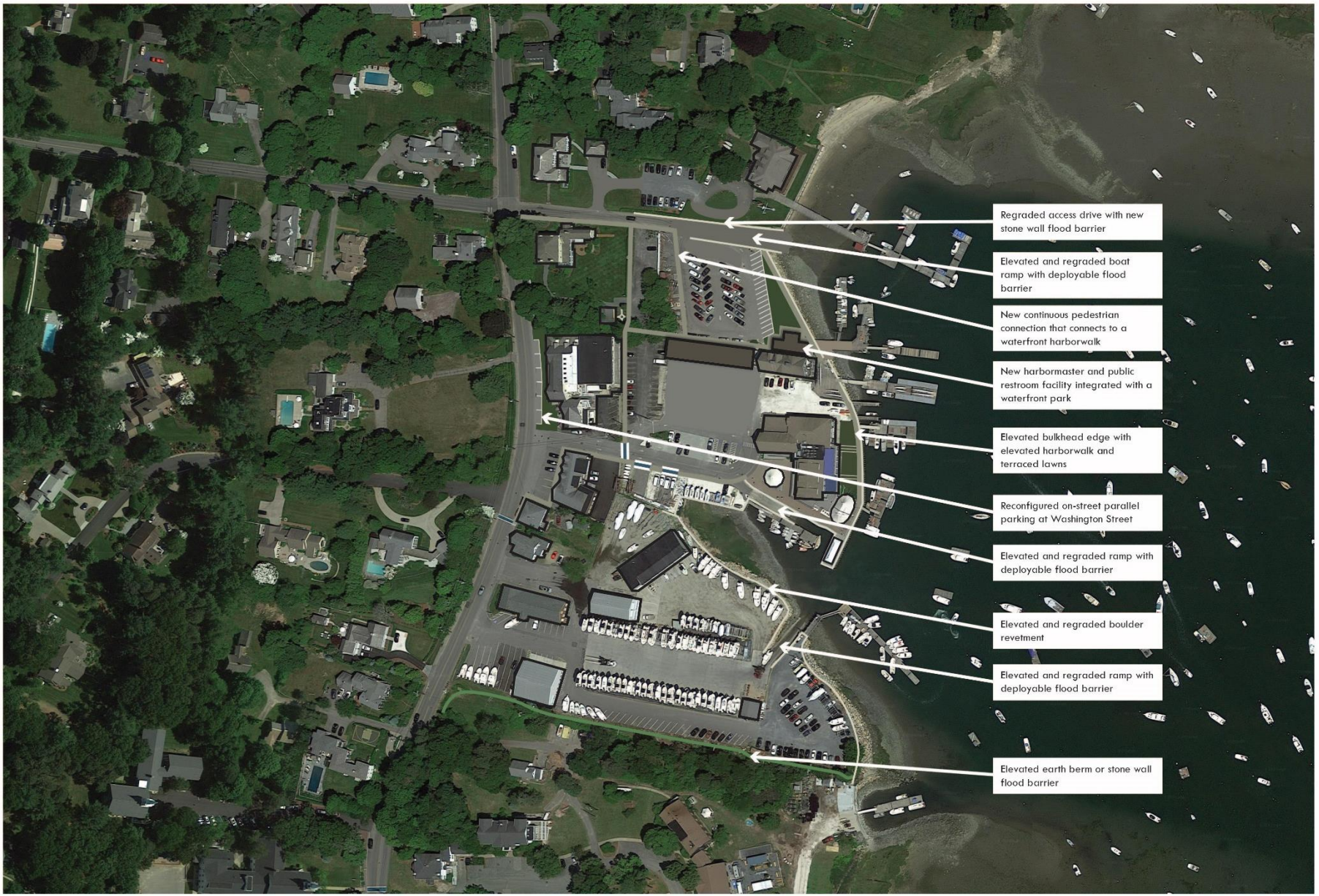
In addition to protecting against sea level rise and ocean water entering the district from the coastal edge, the stormwater in the district must be proactively improved, particularly when resilience improvements such as a raising the coastal edge will have an impact on the flow and collection of stormwater in certain locations. Any regrading, elevated walls, or reconfigured parking areas would require a reconfiguration and improvement of the stormwater infrastructure. As the stormwater system is improved to accommodate these changes

it should also be the subject of a detailed resilience assessment to improve the functioning of the system during storm or flooding events through the use of check valves, location of catchment basins and outfalls, and through low impact development techniques that are integrated into the potential public amenity areas described as part of the district improvements. For example, through eliminating traffic and parking at Mattakeesett through the use of valet, create natural infiltration stormwater retention such as raingardens and bioswales to alleviate additional runoff into the harbor that might carry pollution from vehicle leaks of oil and gas.

Snug Harbor Resilience Concept Illustration

All of the concepts articulated are illustrated on Figure 18. The illustration is for planning purposes only. It depicts a vision for how these concepts may be applied together to build on the great strengths of Snug Harbor while directly addressing the weaknesses defined for the district and improving the future flood resilience with each incremental improvement and investment. The diagram would require coordination between public and private actions and concepts depicted are shown on both public and private properties. The concepts are intended to communicate the ideas and to advance dialogue about the potential of these ideas. The concepts should not be viewed as communicating any specific actions that will be pursued by the Town, particularly when depicting concepts on private properties.

Figure 18 Concept of Snug Harbor Resiliency Solutions



Potential Implementation Approach

For all infrastructure recommendations along the coast and particularly over tidal land and water, the permitting and regulatory context becomes increasingly complex. Compliance with all federal, state, and local laws regulations and permits for proposed activities must be ensured prior to implementation.

Action	*Timeframe*	*Order of Magnitude Construction Cost*	*Potential Funding/Partners*
Policy/Program Recommendations			
Oyster reef breakwater program	Long term *Note:* timing would be connected to barrier beach protection. If that protection were compromised in the future, the natural breakwater concept may become more necessary and urgent.	$1,000 to $5,000 per linear foot of living shoreline with $100 per linear foot annual maintenance costs (Source: National Oceanic and Atmospheric Administration (NOAA) Fisheries	U.S. Army Corps of Engineers, The Nature Conservancy, Coastal Zone Management, Municipal Vulnerability Preparedness Action Grant
Resilient zoning recommendations	Near term	$15,000 technical assistance to define specific language associated with improved resilience requirements in the district or an effort supported by staff time	MA Downtown Initiative, MVP Program, MAPC Technical Assistance, town funding, MA EEA Planning Grant.
Commercial boat launch	Near term	Staff time to open dialogue, identify partners, and institute fees.	Town funding, private funding
Remote parking with valet service	Near term	Staff time to define program, identify partners, and establish agreements	Staff Time to work with businesses to implement, private funding.
Infrastructure Recommendations			

Address boat ramps as flood entry point	Near term	$200,00 to 400,000 per boat ramp	CZM Coastal Resilience Grants or Seaport Economic Council Grant, MA Office of Fishing and Boating Access
Incrementally lift coastal edge	Near to mid term	$1,500 to $2,000 per linear foot to replace seawall, approx. $1,000 per linear foot for full height rock revetment	CZM Coastal Resilience Grants or Seaport Economic Council Grant, MA Office of Fishing and Boating Access
Beach nourishment	Mid term	Approx. $500 per linear foot for beach nourishment	CZM Coastal Resilience Grants, NOAA Coastal Resilience Grant, Municipal Vulnerability Preparedness Grant or Seaport Economic Council Grant
Design for elevated park/civic space at Mattakeesett	Near term	Landscape Architect $100,000	Community Preservation Act Funds
Develop waterfront park/civic space at Mattakeesett	Mid term	$500,000-$3 million depending on the design	Community Preservation Act Funds, MA EEA PARC Grant
Harbormaster facility and public restrooms	Near term	Approx. >$1.0M for new facility.	CZM Coastal Resilience Grants or Seaport Economic Council Grant
Create a vision for a connected harborwalk to serve as the regulatory basis for Chapter 91 licenses	Near Term	Municipal Harbor Plan $50,000	Town Funds, MAPC Technical Assistance Grant, CZM Technical Assistance
Create a connected elevated pedestrian Harborwalk	Long-term	$2-5 million depending on the design, site conditions, and site improvements	Seaport Economic Council Grant, Resilient Communities Grant Program NFWF, Community Preservation Act Funds,
Enhance vehicular circulation and connections	Mid term	Site Design and Engineering	CZM Coastal Resilience Grants or Seaport Economic Council Grant
Parking management	Near term	$15,000 technical assistance to define specific language	MA Downtown Initiative, MVP Program, MAPC Technical

		associated with parking management in the district or an effort supported by staff time	Assistance, OCPC Technical Assistance, Town funding
Stormwater green infrastructure improvements, raingardens or bioswales	Mid term	$35,000 for design and construction depending on scale and site conditions	CZM Coastal Remediation Grant Program, MAPC Accelerating Climate Resiliency Grant, Five Star and Urban Waters Restoration Grant NFWF, Stormwater MS4 Compliance Grant Mass DEP, MA Environmental Trust Grants EEA.

References for cost comparisons:

- Quincy (2019) cost of $14.3M to replace 8,000 linear feet of sea wall - $1,787.50 per linear foot.
- Coastal Zone Management (CZM) – Comparison Chart – Relative Costs of Shoreline Stabilization Options – Seawall average construction cost per linear foot of shoreline estimated at >$1,000, full height rock revetments average construction cost per linear foot of shoreline estimated at >$1,000, beach nourishment average construction cost per linear foot of shoreline estimated at $500
- Hingham Harbor Bathing Beach bathhouse/snack stand and surrounding site improvements funded by 2017 Seaport Economic Council grant of $700,000, town approved $150,000 at 2016 town meeting, and town approved $350,000 (50% match of grant) at 2017 town meeting, for a total project budget of $1.2M
- Fall River MA (2017) $400,000 – reconstruction of boat ramp, addition of new fishing platform, drainage improvements, pavement of parking area for 24 vehicles with trailers and 12 single spaces.
- Southwick MA (2018) $300,000 – reconstruction of boat ramp and new boarding floats.
- Harwich MA (2016) $370,000 – reconstruction of parking lot, reconstruction of parking lot, revetment, and bulkhead.

Appendix A

Duxbury – Snug Harbor Resiliency Study
Community Engagement Plan
Draft 2, June 20, 2019

The intention of this community engagement plan is to clearly delineate the purpose of engagement, identify project leads and supports, present a stakeholder analysis, identify resources and opportunities, delineate the scale of engagement, present a plan for materials, and finally form a timeline for implementation. This plan is a living document and will continue to be updated and refined as the study process progresses.

Purpose and Goals of Community Engagement

Purpose

The purpose of the Snug Harbor Resiliency Study is to identify and recommend zoning, incentives, and regulatory approaches for the Snug Harbor area to manage and improve climate resiliency as well as economic, tourist, and recreational vitality in the face of sea level rise and coastal storms.

The purpose of the community engagement for this Study is twofold:

- **Exchange** knowledge between the harbor's business owners, residents, land owners, and other stakeholders and MAPC and town planning staff regarding the nature of the relationship stakeholders have with the harbor.
- **Engage** stakeholders in crafting a vision with recommendations for the area's long term future by exploring common challenges, identifying shared values, and contending with potential trade-offs.

Goals

- Stakeholders develop a deep understanding of the harbor's current and future challenges so that they are able to provide meaningful feedback about what interventions/changes they want to prioritize.
- Planning staff develop a rich understanding of the current relationship stakeholders have with the harbor.
- All participants develop a shared understanding of the Study and support the creation of recommendations that address the immediate need for improved resiliency in Snug Harbor while ensuring the area continues to be economically vibrant.

Throughout the course of the Study, stakeholders should be informed of the ways they can provide feedback and how they can be involved in the process. There should be a focus on public communication that announces upcoming engagement opportunities, lets the specific stakeholders know the Study's current status, learn about past events, and access relevant information.

Project Leads and Partners

Town of Duxbury Staff
The following staff from the town of Duxbury will be the main team working on the Resiliency Study.

Name	Position/Affiliation	Email
Valerie Massard	Town Planner	massard@town.duxbury.ma.us

Town of Duxbury Task Force
The following individuals will be members of the Resiliency Study task force. The Task Force, which will be appointed by the Town, will act as a guide for this process, both in the formation of the Study and its implementation.

MAPC Staff
The following MAPC staff will be working on the Resiliency Study. MAPC staff will create the structure of the study process; collect data; identify, inform, and engage key stakeholders; and draft the Study.

Name	Position/Affiliation	Email
Josh Fiala	Principal Planner	jfiala@mapc.org
Darci Schofield	Senior Environmental Planner	dschofield@mapc.org
Christian Brandt	Community Engagement Coordinator	cbrandt@mapc.org

Relevant Demographic and Historical Information

Relevant Demographic information

- Population: 15,059 (2010 Census)
- Age: Largest population segments are residents under 18, between 35-49, and between 50-64. Smallest population segment is residents aged 18-24 followed by 25-35.
- Race, Ethnicity: The majority of residents are non-Hispanic White. There are small populations of non-white residents.
- Education: The majority of residents have a BA or higher.
- Employment: The largest employment sector is education, health, and social services.
- Household types: In 2010, the largest household type was family households with children.
- Nearby populations: Neighboring towns have a similar demographic make-up as Duxbury.

Relevant Historical Information
Duxbury has been engaged in planning for sea level rise since as early as 2010, when the towns of Duxbury, Marshfield and Scituate collectively applied for and received a Direct Local Technical Assistance Grant (DLTA) from MPAC to study adaptation and mitigation options for sea level rise. This grant produced the South Shore Coastal Hazards Adaptation Study in 2010 which represented a first step in determining coastal vulnerabilities for the three towns and developing a range of adaptation options. Duxbury has continued to invest in protecting its coast from sea level rise and climate change through a variety of projects with MAPC and other consultants, including the Kleinfelder Sea Level Rise Study (2013), Duxbury's Climate Vulnerability Assessment and Action Plan (2018), and Duxbury's Natural Hazard Mitigation Plan (2018). In addition, Duxbury is in the process of completing the town's Master Plan, called Envision Duxbury.

Equity Considerations

Accessible Information: Throughout the project, MAPC staff will make sure that events and written materials are easy to understand and accessible to all potential stakeholders.

Diversity of Voices: It is paramount that the voices that are represented in this Study reflect the diversity of stakeholders in the Harbor area. Outreach and engagement will focus on including these voices at all parts of the process.

What stakeholders have other plans identified? Previous projects have identified Snug Harbor customers, employees, property owners, seasonal visitors, residents (homeowners), recreational boaters, fishermen, and oystermen.

Stakeholder Analysis

The below stakeholders represent both businesses in the confines of this study area, town departments and boards, and organizations that work in the broader Duxbury and South Shore communities that may have relevant connections, expertise, and information. Primary stakeholders are highlighted in green.

Community Based Organization 1. Duxbury Civic Association (website link broken)	**Media & Press** 1. Duxbury Clipper 2. Duxbury Wicked Local 3. Duxbury Community TV
Municipal Departments 1. Building Department 2. Conservation 3. DPW 4. Emergency Management 5. Facilities 6. Fire Department	**Other Municipal Boards/Commissions/Agencies** 1. Board of Selectmen 2. Board of Health 3. Council on Aging 4. Cultural Council 5. Conservation Commission 6. Duxbury Bay Management Commission

7. Harbormaster 8. Lands and Natural Resources 9. Planning Department 10. Recreation 11. Senior Center 12. Town Manager 13. Duxbury Public Schools 14. Duxbury Housing Authority	7. Duxbury Beach Committee 8. Duxbury Seawall Committee 9. Economic Advisory Committee 10. Historical Commission 11. Shellfish Advisory Committee 12. Planning Board 13. Local Historic District Commission
Community Cultural Groups/Advocates 1. King Caesar Advisory Committee 2. Community Garden Club of Duxbury 3. Duxbury Rural and Historical Society 4. Duxbury Art 5. Duxbury Student Union	**Religious Groups** 1. St. John the Evangelist Church 2. Pilgrim Church of Duxbury
Neighborhood Groups/CDCs 1.	**Developers/Owners** 1. Sweetser's Building Owners
Recreational Groups 1. Duxbury Bay Maritime School 2. Duxbury Yacht Club	**Businesses** 1. Island Creek Oysters 2. Snug Harbor Fish Company 3. Talbots 4. Duxbury Pilates 5. Movementum Realty 6. Portside Real Estate 7. Bayside Marine Corporation 8. US Post Office 9. Winsor House Inn 10. Long Point Marine 11. Snug Harbor Wine 12. French Memories 13. Duxbury Bait and Tackle 14. Duxbury Oyster Company
Business Associations 1. Duxbury Business Association 2. South Shore Chamber of Commerce 3. South Shore Seafood Exchange Inc./South Shore Seafood Development 4. Massachusetts Lobstermen's Association (based in Scituate Harbor)	**Other Stakeholders** 1. South Shore Peer Recovery 2. Duxbury Education Foundation

Facebook Community Groups	Climate, Environment, Green Groups
1. None identified that may be relevant	1. Duxbury Beach Reservation, Inc. 2. Sustainable Duxbury

Resources, Challenges, Opportunities, and Scale of Engagement

Resources

- Prior planning projects: there has been significant efforts in the harbor particularly that have led to the creation of this study. These efforts have helped galvanize the community and have given the planning team significant guidance.

Challenges

- Lack of understanding and knowledge about climate change
- Difficulty coordinating planning and engagement efforts with business people due to their schedules
- Competing interests among primary stakeholders

Scale of Engagement

The scale of this engagement plan is geographically limited to businesses, residents, property owners, and other stakeholders in Snug Harbor, with an emphasis on those businesses operating on the Harbor side of Washington Street. Within that geography, the scale of engagement should be broad.

Messaging Strategy

Communication Modes	Describe how it could be used
Flyers	MAPC will create flyers that will be used for sharing information about upcoming meetings and other engagement opportunities. Flyers could focus on announcements about meetings or serve as an informational pamphlet.
Survey	Duxbury has requested a survey as part of this study. The survey will help reach individual members of the community in and around Snug Harbor and ensure that they are able to provide feedback without having to attend a public meeting.
Social Media	Depending on how involved Duxbury residents are in the town's social media, it may be used to update constituents about meetings or share information.

Engagement Strategy Chart

Below is an outreach strategy chart which will be developed more thoroughly after conversations with key town staff and the study's Task Force. The chart highlights key audiences, potential methods for outreach, approaches for engagement, barriers, and messaging that can support engagement with each group.

Harbor Businesses: water-based	**Outreach methods** ○ Connect directly with individual business ○ Cold Calling ○ Site-Visits to Harbor ○ Reference networking with existing and Town contacts	**Engagement approaches** ○ Connect with Business Association and South Shore Chamber for contacts ○ Surveys will make it easier for these stakeholders to engage. ○ Focus groups will be a useful way to engage these stakeholders	**Potential Barriers** ○ Lack of time, hours clashing with other engagement opportunities ○ Narrow perspective preventing broader engagement (i.e. how will this Study impact me directly!) ○ Competing interests with other stakeholders	**Potential Messaging** ○ Connect Study to their future economic vitality and stability. ○ Climate change/sea level rise threatens their viability. ○ Keep engagement relevant to individual needs and priorities ○ Acknowledge contribution to town.
Harbor Businesses: non-water-based	**Outreach methods** ○ Connect directly with individual business ○ Cold Calling ○ Site-Visits to Harbor ○ Reference networking with existing and Town contacts	**Engagement approaches** ○ Connect with Business Association and South Shore Chamber for contacts ○ Surveys will make it easier for these stakeholders to engage. ○ Focus groups will be a useful way to engage these stakeholders	**Potential Barriers** ○ Lack of time, hours clashing with other engagement opportunities ○ Too busy to participate ○ Narrow perspective preventing broader engagement (i.e. how will this Study impact me directly!) ○ Competing interests with other stakeholders	**Potential Messaging** ○ Connect Study to their future economic vitality and stability. ○ Damage to their buildings from sea level rise and storms threatens vitality. ○ Keep engagement relevant to individual needs and priorities ○ Acknowledge past contribution
Municipal staff/Board member	**Outreach methods** ○ Connect with town staff to identify or use the town's website. ○ Outreach via phone call and email. ○ Connect via municipal meetings.	**Engagement approaches** ○ Invite to attend meetings. ○ Schedule presentations at individual meetings. ○ Connect over the phone or have one-on-one conversations.	**Potential Barriers** ○ If members are volunteer they may have no time to commit to other meetings. ○ Focus of study not directly related to committee/department focus.	**Potential Messaging** ○ Frame importance to town with board/department focus in mind. ○ Frame as a potential political issue for elected staff/board members
Harbor Residents	**Outreach methods** ○ Connect with town staff to identify ○ Utilize outreach notes from prior planning projects to identify ○ If possible: connect with residents at community events	**Engagement approaches** ○ Share survey when available ○ Existing town meetings and committees. ○ Maybe: Mailing to abutting properties with notification of engagement opportunities.	**Potential Barriers** ○ Lack of time/too busy ○ Meetings occurring during dinner time or commute time. ○ Meetings inaccessible due to transportation issues or lack of childcare and child-friendly spaces	**Potential Messaging** ○ Making the Harbor more resilient will protect your homes against storm damage and flooding. ○ Cost of living may go up without resiliency work.
Property Owners	**Outreach methods** ○ Identify through assessor's database or GIS database ○ Connect with town staff to identify key owners. ○ Glean contact information from publically available property data/business data.	**Engagement approaches** ○ Invite to fill out surveys ○ Connect at town meetings ○ One-on-one conversations/interviews.	**Potential Barriers** ○ Lack of investment/knowledge in community (if from outside of Duxbury). ○ Corporate entities without a direct contact person may be hard to reach.	**Potential Messaging** ○ The value of your property will be negatively affected by sea level rise. ○ To preserve your investment we need to address the harbor's resiliency.

Engagement Approaches

On The Ground Engagement Tools	Describe how it will be used
Task Force	Task force will guide the work of the study team. Task force will also serve to connect potential stakeholders to the process.
Outreach Lists	Outreach lists will be maintained using this google sheet.
Public meetings	There will be one public meeting for Boards/Commissions and one public forum. Both will be used to solicit feedback from the intended audience and will offer community members the opportunity to learn more about the harbor and the resiliency related issues it is facing.
Focus groups	Focus groups with residents, water-based businesses, and non-water-based businesses in Snug Harbor will serve to gain more detailed information from key stakeholders.
Tabling	Tabling could be used at existing events and meetings, particularly community-wide celebrations, to bring awareness to the community about the Study.

Other creative messaging/engagement options

- Photo Contest: Community members will be invited to submit their favorite harbor-related photograph/image. At the final public meeting, attendees will be able to vote on their preferred picture. The winning picture will be the cover photo (or something comparable) of the final report.
- Memory Bank: Community members can submit a memory of Snug Harbor that is particularly meaningful, important, or memorable to them.

Community Engagement Activities

The Town of Duxbury has already committed to several engagement opportunities, including three focus groups, one public forum, one public meeting, and two task force meetings.

Focus Groups (3)

Duxbury has committed to three focus groups:

- Focus Group 1: Residents
- Focus Group 2: Water-based businesses
- Focus Group 3: Non-water-based businesses

Each of these focus groups are designed to gather more specific feedback from important constituent groups in Snug Harbor. Possible activities for these groups include:

- Educating stakeholders about the current issues facing Snug Harbor and exploring future problems.
- Building consensus among attendees regarding the problem, including defining terms and explaining, in their own words, what the issues they are facing involve.
- Utilizing a SWOT analysis to guide the focus group process.

- Having stakeholders identify areas of concern on a map of the harbor and explore possible interventions that could address those areas.
- Providing stakeholders with the opportunity to prioritize specific interventions in relation to cost, the problems they address, and the affect they would have on the Snug Harbor community.
- Visually showing stakeholders the extent of sea-level rise and the potential damage to their home, business, or livelihood it would cause.

Public Forum (1)
This public forum will be an opportunity for Snug Harbor's stakeholders to participate in a harbor-wide conversation about the issues facing the area and the opportunities and challenges involved in improving the harbor's resiliency. There are many potentially useful activities to have at this forum, most of which will depend on the information being communicated. Below are several possibilities for consideration:

- Interactive priority-setting utilizing maps, design characteristics/interventions, and dot voting.
- Jeopardy-style quiz about climate change and sea level rise as it relates to the harbor.
- Presentation of successful interventions in other communities, preferably in Massachusetts.
- More traditional poster exhibition with information and data relating to the research findings of the Study.

Public Meeting – Board/Commission (1)
This meeting will be a presentation to a particular board or commission.

Task Force Meetings (2)
Task Force meeting agendas will largely depend on the progress made throughout the planning process.

Feedback Strategy

It is crucial to report back to the stakeholders of this project during and after the process.

- Post updated visioning graphics on the project website.
- Use emails that we collected in the process to report back out to the people that participated in the process.

Feedback Analysis

Feedback will be collected, synthesized, analyzed, and summarized in the final report.

Collection
During the course of the Study process, any feedback that is gathered from focus groups, surveys, and public forums will be compiled in to one document. Each method of gathering feedback will be designed to correspond with the other methods so that feedback data are comparable across the various methods. To do this:

- Questions and prompts at forums and meetings will be phrased similarly
- Open-ended questions will be limited to specific circumstances (i.e. "Anything else to add?)

Analysis and Synthesis
Feedback data will be categorized by topic and, where possible, by stakeholder demographics (non-identifying). Doing this will ensure that the data are easy to parse and well organized. Once data have been coded and organized they will be analyzed for common themes and trends. Data will then be summarized by topic and connections will be drawn between topics.

Incorporation in Study
After the data have been analyzed and synthesized the MAPC team will complete a memorandum. The memorandum will detail what the most common themes and trends were and describe which stakeholders participated. Any feedback and information that is unable to be incorporated or is not relevant to this Study will also be included in the memorandum (or at the very least in an appendix).

Administrative Tasks

- MAPC will update contacts and relationships as needed during this process utilizing an internal database.
- The final contact lists will be sent back out to the Committee so they can do as they wish with the information.

Outreach Timeline and Activities

Below is short term outreach timeline example.

June 2019

M	T	W	T	F	S	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16

17	18	19	20	21	22	23
24	25	26 Task Force Meeting	27	28	29	30

July 2019

M	T	W	T	F	S	S
1	2	3	4 CB Out	5 CB Out	6 CB Out	7 CB Out
8	9	10 Possible Commission/ Board Meeting	11	12	13	14
15 Potential Focus Group	16	17 Potential Focus Group	18	19	20	21
22	23 Potential Focus Group	24	25 Potential Focus Group	26	27	28
29 Potential Focus Group	30	31 Potential Focus Group				

August 2019

M	T	W	T	F	S	S
			1	2	3	4
5	6 Potential Focus Group	7	8 Potential Focus Group	9 Survey completed and released to public	10	11
12 CB Out	13 CB Out	14 CB Out	15 CB Out	16 CB Out	17 CB Out	18 CB Out
19 CB Out	20 CB Out	21 CB Out	22	23	24	25
26	27	28	29	30	31	

September 2019

M	T	W	T	F	S	S
						1

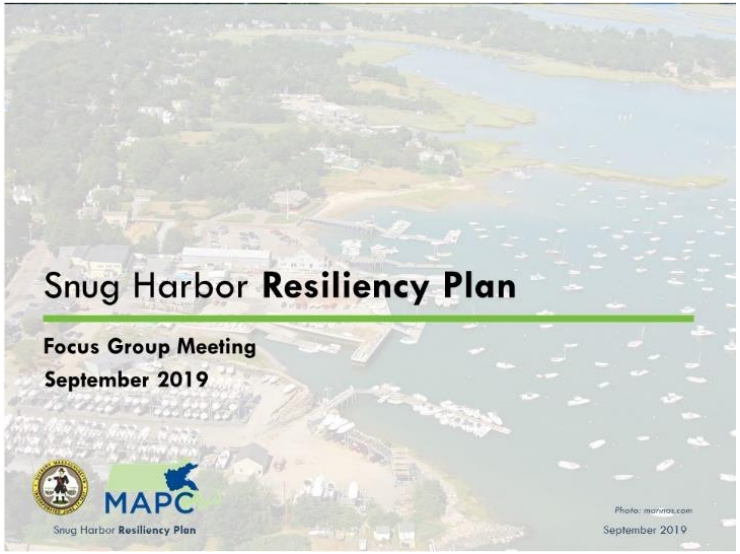
2	3	28	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	28	26	27 Survey completed	28	29
30						

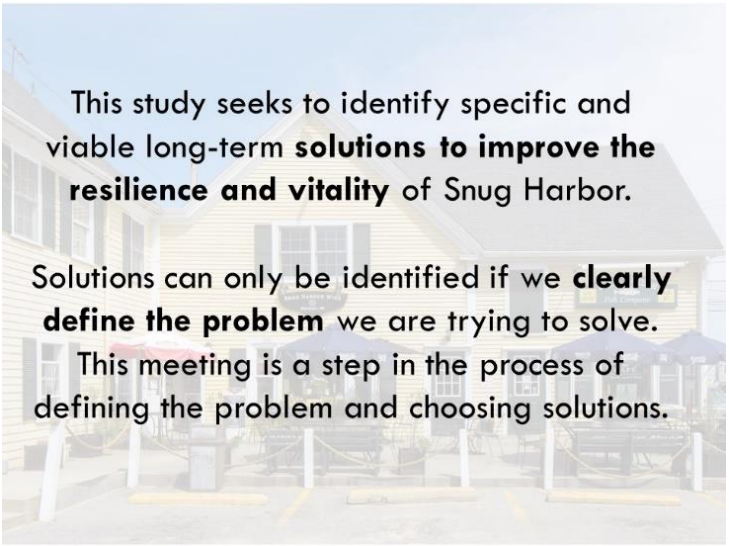
October 2019

M	T	W	T	F	S	S
	1	2	3	4	5	6
7	8	9 Possible Public Forum	10	11	12	13

14	15	16 Possible Public Forum	17	18	19	20
21	22	23 Possible Public Forum	24	25	26	27
28	29	30	31			

Appendix B





Snug Harbor **Resiliency Plan**

Focus Group Meetings

- **Thursday and Friday, September 12 and 13, 2019**
- **90 Minute Meetings**
- **Three Focus Groups**
  1. **Residents in and around Snug Harbor**
  2. **Water-based businesses and institutions (shell fishermen, marinas, DBMS)**
  3. **Land-based businesses and institutions (Winsor House, Churches, French Memories, etc.)**
- **Public Engagement**
  - **Public Forum**
  - **Online Survey**

MAPC

Snug Harbor Resiliency Plan September 2019

Snug Harbor **Resiliency Plan**

Focus Group Meeting Agenda

- **Introductions**
- **Overview of Study**
- **Getting your Resiliency On-Interactive Video Game**
- **Facilitated Exercises**
  - **Share your experiences**
  - **Help us define the problem**
  - **Discuss and build consensus on potential solutions**
- **Open Discussion and Next Steps**

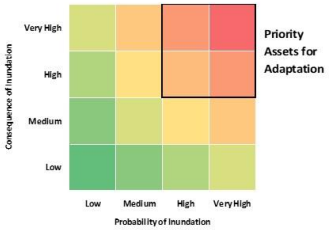
MAPC

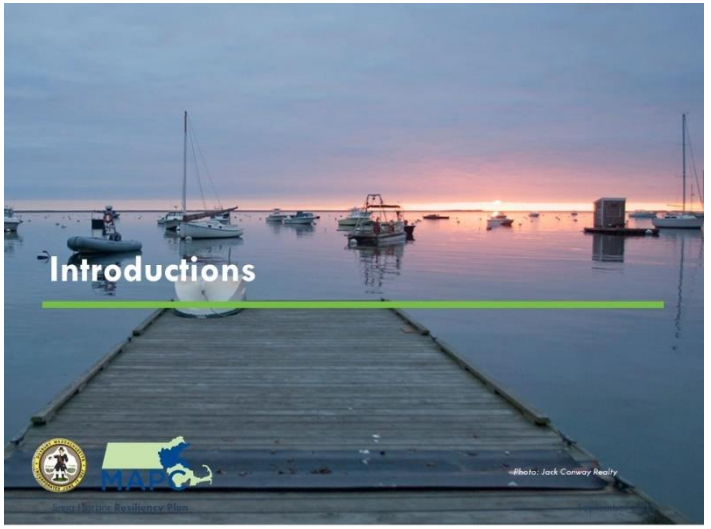
Snug Harbor Resiliency Plan September 2019

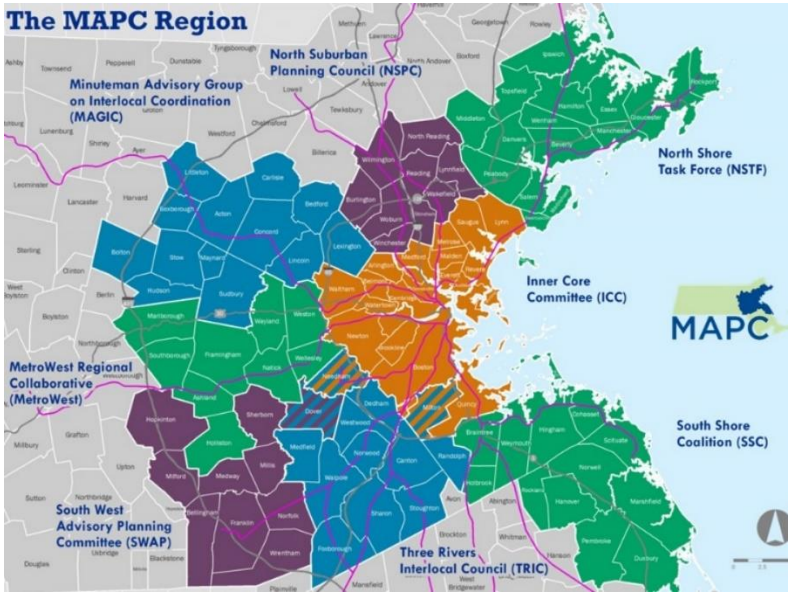
Vulnerability Assessment and Adaptation Planning

Project Approach

- Phase I
  - SLR / Storm Surge Projections
  - Scenario Development
  - Gather asset data
  - Determine Asset Critical Elevations
- Phase II
  - Map Inundation Probability
  - Score Asset Inundation Consequence
  - Vulnerability/Risk Assessment
    - *Risk = Probability * Consequence*
- Phase III
  - Prioritize High Risk Assets
  - Develop Adaptation Strategies for Priority Assets







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MAPC Staff

Darci Schofield
Senior Environmental Planner

Josh Fiala AICP AIA LEED AP
Principal Planner

Christian Brandt
Community Engagement Coordinator

Town of Duxbury Staff

Valerie Massard
Director of Planning

Task Force Members

Valerie Massard	Duxbury Town Planner/ Project Manager
Rob Fawcett	Sweetser
JR	Bayside Marine
Chuck Weillbrenner	Winsor House Inn, Economic Advisory Committee
Ned Lawson	Duxbury Bay Maritime School
Ted Lawson	Duxbury Bay Maritime School
Chris Sherman	Island Creek Oysters
Peter Buttkus	Public Works Director/Tree Warden
Peter Mackin	Water and Sewer Superintendent
Joe Grady	Duxbury Conservation
Erin McGough	Duxbury Historical Society
René Read	Duxbury Town Manager
Shawn Dawlen	Board of Selectmen
Scott Lambiase	Building Commissioner/Director Municipal Services
Cris Lutazzi	Duxbury Beach Reservation, Inc.

Scope of Work

- **Task 1: Existing Conditions**
- **Task 2: Community Engagement**
- **Task 2: Focus Group Charrettes**
- **Task 3: Public Online Survey**
- **Task 4: Public Forums & Board and Commission Meetings**
- **Task 5: Final Report**

Project Outcomes

Detailed Summary of Charrettes and Public Engagement

Conceptual Design

Recommendations (zoning, resiliency strategies, next steps)

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Schedule

Task	Year/Month 2019							
	05	06	07	08	09	10	11	12
Review of Relevant Plans and Existing Conditions	■	■	■					
Task Force Meetings		●				●		
Public Engagement				●	● ●	● ●	●	
Public Survey				■	■	■		
Summary and Analysis of Outreach						■	■	
Conceptual Design, Recommendations, and Final Report							■	■

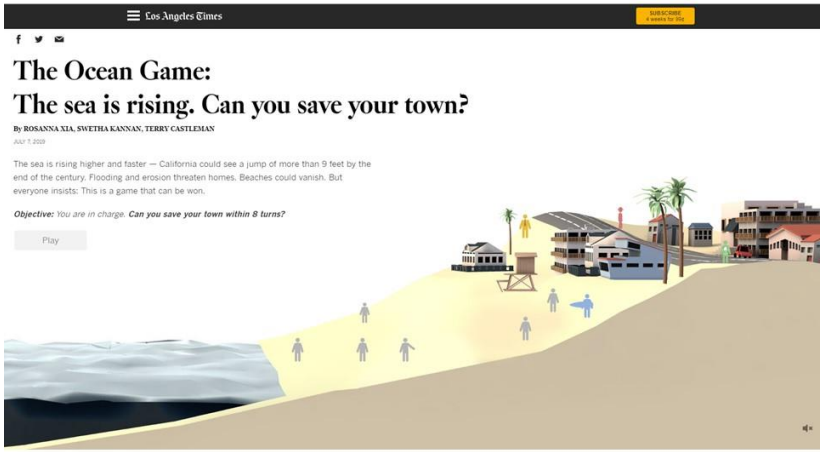
● Community Meeting and Board/Committee Presentations
● Community Open House
● Focus Group Meetings

Previous Studies

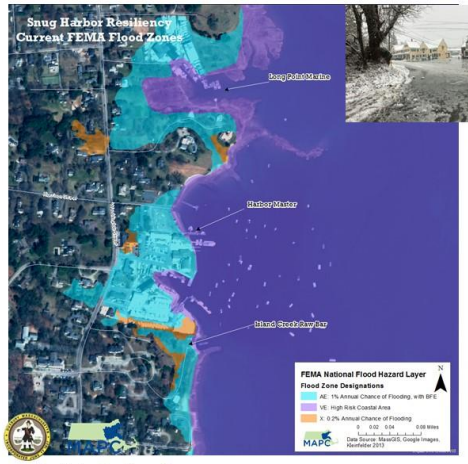
- *South Shore Coastal Hazards Adaptation Study.* MAPC. *2011*
- *Sea Level Rise Study for the Towns of Marshfield, Scituate, and Duxbury, MA.* Kleinfelder. 2013
- *Town of Duxbury Natural Hazard Mitigation Plan.* MAPC. 2018.
- *Envision Duxbury*. MAPC. 2019
- *Open Space and Recreation Plan.* 2017. Town of Duxbury
- *Community Development Plan.* Town of Duxbury. 2004. Dufrense-Henry, Inc.
- Zoning Bylaw

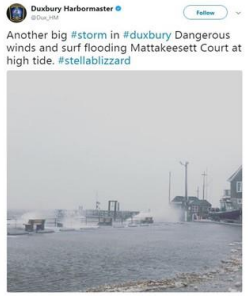
Case Studies

- *Boston Climate Ready Neighborhood Planning: East Boston and others*
- *NYC Planning Resilient Neighborhoods: Sheepshead Bay and others*
- *Estes Park Downtown Plan: A Vision for a Resilient Future*



Coastal Storm Flooding Today



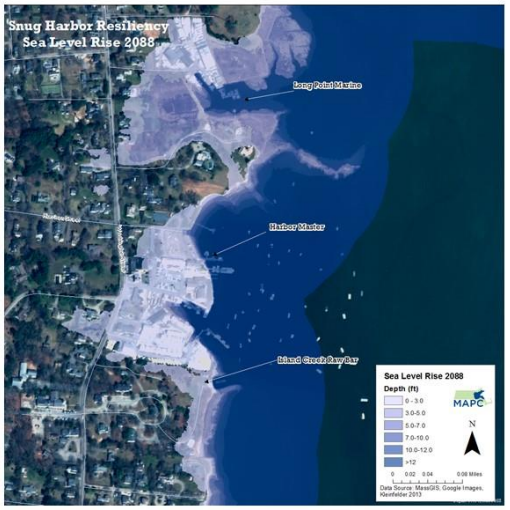


Sea Level Rise Projections

	2030	2050	2070	2100
Boston BH_FRM [1]	8.00 in.	1.50 ft.	3.10 ft.	7.40 ft.
South Shore [2]	8.04 in.	1.85 ft.	3.39 ft.	6.52 ft.
Boston Tide Gauge[3]	0.4-0.9 ft.	2.4 ft.	4.2 ft.	7.6 ft.

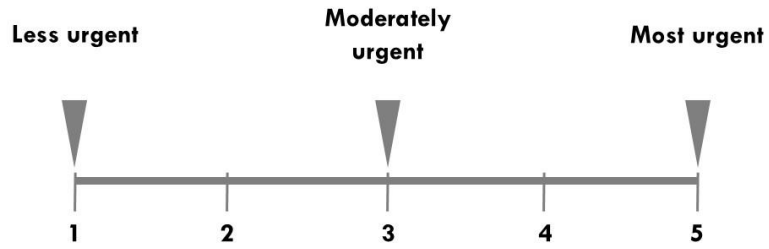
[1] Douglas, E.M., Kirshen, P.H., Bosma, K., et al. 2017. Simulating the Impacts and Assessing the Vulnerability of the Central Artery/Tunnel System to Sea level Rise and Increased Coastal Flooding. J Extreme Events 3 (4): 1650013 (28 pages).
[2] *"Sea Level Rise Study. The Towns of Marshfield, Duxbury, Scituate, MA". 2013. Kleinfelder.*
[3] Northeast Climate Science Center. UMass Amherst. "Massachusetts Climate Change Projections". December 2017

Sea Level Rise 2088



Help us define the problem:

HOW URGENT DO YOU FEEL COASTAL FLOODING ISSUES ARE?



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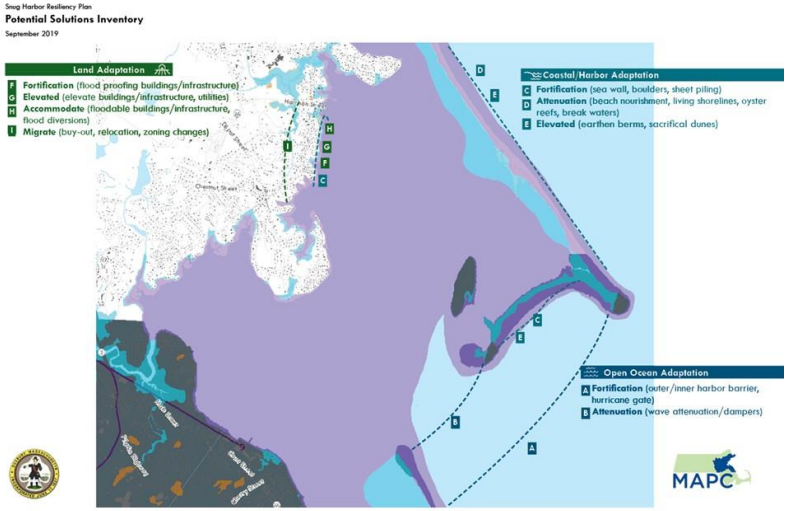
Snug Harbor **Resiliency Master Plan**

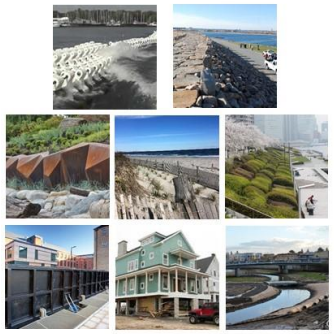
September 2019

Potential solutions diagram:



Snug Harbor **Resiliency Plan**

Potential Solutions Inventory



Open Ocean Adaptation

- Fortification *(outer/inner harbor barrier, hurricane gate)*
- Attenuation *(wave attenuation/dampers)*

Coastal/Harbor Adaptation

- Fortification *(sea wall, boulders, sheet piling)*
- Attenuation *(beach nourishment, living shorelines, oyster reefs, break waters)*
- Elevated *(earthen berms, elevated harbor walk)*

Land Adaptation

- Fortification *(flood proofing buildings/infrastructure)*
- Elevated *(elevate buildings/infrastructure, utilities)*
- Accommodate *(floodable buildings/infrastructure, flood diversions)*
- Migrate *(buy-out, relocation, zoning changes)*

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Snug Harbor **Resiliency Plan**

September 2019

Potential solutions matrix:

Category	Potential Investment $ $ $ $	Potential Impact ↑ ↑ ↑ ↑	Public or Private Funding	Example
Open Ocean Adaptation				
A **Fortification** (outer/inner harbor barrier, hurricane gate)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
B **Attenuation** (wave attenuation/dampers)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
Coastal/Harbor Adaptation				
C **Fortification** (sea wall, boulders, sheet piling)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
D **Attenuation** (beach nourishment, living shorelines, oyster reefs, break waters)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
E **Elevated** (earthen berms, elevated harbor-walk)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
Land Adaptation				
F **Fortification** (flood proofing buildings/infra-structure)	$ $ $ $	↑ ↑ ↑ ↑	Private Funding	
G **Elevated** (elevate buildings/infrastructure, utilities)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
H **Accommodate** (floodable buildings/ infrastructure, flood diversions)	$ $ $ $	↑ ↑ ↑ ↑	Public or Private Funding	
I **Migrate** (buy-out, relocation, zoning changes)	$ $ $ $	↑ ↑ ↑ ↑	Public Funding	

DRAFT - FOR PROCESS DISCUSSION ONLY

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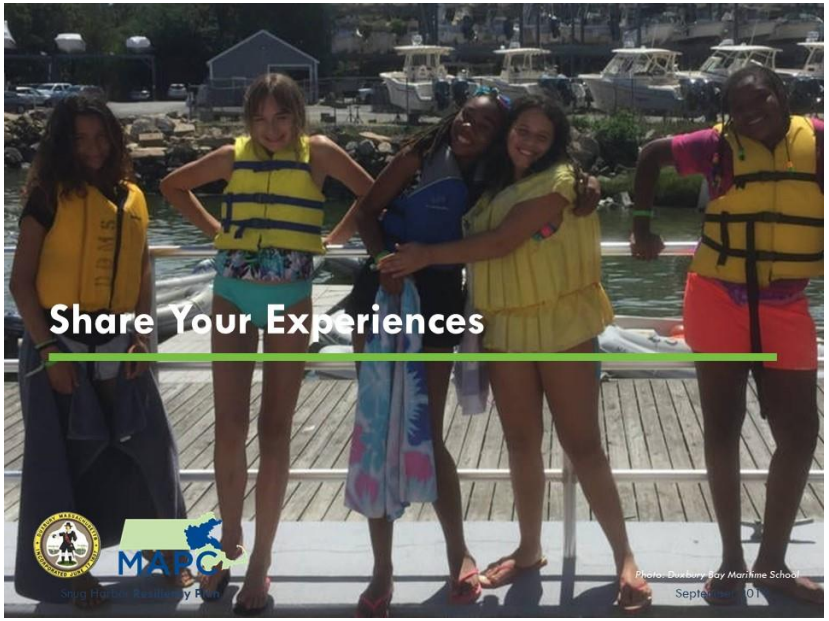

Help us define the problem:

WHAT IS WORKING WELL TODAY?

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Snug Harbor **Resiliency Plan**

September 2019

Help us define the problem:

WHAT IS *NOT* WORKING TODAY?

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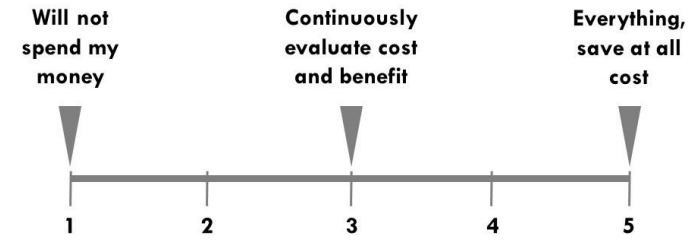
September 2019

Help us define the problem:

WHAT MUST BE HERE IN THE FUTURE?

Help us define the problem:

<u>WHAT WOULD *YOU* DO TO SAVE ALL THAT</u>?



Help us define the problem:

<u>WHAT SHOULD BE DONE COLLECTIVELY TO SAVE ALL THAT</u>?

Snug Harbor **Resiliency Plan**

Next Steps and how to stay involved

- **Task Force Meeting (Late September and Early December)**
- **Community Meeting (late October/Early November)**
- **Question, comments? Contact:**

Darci Schofield, MAPC, dschofield@mapc.org

Valerie Massard, Duxbury, Massard@town.Duxbury.ma.us

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