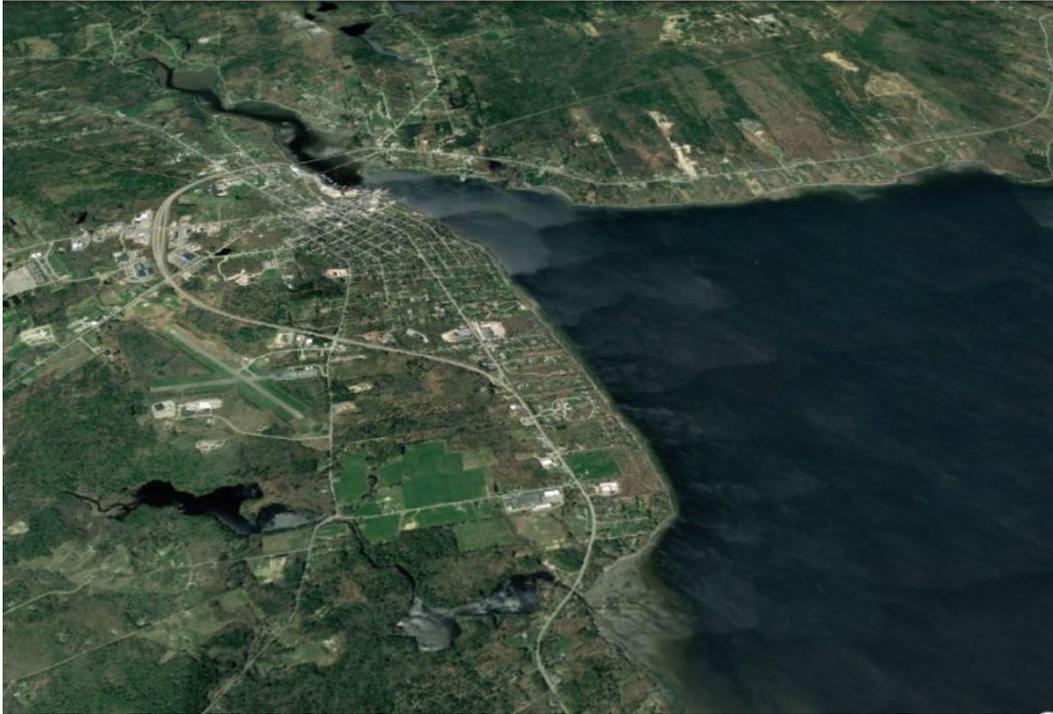


**SEA CHANGE IN THE GULF OF MAINE:  
THE OUTLOOK FOR BELFAST**



**Part Three: Ecosystem-based Resilience**

**A Report to the City Council  
by the  
Climate Change Committee  
Belfast, Maine**

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**September, 2019**

## **Table of Contents**

1. **General Introduction**
2. **Executive Summary: Part Three**
3. **Sources**
4. **Recommended Actions Regarding Sea-Level Rise in Belfast**
  - 4.1 Situation Critical
  - 4.2 Ecosystem-based Resilience

### **Appendices**

- A. Update on Short-Term Recommendations from CCC Sea Change Report, Part Two
- B. *Maine Flood Resilience Checklist: Summary of Findings with Commentary*
- C. Table of Belfast Locations Vulnerable to Sea-Level Rise

## **1. General Introduction**

Belfast’s midcoast location has been intrinsic to its identity, history, and economy from the time when the Wabenaki people fished here for sturgeon up to the present. That heritage naturally leads to concern for the threat of rising sea levels and other coastal impacts of climate change. The damage caused in Belfast Harbor by the wind, waves, and flooding of three severe storms from October 30, 2017 through March 3-4, 2018 highlighted the vulnerability of the City’s coast to inevitable changes in what have always been taken for granted – the climate, the weather, and the ocean.

The City Council approved the formation of the Belfast Climate Change Committee (CCC) in March 2018 and directed the CCC to report on the potential impacts to the City of one

critical aspect of climate change: sea-level rise. This report, entitled Sea Change in the Gulf of Maine: The Outlook for Belfast, comprises three parts with distinct objectives:

**Part One.** Characterization of the nature and probable consequences of changing sea levels in the specific context of Belfast’s harbor and shoreline. (September 2018)

**Part Two.** Characterization of damages from erosion and flooding and estimates of economic implications for Belfast of the projected sea-level rise scenarios. (December 2018)

**Part Three.** Recommendations. (Draft for discussion with City Council, April 2019; final draft, September 2019).

## **2. Executive Summary**

### ***Part Three: Ecosystem-based Resilience***

With Part Three of its three-part report on sea change, the CCC arrives at its recommendations for this initial phase of its work. As with any serious and complicated undertaking, the task itself has evolved. The recommendations in the report here, however, remain fastened to the City Council’s main assignment for the CCC, namely, to present the Council with authoritative scientific information about the causes and predicted degree of sea-level rise<sup>1</sup> over time here in Belfast due to climate change in the context of tides, flooding, surge, wind and waves—which we call, collectively, sea change; to sketch the physical and economic impacts of sea change on our City; and to bring forward the actions that would best protect Belfast’s coastline.

The CCC’s recommendations come from its own research and thought about sea change, including consideration of what other cities have done statewide and beyond. After our initial discussion with the City Council in April 2019, we have decided to present these recommendations with minimal text. The more time has gone by, the more we recognize that the world’s climate is in crisis generally. Indeed, the CCC recently requested, and the City Council approved, a change in our name to the Climate **Crisis** Committee. Sea change happens to be

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<sup>1</sup> It appears that on or about September 24, 2019 another IPCC report will be issued that may substantially increase predictions concerning sea-level rise.

the part of that crisis affecting Belfast most immediately. We feel the recommendations that we make here on sea change are urgent. As a committee, we have already begun carrying out some of them. With Council approval, we are poised to move forward with others, and we already are moving beyond sea change as our major focus, since we know the community favors a wider range of actions. That having been said, the CCC's primary recommendation here for adapting to sea change actually is not limited to sea change alone, but amounts to a comprehensive plan for resilience to climate change overall, which we are calling *Ecosystem-based Resilience*.

### **3. Sources**

In its current report, Part Three of Sea Change in the Gulf of Maine: The Outlook for Belfast, CCC has not referred as much to national or state studies as in previous reports, but has consulted local sources and the two previous parts of our report. The principal new document is a record of the Flood Resilience Checklist exercise conducted on February 14, 2019 by Belfast's City Manager with key City and County staff, as described in Appendix B.

As before, the CCC minutes (on the City of Belfast website, <https://www.cityofbelfast.org/>) document the committee's outreach and networking activities, and a CCC digital library that is being compiled provides public access to references and literature consulted.

## **4. Recommended Actions Regarding Sea-Level Rise in Belfast**

### **4.1 Situation Critical**

Climate change is a general crisis, and sea-level rise is a particular crisis caused by climate change that is already affecting Belfast. The bulk of residential properties in Belfast are not vulnerable to sea-level rise, unlike the situation for communities in southern Maine. On the

other hand, certain critical infrastructure and some of Belfast's most valuable commercial assets are located along the working waterfront or areas in East Belfast that are vulnerable. The City needs to make some basic decisions on its long-term plans as fast as is feasible, and begin assembling a wide range of resources so that Belfast can become more resilient in meeting this crisis. Decisions on adapting to sea-level rise should be given top priority, not simply in terms of environmental goals but also in terms of social and economic goals.

Finding funds to implement the actions recommended here is as critical as the actions themselves. The City cannot afford to do nothing. It needs to ramp up its capability to account for the full cost of repairs due to sea change, and thus to judge the effectiveness of short-term solutions so far. Beyond that, it needs the means to embark on large-scale, long-term actions. These can be more expensive. For a big-city example, Boston has pledged 10 percent of its 2020 capital budget to fund resiliency projects.<sup>2</sup> On the other hand, because such projects often cross conventional jurisdictional boundaries, they can also gain access to new sources of funding. Relatively new approaches to financing climate-change projects, such as accounting for the ecosystem services they provide and measuring their social return, are also possible.

### **Recommended actions on a crisis basis**

*[Policy]*

- **Adopt a policy risk horizon.**<sup>3</sup>
- **Determine in more detail the location of Belfast's most vulnerable areas**
- **Constrain development in vulnerable areas so as to minimize long-term risk from sea change.**

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<sup>2</sup> Norton, Mary Caperton, "Boston is taking Action to Adapt to Sea Level Rise" (Science News; August 6, 2019), <<https://www.sciencenews.org/article/boston-adapting-rising-sea-level-coastal-flooding>> Various financing strategies Boston tried are mentioned in the article. Of course, Belfast isn't Boston. The CCC notes a more relevant conference for municipal officials in Maine to be held by the Island Institute at Belfast on September 27, 2019 entitled "Sea Level Rise--Who Pays and How?"

<sup>3</sup> For this term, see Appendix B below, p. 10.

- **Explore jurisdictional flexibility, via the Maine State Climate Council, possibly via federal legislation as well, to integrate City planning for sea-level rise with County emergency planning resources.**

*[Operations]*

- **Adapt City department/s recordkeeping to track particular costs of sea-level rise.**
- **Update the City’s GIS capabilities to incorporate more types of local data.**
- **Budget and plan capital expense per policy risk horizon, once adopted.**

*[Regulations]*

- **Examine City regulations re flexibility for dealing with sea-level rise.**
- **Set clear policy for Comprehensive Plan Committee and Planning Board to take into account sea-level rise and other impacts of climate change throughout all their planning and deliberation on specific applications.**
- **Assist in coordinating government authorities at the state and local level to improve the effectiveness of coastal regulations (e.g. floodplain development permits, real-estate disclosure rules, setback requirements for building on coastal bluffs, improving temperature and chemical conditions in Penobscot Bay to sustain biodiversity).**

## **4.2 Ecosystem-Based Resilience**

*[Background]*

**4.2.1** The CCC believes that “Our best defense against nature is often nature itself.”<sup>4</sup> This insight is one part of what we call “Ecosystem-based Resilience,”<sup>5</sup> an approach to environmental change based on the following principles.

- It recognizes fundamental interdependencies between human communities and their natural ecosystems: the life of one depends on the life of the other.

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<sup>4</sup> Bloomberg, Michael and Carl Pope, *Climate of Hope* (New York: St. Martin’s Press, 2017), p. 229.

<sup>5</sup> This term is paraphrased and abbreviated from one used in a fisheries context by Paul Anderson, Executive Director of the Maine Center for Coastal Fisheries. For the principles, see Groening, Tom, *The Working Waterfront* (August 2019), p. 16.

- It focuses on Place: each community and its ecosystem/s are particular, local.
- It acknowledges the values that ecosystems hold for their communities.
- It attends to changing conditions.

For this report on sea change, Belfast’s relevant ecosystem at a large scale is the entirety of its coastal area and watershed. This ecosystem is threatened most dramatically by flooding, wind, and wave-force damages to coastal infrastructure from sea-level rise and the increased intensity and frequency of storms. Other impacts are just as significant in the long term, if not more so, however. These include:

- Shoreline erosion—including both removal and deposition of coastal sediments—and its infrastructure and ecological consequences;
- Temperature and chemical changes in coastal waters that result in ecosystem shifts, a decrease in biodiversity, losses in the economic value and viability of traditional natural resources and overall quality of coastal life on account of:
  - Changes in organismal distributions (e.g., lobsters);
  - Increasing populations of invasive species (e.g., green crab);
  - Accelerated eutrophication and associated, sometimes highly toxic, algal blooms.

So far, solutions defending against the impacts of sea-level rise have been primarily impermeable and static. They chiefly concern erosion. They include building jetties, groins, or breakwaters, installing wave attenuators, dredging channels, raising roads, bridges or buildings, and armouring (employing structural barriers, such as sea walls) of all kinds.

Defensive solutions based on nature are permeable and dynamic. They, too, can cope with erosion. But they also can mediate temperature and chemical changes in the water, in order to sustain biodiversity; and they can sequester carbon. In short, they serve both adaptation and mitigation. A list of such solutions includes conserving and restoring smaller-scale natural ecosystems within the watershed (wetlands, river mouths, beaches, dunes, intertidal and subtidal habitats); designing containment areas; establishing appropriate vegetative cover along shorelines; and mandating low-impact development practices (managing runoff from roofs, roads, parking lots, etc. with permeable surfaces or swales) on properties near the shore. Such

practices provide natural filters, sponges, buffers, or detours as sea change wears on. They expand the list of options the City can consider to solve the problems of sea change. The more tools, the greater the possibility that good solutions can be found to fit the particulars of sea change here in Belfast.

Ecosystem-based Resilience does have a cost, since in many cases sufficient local data to plan solutions here based on nature are not immediately available. Research must be done. On the other side of the ledger, however, Ecosystem-based Resilience is certain to fit the scale of the problem, and it yields full value from services offered by nature essentially for free.<sup>6</sup>

**4.2.2** In keeping with the principles of Ecosystem-based Resilience offered above, the CCC makes the following recommendations re natural and social systems.

#### **Recommended actions re natural systems**

- **Prioritize defensive solutions utilizing natural systems themselves.**
- **Develop and use detailed, place-based information on local natural systems.**
- **Begin by monitoring weather, tides, runoff and strategic natural flora and fauna in real time.**

#### **Recommended social actions**

*[Community involvement]*

- **Engage the community in long-term planning for resilience.**
- **Foster community awareness and appreciation of coastal resources through education, public art, and other forms of interpretation.**
- **Arrange for long-term coordination among research scientists and citizens in collaborative investigations, or “citizen science”, to obtain information on natural systems per earlier recommendations.**

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<sup>6</sup> Bloomberg, *Ibid.*, p. 210.

[Land use]

- **Advocate a Comprehensive Plan designed at adequate and integrated spatial and temporal scales to encourage development that is sustainable.**
- **Require low-impact development practices on all vulnerable properties.**
- **Facilitate cooperation among shoreline property owners, both private and public, in an overall vision for a resilient shoreline and offer incentives and advice on ways for them to achieve it.**

**Recommended social/natural actions: managed retreat from vulnerable locations**

*[This solution combines actions re natural systems with social actions. It is the most flexible of all solutions to sea-level rise. Though at times the cheapest solution, it can also be expensive. In either case, it is arguably the most cost-effective.]*

- **Leveraging federal disaster funds, strategically buy out private properties vulnerable to sea-level rise.**
- **Discourage development strategically on private or public properties that are vulnerable and undeveloped.**
- **Proactively plan retreat from developed but vulnerable public properties.**
- **Achieve public benefits cost-effectively from both public and private properties that would otherwise only be liabilities.**
  - **Assemble and redesign parcels of open space for reuse as conservation or restoration projects that can offer benefits in terms of public recreation, scenic amenities, and sequestration of greenhouse gases.**
  - **Assemble parcels of open space that can be designed and developed for the dual purposes of a) containing surges and floodwaters during storms and b) at other times providing public space for recreation or other uses (e.g. a skating park, an outdoor amphitheatre, etc.).**

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<sup>7</sup> Siders, A.R; Myuki Hino; Katharine J. Mach; "The case for strategic and managed climate retreat", *Science*, v. 365, issue 6455 (23 August 2019). Although the article primarily concerns managed retreat for entire communities, many of its points apply to any managed retreat project.

# APPENDICES

## Appendix A

### **Update on Short-Term Recommendations from Sea Change Report, Part Two**

In December 2018, the CCC presented to the City Council Part Two of its three-part report, Sea Change in the Gulf of Maine: The Outlook for Belfast. Part Two contained five short-term recommendations subsequently authorized by the Council and pursued by the CCC. Here is an update.

- **Join the Global Covenant of Mayors for Climate and Energy.** The Mayor joined this group on behalf of Belfast in February 2019. Member cities are required to complete two documents within two years: a carbon footprint report, and a Climate Action Plan. A CCC project group has formed and is in the early stages of preparing a carbon footprint for Belfast.
- **Support statewide and other initiatives that support the goal of developing a climate adaptation strategy.** The Council has instructed us to come to them for approval when taking public positions on particular legislative and other initiatives that may affect the City's ability to deal with climate change. We have done so several times and will continue to do so.
- **Continue and expand collaborations with non-governmental organizations and academics studying climate.** With the Council's approval, we have already collaborated on several conferences and events during 2018-19 with a variety of organizations, and are currently involved in planning two events for next spring: one for public education, commemorating 1976 and 1978 high water marks in Belfast, an event that involves state representatives of federal agencies; the other for sharing expert advice on climate-change planning, the annual conference of the Maine Climate Change Adaptation Providers (CCAP). Finally, we are engaged in three separate long-term collaborative projects to gather data on weather and water conditions in Belfast's portion of Penobscot Bay. Working with the Belfast Harbor Committee, the Gulf of Maine Research Institute (GMRI), the Belfast Bay Watershed Coalition (BBWC), and the Maine Coastal Observing Alliance (MCOA), we are trying to establish a basis for understanding

our local marine environment more thoroughly as a first move toward achieving ecosystem resilience. Two of the projects emphasize public involvement via citizen science, also a CCC objective. Collaborative labor and funding are supporting these projects so far.

- **Develop weather and water data specific to Belfast Bay.** *(See above)*
- **Complete the Maine Flood Resilience Checklist.** *(See Appendix B below)*

## **Appendix B**

### **Maine Flood Resilience Checklist**

On February 14, 2019, City Manager Joe Slocum convened a meeting with relevant staff to complete the *Maine Flood Resilience Checklist (FRC)* as a planning exercise. An annotated record of the exercise was made by the City Manager and his Administrative Assistant and circulated to staff attendees for their review, as well as to CCC members, for use in this report. [i] Since, by itself, the *FRC* is simply a list of questions to be answered Yes/No, with occasional source notes offered and minimal explanations, we have summarized the key findings below. They are organized around the *FRC*'s five sections, though not in the same order. We have included here a running commentary on the findings, and we have used the findings as the basis for some of our recommendations.

#### **Summary of findings from the FRC, with commentary**

##### 1. General Risk & Vulnerability

- a. A policy risk horizon is a political decision based on science. The City has not decided on: a) what time periods it wants to select for carrying out climate-change policies (e.g. 10 years, 30 years, 80 years); and b) what degree of risk it wants to select in carrying out climate-change recommended policies (e.g. 2', 4', 8', 11' of sea-level rise; 0%, 10%, 25% increase in heavy precipitation events; or representative concentration pathway [RCP] 2.6, RCP4.5, RCP6.0, RCP8.5). Absent a policy risk horizon, the City cannot effectively develop policies on climate change.
- b. In Part One of its Sea Change report (p. 19), the CCC has illustrated seven sections of the Belfast shoreline that are at greatest risk from sea changes such as sea-level rise, surge, and storms. The photo was adapted from our own research into available scenarios at <https://www.maine.gov/dacf/mgs/hazards/slosh/index.shtml>. Belfast's Planning & Codes Department makes available online a thorough array of maps for public use via GIS software that link City zoning with information provided by the Army Corps of Engineers (ACOE), the Federal Emergency Management Agency (FEMA)—the FEMA flood insurance maps—or by the State of Maine. Some additional useful layers for the GIS maps could only come from local

knowledge that would never be developed statewide, however. One example would be a layer incorporating archival records of the sea changes along Belfast's coastline during its history. Belfast has an excellent historical society and other regional museums contain photographs and written materials from Belfast too, but information related to past flooding, erosion, deposition, man-made fill, the extent of coastline vegetation, and other such data series have not generally been collated. Another useful GIS layer might have to do with updated information from Public Works on road damage and repairs related to flooding, and details about Belfast's storm-sewer locations draining into Belfast Bay, along with their damage and repairs, acknowledging that some storm sewers from years gone by are yet to be discovered! The point here is that updating and digitizing City record-keeping, along with integrating new types of data into the City's GIS, would help Belfast assess its general risk and vulnerability to sea-level rise and also enable cost/benefit analyses of certain actions.

## 2. Natural Environment

Per the *FRC*, Belfast has identified and mapped its wetlands, coastal and wetland buffers, natural areas of significance, and the Coastal Barrier Resources System. Historical information about the City's natural resources is fragmented, however, either due to lack of records, or records that have been proprietary.

## 3. Social & Economic

In general, Belfast's diversified economy helps make it resilient to impacts from sea change. Belfast's business groups may see an opportunity to encourage/help their members anticipate sea change or adapt to community-wide impacts of climate change. Could the City's Economic Development Office recognize climate change within its purview?

Belfast's Assessor has used the City's GIS to map the location and valuations of all properties in the City, public, commercial or residential. In Part Two of its three-part report, the CCC used

this data to make rough estimates as to the potential tax revenue impacts of sea change on residential and commercial coastline properties. Significantly, what remains to be assessed is the level of flood insurance coverage in existing or future probable flood hazard areas, a difficult task, since so much insurance information is proprietary.

Culturally or historically significant properties or artifacts may need to be examined in terms of their sensitivity to impacts from climate change.

Belfast is strong on social capital, and its citizens have organized groups to undertake many varied efforts to deal with climate change. The City Council has supported these efforts, and initiated several of its own. More particularly, the City Council has supported the Energy Committee in replacing fossil fuels with renewable energy for City buildings, and has established the CCC to take on broader tasks, such as community education. Although an emergency education and outreach plan for the general public and for schools has been prepared by the Waldo County Emergency Management Agency (EMA), which has also provided signage throughout Belfast on evacuation routes, a broader awareness about the effects of climate change on the community needs to be cultivated.

#### 4. Critical Infrastructure and Facilities

Detailed information is available for most of Belfast's critical infrastructure and facilities per the *FRC*. Most facilities do not experience problems with flooding. Others may currently be at risk, and will become more so: these include the wastewater treatment plant and associated transport system; the harbor facility as a whole, including piers, wharves, and commercial docks; the stormwater system; certain culverts; and a small number of roads.

The *FRC* reveals a problem with the information available on critical infrastructure: it is divided among separate parties or jurisdictions. The City has some of the information, with pieces held by different departments offering varied degrees of access even to City officials, much less the public. The Water District specializes in water resources; CMP handles the power grid; Waldo County Dispatch runs the emergency communications; Waldo County General Hospital knows about the hospitals and other critical health facilities; MDOT deals with the bridges; the Waldo County Emergency Agency (EMA) is in charge of evacuation routes and coordinates information

about other generalized infrastructure with emergency functions. None of this would be a problem if all the information were available in digitized form to each interested party or jurisdiction via GIS, but it is not.

In terms of action to arrange back-up systems for critical infrastructure and facilities, to figure out schedules for repairs and cleanup after severe storms, and to allow for those operations in departmental maintenance budgets, the City has so far moved in a limited way, hazard-by-hazard. The annual operations budget does not separate out, document or track costs associated with flooding due to sea change in particular; on the other hand, the City does have extra reserves for storm recovery, and its capital budget does contain projects to improve critical infrastructure and facilities in the light of existing and potential future flood hazards. If the relevant record-keeping were updated and digitized, as mentioned above under “General Risk & Vulnerability”, the City’s budgets could deal with sea change more effectively.

## 5. Community Planning

Community planning in Belfast happens in large part via its Comprehensive Plan. The Comprehensive Plan is ripe to be amended with a significant statement of principle re climate change or, put another way, a large-scale vision of community resilience. The big picture could eliminate some inconsistencies. For example, Belfast participates in the National Flood Insurance Program and is in good standing. It has also adopted the most recent Maine Uniform Building and Energy Code, which indirectly addresses climate change. But the City’s floodplain ordinance recognizes no more than the existing 100-year floodplain on the FEMA FIRM maps. A similar example...as required by the state, the City has a local hazard disclosure policy related to properties in the floodplain. But the hazard disclosure policy does not extend to properties outside the floodplain that are already affected by extreme storms and will only become increasingly at risk. In these two examples and more, on the basis of local rule, Belfast should be able to exceed minimum state standards.

Other examples? As to critical infrastructure and facilities, advance planning that fully covers sea change is only done case-by-case for new critical infrastructure and facilities. What about advance planning to discuss when the City should relocate or even abandon existing critical

infrastructure or facilities in vulnerable locations? At a minimum, green infrastructure approaches for stormwater management could be considered routinely.

Finally, consider broader issues of land-use policy. So far in Belfast, setting limits on public investment in areas vulnerable to existing or future flood hazards may be taken into consideration case-by-case, but has not been established as a policy. If a policy were to be put in place, the City could adopt special procedures for post-storm permitting and inspection to steer redevelopment away from vulnerable locations. It could also prioritize vulnerable areas for acquisition, and it could encourage offering private owners economic incentives or other voluntary means of improving their properties to reduce risks from sea change.

Running through the *FRC* is a major emphasis on a second type of community planning other than the Comprehensive Plan but not having anything to do with land use and not fully controlled or coordinated by the City: this is emergency planning, or, as the *FRC* typically puts it, “hazard/disaster” planning. It is administered largely by state/county officials. It is thorough and detailed, and coordinates extensive resources. [ii] The goal of such planning, however, is to do no more and no less than what it advertises, which is to help in disasters. It is meant to be a life-preserver, a temporary flotation device, not a plan for resilience. Given that climate change has now grown to emergency proportions, however, paired adjustments in the parallel municipal “comprehensive” and state “hazard/disaster” planning systems seem to make common sense. The goal of the Waldo County Emergency Planning Agency (EMA) is “to build a sustainable, self-sufficient and resilient community that comes back stronger following a major disaster event.” Why would it be difficult for the EMA to make common cause with the City of Belfast, whose goal is to build a sustainable, self-sufficient, and resilient community that takes strong measures to head off the major disaster that is climate change?

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[i] The annotated record of the *FRC* is available from the City Manager’s office, with the identifier DOC0202019-02202019163300.

[ii] Per Dale Rowley, participant in the *FRC* for the Waldo County Emergency Management Agency (EMA): Mutual aid agreements with neighboring communities have been agreed upon; the EMA assesses the vulnerabilities of critical infrastructure and facilities, society

and the economy; practice drills are run by the EMA; the EMA distributes educational materials to the community; the Coast Guard sends flood warnings when storms warrant them; a dedicated EMA communications center relays alerts; and evacuations to shelters in Belfast or other points proceed along lines laid out by EMA officials per its studies of particularly vulnerable populations. For storm response and recovery, equipment can be acquired through EMA links online; mechanisms are in place to receive public assistance and other external funds for recovery work, tracked and reported as such by the City per MEMA/FEMA requirements; on the basis of this emergency funding, the City has a line of credit to ensure capital flow until recovery is finished.

## Appendix C

### Table of Belfast Locations Vulnerable to Sea-Level Rise

<b>Type of Problem</b>	<b>Vulnerable Areas of Belfast</b>
Nuisance flooding – high tides	Downtown waterfront area (McCrum’s, Belfast Yards, sewage treatment plant, Marshall & Thompsons Wharves, Nautilus Restaurant & parking lot, Harbormaster’s Building, Boat Launch and docks, Heritage Park, Naron lot parking and marina)
Storm flooding	<ul style="list-style-type: none"> <li>· Downtown waterfront area</li> <li>· Head of the Tide</li> <li>· Young’s Lobster Pound</li> </ul>
Wind & wave damage associated with storms	<ul style="list-style-type: none"> <li>· Bridges – Rt. 1, Armistice, City Point</li> <li>· Downtown waterfront area</li> <li>· Boat House</li> <li>· Robbins Road</li> <li>· Private docks and waterfront businesses &amp; homes</li> </ul>
Erosion – cutting, removal of sediments	<ul style="list-style-type: none"> <li>· 5 areas reviewed by Gartley &amp; Dorsky for potential riprap reinforcement (Robbins Rd., Armistice Bridge eastern footing, Marshalls Wharf, Heritage Park, City Park)</li> <li>· Private shorelines</li> </ul>
Erosion – deposition of sediments	<ul style="list-style-type: none"> <li>· Harbor channel</li> <li>· East side mud flats</li> </ul>
Ecosystem changes	<ul style="list-style-type: none"> <li>· Disappearance of eel grass beds in Belfast Bay estuary</li> <li>· Population growth of invasive species (e.g., green crabs, periwinkles, colonial tunicates) leading to ecosystem shifts</li> <li>· Other? –species diversity &amp; abundances of invertebrates, fish, birds, algae, macrophytes?</li> </ul>