Project Report

Blue Hill Climate Vulnerability Assessment: Coastal Flooding and Adaptation

Blue Hill, Maine

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Table of Contents

List of Tables

List of Figures

Tables

Figures

Appendices

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Acronyms and Abbreviations

1% annual chance storm	An event that has a 1% chance of being equaled or exceeded each year. It is the storm condition that FEMA uses to determine their flood insurance rate maps. Also known as the "100-year storm."
BFE	Base Flood Elevation. This is the water elevation that is expected to occur during a 1% annual chance storm. This elevation accounts for wave action (wave crests, wave setup, and wave runup) on top of the Still Water Elevation (SWEL).
"Commit to Manage"	The Maine Climate Council's (MCC) sea level rise recommendation, based on an intermediate rate of sea level rise.
DEM	Digital Elevation Model
EPA	Environmental Protection Agency
FEMA	The Federal Emergency Management Agency, responsible for distributing Flood Insurance Rate Maps (FIRMs) and determining present-day BFEs
FIRMs	Flood Insurance Rate Maps, or maps showing the flood extents and BFEs, distributed by FEMA
FIS	Flood Insurance Study, issued by FEMA to accompany the FIRMs and provide details regarding the basis of the BFEs and extents.
GEI	GEI Consultants, Inc.
GIS	Geographic Information System
GMRI	Gulf of Maine Research Institute, a GEI partner on this project responsible for community engagement
GOPIF	Governor's Office of Policy Innovation and the Future, a source of funding for this project through a Community Action Grant
HAT	Highest Astronomical Tide
ILF	In Lieu Fee
KYC	Kollegewidgwok Yacht Club
LiDAR	Light Detection and Ranging
Maine DACF	Maine Department of Agriculture, Conservation, and Forestry
Maine DEP	Maine Department of Environmental Protection
Maine DOT	Maine Department of Transportation
Maine ECSB	Maine Emergency Services Communication Bureau
MCC	Maine Climate Council
MGS	Maine Geological Survey
MHHW	Mean Higher High Water, the average of the higher high water height of each tidal day observed over the National Tidal Datum Epoch.
MHPC	Maine Historic Preservation Commission
MUBEC	Maine Uniform Building and Energy Code
NAVD88	The North American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NMFS	National Marine Fisheries
NOAA	The National Atmospheric and Oceanic Administration

NRPA	Natural Resources Protection Act
PBR	Permit-by-Rule
PCR	Pre-Construction Notification
“Prepare to Manage”	The Maine Climate Council’s (MCC) sea level rise recommendation, based on a high rate of sea level rise.
SLR	Sea Level Rise
SVNF	Self-Verification Notification Form
SWEL	Still Water Elevation
Town	Town of Blue Hill, Maine
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish & Wildlife
VDATUM	Vertical Datum Transformation, a NOAA tool for converting between vertical datums

Executive Summary

This report presents the findings of the Blue Hill Climate Vulnerability Assessment, which aims to evaluate the risks of coastal flooding, storm surge, and sea level rise to critical infrastructure and open spaces in the Town of Blue Hill, Maine (the "Town"). This study was performed by GEI Consultants, Inc. (GEI) in partnership with the Gulf of Maine Research Institute (GMRI) and an oversight committee composed of representatives from the Towns of Blue Hill, Brooksville, and Surry. The assessment presented in this report provides an evaluation of the Town's coastal flood vulnerability and offers recommendations for adaptation. The project was funded through a Community Action Grant from the Governor's Office of Policy Innovation and the Future (GOPIF), with additional funding support from the Town of Brooksville.

The primary objective of this assessment was to identify vulnerable infrastructure within the town that could be impacted by coastal flooding due to increasing sea levels and more frequent storm events. The study utilized nine flood scenarios to model potential flooding impacts under present-day conditions, as well as future projections for 2050, 2070, and 2090, based on guidance from the Maine Climate Council. These scenarios accounted for both daily high tide levels and the 1% annual chance storm surge (commonly referred to as the "100-year storm") under different sea level rise projections. This analysis was performed using Geographic Information System (GIS) tools, which allowed for mapping of flood extents and the identification of critical assets at risk.

E.S.1. Key Findings

The assessment identified several assets, including roads, culverts, bridges, buildings, and conservation lands, that would be vulnerable to flooding under both current and future conditions.

- **Roads:** Several roads would be particularly vulnerable to flooding, with East Blue Hill Road, Falls Bridge Road, and Parker Point Road highlighted as high priority for adaptation due to their flood exposure and importance as evacuation routes.
- **Culverts and Bridges:** We identified five state-owned culverts and three state-owned bridges, including the East Blue Hill Bridge and Mill Island Bridge, as being at risk of inundation during significant storm events. These structures are critical for maintaining connectivity within the town and for emergency access.
- **Buildings and Critical Facilities:** We identified approximately 50 buildings that would be impacted by flooding, including the Blue Hill Wastewater Treatment Facility. While most buildings in the town are not immediately at risk, some could experience daily flooding as early as 2050 in the absence of implementing adaptation measures.
- **Conservation Lands and Cemeteries:** Approximately 69 acres of conservation land and several cemeteries would likely experience flood inundation under present-day and future sea level rise scenarios.

E.S.2. Adaptation Strategies

The report outlines a range of adaptation strategies for the Town to consider that would help reduce the impacts of flooding on critical infrastructure. These strategies are designed to address both immediate risks (up to 2050) and longer-term threats (through 2090 and beyond). The adaptation options are grouped into structural and non-structural measures:

- **Structural Measures:**
  - **Road Elevation and Protection:** We recommend elevating key roads such as East Blue Hill Road and Falls Bridge Road to prevent inundation during high tides and storm surges. Where elevation is not feasible, the installation of protective structures such as sea walls, or relocation of the roadways (i.e., inland, upland), may be considered.
  - **Building Adaptations:** For buildings at risk of flooding, we recommend considering wet and dry floodproofing techniques, as well as the elevation of structures above predicted flood levels. In some cases, it may be necessary to consider retreat with the relocation of vulnerable structures away from flood-prone areas.
  - **Piers and Wharves:** The adaptation of piers and wharves, including the Blue Hill Village Wharf and the South Blue Hill Wharf, could focus on elevating and reinforcing structures to withstand increased water levels and wave action.
- **Non-Structural Measures:**
  - **Flood Monitoring Systems:** We suggest implementing a water level monitoring and alert system to provide real-time data on flood risks, allowing the town to respond more effectively to potential flooding events.
  - **Emergency Preparedness:** Developing emergency response plans would likely increase public safety during extreme storm events. Additionally, public awareness campaigns to educate residents about the dangers of driving or walking through floodwaters will help reduce risks during emergencies.
  - **Regulatory Improvements:** The Town could update local ordinances to enforce stricter building codes and floodplain management regulations. This could include adopting more stringent requirements for new developments in flood-prone areas and integrating climate change considerations into the Town's comprehensive planning efforts.

E.S.3. Cost Estimates and Funding Opportunities

The report provides preliminary cost estimates for implementing the recommended adaptation measures. Adapting critical infrastructure can be a significant investment, but the town may be able to leverage state and federal grant programs to offset costs. The report identifies several potential funding sources which could support the town's efforts to build long-term flood resilience.

E.S.4. Next Steps

This vulnerability assessment is a high-level analysis designed to guide the Town's flood adaptation efforts. Future work should include conducting site-specific field investigations, refining coastal flood risk through wave modeling, and preparing engineering designs for identified adaptation projects. The town should also continue engaging with the public and other stakeholders to build support for the necessary adaptation measures.

To enhance public access to the findings, the results of this study will be available online through an ArcGIS StoryMap, which will provide interactive maps of the flood risk scenarios and adaptation recommendations. This resource will be made available by the project closeout date of December 31, 2024.

In conclusion, this assessment underscores the importance of proactive adaptation planning to safeguard the Town of Blue Hill against the increasing risks posed by coastal flooding. By implementing the recommended strategies, the town can enhance its resilience and protect critical infrastructure, natural resources, and the well-being of its residents.

1. Introduction

This report presents the methods and findings of a vulnerability assessment for the Town of Blue Hill (the "Town") in Hancock County, Maine (Figure 1). The purpose of the project was to evaluate the vulnerability of infrastructure and open spaces to flood risk due to storm surge and sea level rise and to provide adaptation strategies and timeframe recommendations for adaptation projects to increase the Town's resiliency to flood inundation.

This work was based on our proposal dated August 4, 2023. The project team consisted of GEI Consultants, Inc. (GEI), the Gulf of Maine Research Institute (GMRI), and an Oversight Committee with several members from the Town of Blue Hill, the Town of Brooksville, and the Town of Surry. This project was funded with a Community Action Grant through the Governor's Office of Policy Innovation and the Future (GOPIF) Community Resilience Partnership with additional funding support from the Town of Brooksville. This report provides a data review and data gap analysis, an overview of the flood exposure methodology, flood risk results which summarizes vulnerable infrastructure and places, general flood adaptation recommendations, and site-specific adaptation recommendations for select assets in the Town. Climate risks associated with heat, power outages, clean drinking water and drought, ocean acidification, shifts in plant hardiness zones, tick-borne diseases, and vulnerabilities to the working waterfront economy will be summarized separately as part of this project.

The flood scenarios included in this evaluation represent specific storm conditions and rates of sea level rise. Actual storms, sea level rise rates, and flood conditions will vary from conditions presented in this report. The purpose of this evaluation was to help the Town plan and prepare for resiliency projects. An important next step after this study would be to conduct site-specific detailed analysis for identified adaptation projects. The site-specific analyses could include wave modeling, site survey, permitting, and design, among other tasks.

The results of the flood vulnerability and adaptation study presented in this report will be available to view online as part of an ArcGIS StoryMap. The StoryMap will be available before the project closeout date of December 31, 2024.

Elevations in this report are referenced to the North American Vertical Datum of 1988 (NAVD88) unless otherwise specified.

2. Data Review

Data review was performed to evaluate previous work and available information to use for flood vulnerability and adaptation planning. This section summarizes the existing regional resiliency plans and policies related to climate and flood vulnerability for the Town of Blue Hill.

Details of the data used for the flood vulnerability analysis, limitations of existing data, and next steps to improve upon available data, are provided throughout this report.

2.1. Existing Regional Resiliency Plans, Policies, and Data

The Town of Blue Hill is on the Blue Hill Peninsula and within Hancock County. For these regions, we reviewed the Hancock County Hazard Mitigation Plan, planning efforts conducted by the group "Blue Hill Peninsula Tomorrow," and the 2022 report by rbouvier consulting titled "Assessing the Carrying Capacity of the Blue Hill Peninsula." In addition to a regional review, we have summarized Town-specific resiliency plans, policies, and data, such as the Blue Hill Sea Level Rise Task Force, town-specific ordinances, and availability of GIS data.

2.1.1. Hancock County Hazard Mitigation Plan 2024 Update

A hazard mitigation plan proposes ways to reduce loss of life and property by minimizing the impact of disasters. The 2024 Hancock County Hazard Mitigation Plan Update (Hancock County EMA, 2024) outlines four main hazards in the county: severe winter storms, flooding, severe summer storms, and wildfires. The plan specifies that these hazards were selected based on review of the Maine State Hazard Mitigation Plan 2023 Update (MEMA, 2023), past disaster declarations, mapped data, risk assessments, and input from residents and municipalities. Within each of the four hazard types, additional sub-types are defined, such as freezing fog as it pertains to severe winter storms, coastal flooding from storm surge as it pertains to flooding, and microbursts (i.e., strong winds) as they pertain to severe summer storms. Locations where hazards have occurred in the past are listed for each community. The following hazards and locations were identified for Blue Hill in the Hancock County Hazard Mitigation Plan 2024 Update: coastal flooding, and flooding from winter and summer storms.

The plan notes opportunities for improvement of local plans and policies, including developing a town-specific zoning ordinance, and adopting building codes. Blue Hill does not have a town zoning ordinance. Additionally, since the population of Blue Hill is below 4,000, the town is not required to have an adopted building code. However, Blue Hill could adopt a building code that aligns with the Maine Uniform Building and Energy Code (MUBEC).

2.1.2. "Assessing the Carrying Capacity of the Blue Hill Peninsula" Report

In August 2022, rbouvier consulting published a report on behalf of Blue Hill Heritage Trust (BHHT), that explored the carrying capacity of the Blue Hill Peninsula (rbouvier consulting, 2022). The purpose of the report was to examine population trends and projections related to climate-related migration and assess the physical, economic, and social carrying capacity of the peninsula to accommodate and increase in population. The study found that there was an increase in temporary and permanent migration between 2018 and 2022, likely due to the COVID-19 pandemic. The study results found that climate migration was voluntary and due to perceived dangers at the location people where people were moving from (e.g., wildfires, hurricanes, etc.). The study noted that the Blue Hill wastewater treatment plant is operating at 84% of its permitted capacity. The study suggested the wastewater treatment plant would likely not be able to withstand a significant increase in population.

2.1.3. Blue Hill Peninsula Tomorrow

In 2021, eight communities within the greater Blue Hill Peninsula formed Blue Hill Peninsula Tomorrow – a multi-town effort to identify the potential impact of climate change on the Blue Hill Peninsula and explore ways to maximize mitigation and adaptation opportunities through collaboration. In addition to virtual meetings, the group manages a website for report and information compilation hosted on the Hancock County Planning Commission page.

2.1.4. Blue Hill Task Force on Sea Level Rise

On September 14, 2020, the Blue Hill Task Force on Sea Level Rise submitted their final report on sea level rise in Blue Hill to the town's select board (Blue Hill Task Force, 2020). The report reviewed scientific data related to sea level rise, identified town infrastructure that would be impacted by sea level rise and storm surge, developed alternative strategies for adapting to and/or mitigating impacts to flooding, developed rough cost estimates for adaptation projects, and recommended a preferred strategy and prioritization schedule for addressing vulnerable infrastructure.

Key infrastructure identified in this report as at risk for vulnerability include: the wastewater treatment facility, the wharf in South Blue Hill, the Blue Hill Fire Department and Town Landing, Seaside Cemetery, Town Park, Parker Point Road, Parker Point Road near the country club, Water Street at the town landing and fire department, the road and bridge at Mill Stream, Rt. 176 at Peter's Cove, Jay Carter Road at the culverts between Jim Dow and Treitlers, the bridge over McHeard Stream, Curtis Cove Road at the Curtis Cove Beach, the causeway on Falls Bridge Road, and South Blue Hill Wharf Road.

The Sea Level Rise Task Force recommended the town commit to manage for 1.1 to 1.8 ft of sea level rise by 2050 and 3.0 to 4.6 ft by 2100. Additionally, the Sea Level Rise Task Force recommended preparing for significantly higher sea level rise, including 3.0 ft by 2050 and 8.8 ft by 2100, especially for infrastructure that is vital to the town and lacks tolerance for flooding, such as the wastewater treatment facility.

The recommendations to address these vulnerable sites and roads were briefly outlined in the report. For roads and bridges that are State-owned, the Sea Level Rise Task Force recommended working with MaineDOT to address vulnerabilities. For the other town-owned sites and roads, the Task Force recommended that a comprehensive vulnerability assessment be conducted by an engineering firm to confirm and address vulnerabilities and form a comprehensive plan for long-term solutions for locations like the Seaside Cemetery and the Town Park.

2.1.5. Town Ordinances

Ordinances are pieces of legislation developed and enacted by a municipality that, for example, govern how property is used and developed. They are local laws for residents to follow, in addition to – and sometimes more restrictive than – federal or state laws. Ordinances are specific to each municipality and can help communities maintain their character or goals for the future.

The Town of Blue Hill participates in the National Flood Insurance Program (NFIP) and maintains local floodplain management ordinance consistent with the NFIP and the standards set forth by the National Flood Insurance Act of 1968. While this ordinance meets the necessary criteria for damage relief funding from flood hazards, outlined in the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) for Hancock County (FEMA, 2016), the ordinance language contains no additional or more stringent standards for risks related to sea level rise or increasing storm frequency/intensity.

In addition to the Floodplain Management Ordinance, the Town of Blue Hill also has a Shoreland Zoning Ordinance which regulates land use activities in the “shoreland zone.” As noted previously, the Town does not currently have a Building Ordinance or a Land Use Zoning Ordinance. These additional ordinances could offer avenues for more stringent guidelines and regulations around infrastructure adaptation.

2.1.6. GIS Data

The Town of Blue Hill does not maintain a GIS database of town-owned infrastructure, such as transportation infrastructure (i.e., road, sidewalks, etc.), drainage infrastructure (i.e., culverts, catch basins, drainage ditches, etc.), or sewer infrastructure (i.e., pump stations, outfalls, etc.). Additionally, citizens of the Town may also benefit from maintaining information on “protective” infrastructure that is not town-owned but that is within the town, such as buildings and coastal structures (i.e., riprap, seawalls, etc.). GIS data used for this flood vulnerability study, and limitations of the data, is outlined in Section 3 of this report.

2.2. Opportunities for Policy, Plan, and Data Improvement

We have provided a summary of opportunities for improvement of the plans and data reviewed related to flood vulnerability. The following points are general opportunities for improvement. More detail on how to improve specific data sources is provided throughout this report.

- **Comprehensive Plans.** Consider incorporating climate change vulnerabilities into a comprehensive plan. These vulnerabilities could be acknowledged in the individual and associated sections within the plan and as a standalone section in the Comprehensive Plan Appendices. Vulnerability assessments, like this current project, could be used to further develop goals that have a climate-related vulnerability component. As comprehensive plans are community documents, informing residents about vulnerabilities and their impact on visions for the future would help the public understand the implications for not addressing issues.
- **Local Ordinances.** The Town of Blue Hill could adopt building and land use zoning ordinances to enforce more restrictive infrastructure requirements that would be protective of buildings or

other infrastructure in vulnerable settings. Additionally, the existing floodplain management ordinance is based on FEMA Flood Insurance Rate Maps which do not include sea level rise in the mapped hazard areas. The floodplain management ordinance could adopt more stringent rules and mapping to account for sea level rise.

- **Collaboration with Maine DOT.** There are several vulnerable roads identified from previous studies and from work on this project that are owned by Maine DOT. The Town of Blue Hill could work collaboratively with Maine DOT to address these vulnerable roadways. An example of municipality working collaboratively with Maine DOT on a state-owned road adaptation project is the Route 1 and Route 9 resiliency project in the Town of Scarborough (Scarborough, 2024).

- **GIS Database of Assets.** Consider developing a process for cataloging data and maintaining a GIS database of assets. The GIS asset database should, at a minimum, include the geographic coordinates of an asset and the asset type. However, a robust database could include details on the dimensions, elevations, and conditions of the asset and the date when the data entry was logged. The database could also indicate, for example, the water surface elevation or duration of flooding that would render the asset unusable. There are readily available online databases with GIS data, many of which were used in this study, but there is a lack of data on infrastructure within the town, such as culverts and building footprints (the existing data is from 2018), and utility locations.

3. Flood Risk Assessment

Coastal flood risk for the Town was evaluated for nine flood scenarios. The scenarios included present-day sea levels and estimated sea levels in 2050, 2070, and 2090 based on sea level rise guidance provided by the Maine Climate Council (2024). For present-day sea levels, flood risk due to 1% annual chance still water levels ("100-year storm surge") was evaluated. For the 2050 and 2070 timeframes, flood risk was evaluated for average daily tide levels (represented as mean higher-high water [MHHW]) in addition to 1% annual chance storm surge elevations. Each scenario featured a water surface elevation representative of a timeframe, sea level rise value, and tide scenario (i.e., MHHW or 1% annual chance storm surge events).

The flood scenarios evaluated as part of this study represent static water levels (i.e., standing water or inundation without waves). The effect of wave action, including the flood extents due to wave runup and/or overtopping, was not included in the analysis. Thus, the flood depths and extents in this report likely underestimate those that would likely occur during the flood scenarios representative of coastal storms, where wave action is expected to occur. Additionally, flood risk due to rainfall events was not included as part of this study. The results from this evaluation should be used to identify and prioritize infrastructure at risk of flooding from coastal effects absent precipitation and/or wave impacts. Flood elevations included in this study should not be used in design. The data sources used for water levels and sea level rise estimates are described in further detail in the following sections.

A GIS-based analysis was performed using the nine flood elevations and a topographic surface of the study area to evaluate the extent of flooding for each scenario. A GIS database of "assets," such as transportation infrastructure, building infrastructure, property parcels, and conservation lands, was compiled and used to identify infrastructure and areas at risk of flood inundation for the nine flood scenarios. The following sections describe the GIS analysis in more detail.

3.1. Methodology

3.1.1. Topography Data

A Digital Elevation Model (DEM) was developed by mosaicking multiple DEMs developed from LiDAR (Light Detection and Ranging) surveys (USGS, 2021). The original surveys have a resolution of 1-meter, meaning the terrain is divided into 1-meter grids with each grid cell being represented by a single elevation value. The elevations within each grid cell reference the NAVD88 datum.

3.1.2. GIS Asset Data

We compiled a GIS database of assets using primarily publicly-available data sources that were included as part of this vulnerability analysis using data from publicly available data sources. The GIS data included:

- Roads.
- Evacuation routes.

- Parcels.
- Conservation parcels.
- Building footprints.
- Critical facility locations (hospitals, government buildings, schools, and fire stations).
- Cemeteries.
- Boat launches.
- Large culvert and cross culvert locations on state-owned roads.
- Drinking water well locations.
- Bridges.

A detailed list of file names, sources, and dates data were accessed can be found in Appendix A. It is important to note that public GIS data accessed online can be updated over time. The data used in this study represents a snapshot in time. More details and limitations on the GIS data sources is provided within the results sections of this memo.

3.1.3. Water Levels

This study evaluated infrastructure and areas at risk of flooding during MHHW and 1% annual chance stillwater elevations. MHHW is the average of the higher high-water height of each tide cycle, meaning that areas identified in the flood vulnerability results as inundated during MHHW would likely experience daily flooding. The MHHW elevation for the Towns was estimated for present-day sea levels using the National Oceanic and Atmospheric Association (NOAA) Vertical Datum Transformation (VDATUM) tool (NOAA, 2023). The average MHHW for the Towns is approximately 5.3 ft NAVD88.

The FEMA Flood Insurance Study (FIS) for Hancock County was used to estimate the 1% annual chance stillwater elevations (SWEL) (FEMA, 2016). The FIS provides an estimated 1% annual chance SWEL for each shoreline transect included in the FEMA study. There are 3 FEMA transects in Surry, 9 in Blue Hill, and 12 in Brooksville. The average 1% annual chance SWEL for these transect locations is 9.4 ft NAVD88, representing approximately 4.1 ft of storm surge above MHHW conditions. Before 2016, the FEMA FIS for Hancock County was previously updated in 1990 (FEMA, 1990). There is no readily available information for when FEMA may next update the FIS for Hancock County.

Sea level rise estimates were added to present-day MHHW and 1% annual chance SWEL to estimate future MHHW and 1% annual chance storm surge elevations, described in further detail in the following section.

3.1.4. Sea Level Rise

The Maine Climate Council (MCC) has recommended sea level rise estimates for Maine communities to consider when planning and designing for flood adaptation. The MCC has recommended that Maine communities “Commit to Manage” an intermediate rate of sea level rise and “Prepare to Manage” a high rate of sea level rise. The MCC sea level rise recommendations were first issued in 2020 and were based on 2017 projections provided by NOAA (MCC, 2020a). This vulnerability assessment was performed in 2023 and used the MCC 2020 recommendations. However, the MCC updated the sea level rise recommendations for the "Prepare to Manage" scenarios following updated sea level rise projections issued by NOAA in 2022 (MCC, 2024). The "Prepare to Manage" sea level rise value of 3.0 ft has shifted from likely to occur by 2050 to likely to occur by 2070. The "Prepare to Manage" value of 2.4 ft has shifted from likely to occur by 2070 to likely to occur by 2090. We have updated the timeframes used in this study to reflect the recent changes to the MCC recommendations. The updated sea level rise scenarios for the Bar Harbor tide gage for the years 2020 to 2150 are summarized in Table 3-1.

Table 3-1. Sea Level Rise Estimates

Timeframe	Sea Level Rise Amount (ft) Intermediate Rate Median (likely range)	Sea Level Rise Amount (ft) High Rate Median (likely range)
2020	0.4 (0.3-0.5)	0.4 (0.3-0.5)
2030	0.6 (0.4-0.8)	0.6 (0.4-0.9)
2040	0.9 (0.7-1.2)	1.0 (0.7-1.4)
2050	1.2 (0.9-1.5)	1.5 (1.0-2.0)
2060	1.5 (1.2-2.0)	2.1 (1.5-2.8)
2070	1.9 (1.5-2.4)	2.9 (2.2-3.7)
2080	2.4 (1.9-3.0)	3.9 (2.8-4.9)
2090	3.0 (2.3-3.6)	4.9 (3.5-6.2)
2100	3.6 (2.7-4.4)	6.0 (4.3-7.5)
2110	4.4 (3.1-5.4)	7.2 (5.2-8.9)
2120	5.0 (3.5-6.7)	8.3 (5.9-10.5)
2130	5.6 (4.0-8.4)	9.3 (6.5-12.4)
2140	6.2 (4.3-10.6)	10.2 (7.0-14.6)
2150	6.7 (4.7-13.1)	10.9 (7.6-16.9)

Source: Sea level rise estimates for the Bar Harbor, Maine, NOAA buoy taken from Table 3 in the 2024 Maine Climate Council report (MCC, 2024)

3.1.5. Flood and Mapping Scenarios

The nine flood scenarios used in this study and their respective flood elevations are summarized in Table 3-2.

Table 3-2. Summary of Flood Scenarios

MCC SLR Scenario	Timeframe	SLR Amount (ft)	Tidal Conditions	Flood Elevation (ft, NAVD88)
	Present Day	0.0	100-year	9.4
Commit to Manage	2050	1.5	MHHW	6.7
			100-year	10.8
	2070	2.4	MHHW	7.6
			100-year	11.7
Prepare to Manage	2070	3.0	MHHW	8.2
			100-year	12.3
	2090	5.0	MHHW	10.2
			100-year	14.3

Note: Sea level rise estimates are based on relative increases from mean sea level in the year 2000, which is approximately 0.1 ft lower than present-day mean sea level. This difference in mean sea level was accounted for in the Flood Elevations used in this study.

For reporting purposes, the flood scenarios were arranged from lowest to highest water surface elevation and numbered from 1 to 9. Flood Scenario 1 would have the smallest inundation extent and lowest water surface elevation and Flood Scenario 9 would have the largest inundation extent and highest water surface elevation. Areas that would be inundated for lower scenarios numbers would be considered more vulnerable while areas inundated under higher scenario numbers would be considered less vulnerable. Table 3-3 shows a description of the flood scenario with the corresponding scenario number to be used in the results summary tables. The flood scenario numbers table is also provided in Appendix B.

Table 3-3. Flood Scenario Numbers

Flood Scenario Description	Water Surface Elevation (NAVD88, ft)	Flood Scenario Number
2050, High Tide, Commit to Manage (1.5 ft SLR)	6.7	**1**
2070, High Tide, Commit to Manage (2.4 ft SLR)	7.6	**2**
2070, High Tide, Prepare to Manage (3.0 ft SLR)	8.2	**3**
Present Day, 100-year Storm	9.4	**4**
2090, High Tide, Prepare to Manage SLR (5.0 ft SLR)	10.2	**5**
2050, 100-year Storm, Commit to Manage (1.5 ft SLR)	10.8	**6**
2070, 100-year Storm, Commit to Manage (2.4 ft SLR)	11.7	**7**
2070, 100-year Storm, Prepare to Manage (3.0 ft SLR)	12.3	**8**
2090, 100-year Storm, Prepare to Manage (5.0 ft SLR)	14.3	**9**

Notes:
1. "High Tide" refers to MHHW elevation. "100-year Storm" refers to the 1% annual chance stillwater elevation.
2. "Water Surface Elevation" includes SLR as applicable.

3.1.6. Asset Adaptation Prioritization

The water elevations for the nine flood scenarios were used to create nine flood inundation extents. The flood inundation extents for each scenario can be viewed on the corresponding ArcGIS StoryMap that will be developed as part of this project. The nine inundation extents were used to identify which GIS-based "assets" would be exposed to flooding for each scenario included in this study. Some assets, such as roads, were further categorized into "High," "Medium," and "Low Priority" in terms of prioritizing roads for flood adaptation.

Assets identified as being at risk of flood inundation for Flood Scenarios 1 through 4 were initially categorized as high priority for adaptation in terms of flood exposure. These assets would likely be inundated during 1% annual chance storm surge events for present-day water levels. Additionally, some of these assets would likely experience daily flooding by 2050 or 2070.

Assets identified as being at risk of flood inundation for Flood Scenarios 5 through 7 were initially categorized as medium priority for adaptation in terms of flood exposure. These assets would likely be inundated during 1% annual chance storm surge events in the years 2050 and 2070 for the "Commit to Manage" sea level rise scenario and would likely experience daily flooding in 2090 under the "Prepare to Manage" sea level rise scenario.

Assets identified as being at risk of flood inundation for Flood Scenarios 8 and 9 were initially categorized as low priority for adaptation in terms of flood exposure. These assets would likely experience flooding during 1% annual chance storm surge events in the years 2070 and 2090 for the "Prepare to Manage" sea level rise scenario.

After the initial prioritization based on flood exposure, assets were moved up or down in priority using input collected during the community mapping event, the potential use of the asset during emergencies (i.e., a road as an evacuation route), and the relative number of people who may be impacted if the asset were to be inundated.

The results of the flood exposure analysis have been summarized in the following sections of this report. The table of flood scenarios and the results summary tables included within this report are also included in Appendix B of this report.

3.2. Flood Risk Results

3.2.1. Roads

We have suggested that four roads in Blue Hill be given "High Priority" to in terms of flood adaptation. These roads were given high priority due to a combination of the estimated flood exposure, the potential use of these roads as evacuation routes, and the relative amount of people who may be impacted if the road were to be inundated. We recommend that the Town of Blue Hill focus on "High Priority" roads first when considering flood adaptation measures. Using the same criteria, we identified an initial list of four "Medium Priority" and eight "Low Priority" roads. A summary of the roads inundated and estimated length of inundation (i.e., in the direction of travel) for each of the nine flood scenarios is provided in Table 3-4.

The road locations and lengths used in this analysis are based on a GIS shapefile of roads developed by Maine Emergency Services Communication Bureau (Maine ESCB, 2021). The digital data represents a snapshot in time and are based on road alignment developed by others. Actual road locations may differ. We based our inundation analysis on the digital road data described above and the terrain data compiled for this study. These results should be considered approximate.

Table 3-4. Roads Flood Risk Exposure Summary, Length of Inundation (ft)

Road Name	Ownership	1	2	3	4	5	6	7	8	9
High Priority Roads										
E Blue Hill Rd	State	-	-	-	-	24	165	424	522	821
Falls Bridge Rd	State	-	-	-	-	197	311	540	658	1,204
Parker Point Rd	Town	-	-	-	-	-	76	148	181	323
Jay Carter Rd	Town	-	-	-	-	-	-	147	202	289
Medium Priority Roads										
Kyc Ln	Town	-	-	37	101	131	140	153	156	175
Salt Pond Rd	State	-	-	-	-	78	111	151	169	223
Leveque Ln	Town	-	-	-	-	-	36	147	171	208
Curtis Cove Rd	Town	-	-	-	-	-	-	-	-	145
Low Priority Roads										
Steamboat Wharf Rd	Town	-	-	-	-	-	-	13	30	81
Shady Ln	Town	-	-	-	-	-	-	4	14	28
Allen Point Ln	Town	-	-	-	-	-	-	-	56	237
Osprey Ln	Town	-	-	-	-	-	-	-	-	13
SC Ln	Town	-	-	-	-	-	-	-	-	159
Seal Ledge Ln	Town	-	-	-	-	-	-	-	-	47
Tides End Ln	Town	-	-	-	-	-	-	-	-	34
Woods Point Rd	Town	-	-	-	-	-	-	-	-	477

3.2.2. Culverts

We have identified five culvert crossing locations (one "large culvert" and four "cross culverts") that were included in the Maine DOT culvert database for cross culverts (MaineDOT, 2021a) and large culverts (MaineDOT, 2021b) that would likely be fully submerged and the deck of the road at the culvert would be overtopped for one or more of the nine flood scenarios included in this study. We based this analysis on the Maine DOT culvert database locations and the terrain data compiled for this study. The culvert crossings identified as being at risk of inundation, and an included descriptor of their location, are provided in Table 3-5.

Maine DOT defines a large culvert as "a pipe or structure with a total span width greater than 5 feet and less than 10 feet OR any multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening, and the total flow area is between 20 and 80 square feet" (MaineDOT, 2021b). Maine DOT defines a cross culvert as "a pipe or structure that has a span of less than 5 feet or multiple pipes or other structures with a combined opening of less than 20 square feet in area" (MaineDOT, 2021a).

Culverts on non-state roads, such as local or private roads, were not included in this evaluation due to lack of digital data. There are likely culvert crossing locations that would be overtopped for the flood scenarios included in this study that have not been captured in these results. Additionally, this study does not consider whether the size of the culvert is appropriate for present-day or future flood and flow scenarios, but instead identifies roads at culvert crossing locations that would likely be overtopped.

The culvert locations are based on the large culvert and cross culvert shapefiles maintained by MaineDOT. These results should be considered approximate.

Table 3-5. Maine DOT Culverts Flood Exposure Summary (Y/N)

Culvert Location	1	2	3	4	5	6	7	8	9
Large Culverts									
E Blue Hill Rd *near Peter's Cove*	-	-	-	-	-	Y	Y	Y	Y
Cross Culverts									
Salt Pond Rd *near Lone Cove before pole # 107 near Lone Cove*	-	-	-	-	Y	Y	Y	Y	Y
Falls Bridge Rd* *Approx. 0.25 miles NW of Blue Hill Falls Bridge on the Mill Island Causeway*	-	-	-	-	Y	Y	Y	Y	Y
Falls Bridge Rd *Approx. 580 ft SE of intersection with Parker Point Rd.*	-	-	-	-	-	Y	Y	Y	Y
Falls Bridge Rd *Approx. 740 ft SE of intersection with Parker Point Rd.*	-	-	-	-	-	-	-	-	Y

Notes:
1. MaineDOT in some instances refers to the culvert along Falls Bridge Rd on the Mill Island Causeway as the “Mill Island Bridge.”

3.2.3. Bridges

We have identified three bridges from the Maine DOT bridge database (MaineDOT, 2021c) with bridge approaches and bridge decks that would likely be overtopped due to the flood scenarios included as part of this study: the East Blue Hill Bridge, the Mill Island Bridge, and the Peter’s Brook Bridge. The Blue Hill Falls Bridge was replaced and elevated by 4.0 ft in May 2024. The newly reconstructed bridge has a low point elevation of 17.7 ft which is above the flood scenarios included in this study (M. The East Blue Hill Bridge is in the Maine DOT 2024-2025-2026 work plan, with a scope of work listed as “Bridge Replacement – PE Only” (Maine DOT, 2024a). This work could include elevating the existing bridge, but details of the goals of the project are not readily known. The Maine DOT 2024-2025-2026 work plan for Blue Hill is provided in Appendix C.

The flood scenarios that would likely inundate these bridges are summarized in Table 3-6. We based this analysis on the terrain compiled for this project and our review of aerial imagery. In the event the bridges were burned out of the terrain, we used the raw LiDAR point data to perform this analysis.

The East Blue Hill Bridge and the Mill Island Bridge would likely experience daily flood inundation during high tides for 5.0 ft of sea level rise (the "Prepare to Manage" scenario for 2090) and during 1% annual chance storm surge for the four rates of sea level rise included in this study.

Falls Bridge Road, which includes the Mill Island Bridge, serves as a primary evacuation route for residents in Blue Hill. The Maine DOT has indicated that this road is particularly vulnerable to flood inundation (Maine DOT, 2024b). Alternate routes, specifically along Hales Hill Road and Reach Road through Brooklin headed into Sedgwick, would likely experience flood inundation due to coastal storm surge and/or sea level rise.

The Mill Island Bridge is a culvert along the causeway north of Mill Island. This culvert has also been included in the results for culverts in a previous section of this memo. While the newly reconstructed Blue Hill Falls Bridge likely reduces the risk of flood inundation at the Blue Hill Falls Bridge location on Falls Bridge Road (Route 175), the risk of flood inundation at the Mill Island Bridge location would remain, which would prevent travelers from using the road during periods of inundation.

The bridge location data used in this study were based on a MaineDOT shapefile of bridge locations provided by the MaineDOT Open Data Map Server. This digital data represents a snapshot in time and actual bridge locations may vary. Bridges that are not part of the Maine DOT database would not be included in this evaluation. These results should be considered approximate.

Table 3-6. Maine DOT Bridges Flood Exposure Summary (Y/N)

Bridge Name	1	2	3	4	5	6	7	8	9
East Blue Hill Bridge[1]	-	-	-	-	Y	Y	Y	Y	Y
Mill Island Bridge[2]	-	-	-	-	Y	Y	Y	Y	Y
Peter's Brook Bridge	-	-	-	-	-	-	-	-	Y
Blue Hill Falls Bridge[3]	-	-	-	-	-	-	-	-	-

Notes:
1. The East Blue Hill Bridge is included in the Maine DOT 2024-2025-2026 work plan for Blue Hill (Maine DOT, 2024a).
2. The Mill Island bridge is a culvert and is also included in the culvert section of this memo.
3. The results are based on the low point EL. 17.66 ft of the bridge reconstructed in 2024 (Maine DOT, 2021).

3.2.4. Buildings and Critical Facilities

We have identified approximately 50 buildings that would likely be at risk of flood inundation for one or more of the nine flood scenarios evaluated as part of this study, which represents approximately 2.2% of the total number of buildings in Blue Hill. We base our analysis on the elevation of the ground surface adjacent to buildings using the terrain compiled for this study and the building footprint database used for this study (Microsoft, 2018). Approximately 19 buildings would likely be at risk of flood inundation for present-day sea levels and 1% annual chance coastal storms, without the addition of wave action. With 1.5 ft of sea level rise (i.e., the "Commit to Manage" scenario for 2050), approximately 10 buildings would be at risk of flood inundation during high tides. The flood exposure results for buildings in

Blue Hill for the nine scenarios included as part of this study are summarized in Table 3-7. This study does not refer to the structural integrity of buildings, but rather evaluates the potential for inundation.

These numbers are approximate and based on building footprint data generated using satellite imagery around the year 2012, according to the Microsoft building footprints layer for North America (Microsoft, 2018). From our review of the data, it appears that the building footprints for the study area were based on imagery taken prior to 2012. As a result, the number of building footprints used in this analysis is likely less than the actual number of buildings and represents a snapshot in time. In addition to representing residential structures, these building footprints also may include sheds, boathouses, or other appurtenant structures.

Table 3-7. Buildings Flood Exposure Summary

Buildings	1	2	3	4	5	6	7	8	9
# Impacted	10	14	16	19	24	25	28	32	50
% Impacted (%)	0.4	0.6	0.7	0.8	1.1	1.1	1.2	1.4	2.2

Two of the buildings at risk of flood inundation were identified in the Final Report to the Select Board on Sea Level Rise in Blue Hill (2020) as being critical buildings and/or facilities for the Town of Blue Hill– the Wastewater Treatment Facility and the Blacksmith Shop on the wharf below the fire station. The Blacksmith Shop, located on the Town Wharf, would likely experience flood inundation for 1% annual chance coastal storm events and present-day sea levels. The Wastewater Treatment Facility would likely experience daily flood inundation during high tides for 5.0 ft of sea level rise (the "Prepare to Manage" scenario for 2090) and during 1% annual chance coastal storm events for the four rates of sea level rise included in this study.

The flood risk assessment results suggest that other buildings identified in that report, such as the Stavola House, the Fire Station, and the Northern Light Blue Hill Hospital, would not be likely to experience flood inundation due to the flood scenarios included in this study. However, the properties surrounding these buildings would likely experience flood inundation for one or more of the flood scenarios included in this study. Table 3-8 summarizes the flood exposure results for these facilities.

Table 3-8. Critical Facilities Flood Exposure Summary

Critical Buildings	1	2	3	4	5	6	7	8	9
Blacksmith Shop (on Village Wharf)	-	-	-	Y	Y	Y	Y	Y	Y
Wastewater Treatment Facility	-	-	-	-	Y	Y	Y	Y	Y
Fire Station	-	-	-	-	-	-	-	-	-
Stavola House	-	-	-	-	-	-	-	-	-
Northern Light Blue Hill Hospital	-	-	-	-	-	-	-	-	-

3.2.5. Parcels

We based our review of parcel inundation based on the Blue Hill parcel layer obtained from the Maine Office of GIS (2021) and the elevation of the ground surface of the parcels using the terrain compiled for this study. There would be approximately 391 parcels at risk of being partially or fully inundated for one or more of the nine flood scenarios included as part of this study, representing approximately 18.5% of the total number of parcels in Blue Hill. The area of parcels inundated (i.e., the area of land in the town limits of Blue Hill) would be approximately 244 acres for Flood Scenario 9, which would represent approximately 0.6% of the total land area in Blue Hill. Table 3-9 summarizes the flood exposure results for parcels in the Town of Blue Hill.

These parcels include vacant lots in addition to parcels with buildings, such as residential houses. These numbers are approximate and based on digital parcel boundaries provided to the State by individual communities or residents. The parcels in Blue Hill have a submission date of December 10, 2010 listed on the State's Geolibrary Parcel Viewer Application. As a result, these parcels represent a snapshot in time and may not include recent revisions to parcel boundaries.

Table 3-9. Parcels Flood Exposure Summary

Parcels	1	2	3	4	5	6	7	8	9
# of Parcels Partially or Fully Inundated	349	353	357	365	367	368	372	376	391
% of Total Parcels Partially or Fully Inundated (%)	16.5	16.7	16.9	17.3	17.4	17.4	17.6	17.8	18.5
Area of Parcels Inundated (acre)	35	56	69	97	115	130	155	174	244
% of Total Parcel Area Inundated (%)	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.6

3.2.6. Cemeteries and Conservation Land

Cemetery locations were based on a digital dataset of cemetery locations for the State of Maine maintained by the Maine Old Cemetery Association and the Maine Office of GIS (2021). Our inundation analysis was based on the digital data of cemetery locations and the terrain data compiled for this study.

The flood vulnerability study results suggest that three property boundaries that include cemeteries would likely experience flood inundation for the nine flood scenarios included in this study. The flood exposure summary for properties in Blue Hill that include cemeteries is provided in Table 3-10.

This study has identified properties at risk of flood inundation that include cemeteries, but the boundaries of the cemeteries themselves may be outside of the likely flood extents. We recommend further review of the flood extents for these locations with the cemetery boundaries to refine the flood risk exposure for these cemeteries.

Table 3-10. Cemeteries Flood Exposure Summary (Y/N)

Cemetery	1	2	3	4	5	6	7	8	9
Curtis	Y	Y	Y	Y	Y	Y	Y	Y	Y
Long Island	Y	Y	Y	Y	Y	Y	Y	Y	Y
Seaside	Y	Y	Y	Y	Y	Y	Y	Y	Y

We evaluated the flood risk of land designated as conservation areas in the Town of Blue Hill. Conservation areas were first identified using GIS data managed by Maine's Department of Agriculture, Conservation and Forestry (Maine DACF, 2023). While the data is updated regularly, conservation organizations, land trusts, and municipalities must submit new or updated parcel easements to the State for them to be included in the data. GEI worked with George R. A. Fields, Associate Director at the Blue Hill Heritage Trust to obtain additional information on conservation parcels that were not reflected in the State's shapefile.

The flood risk analysis results suggest that approximately 69 acres of land designated as conservation land would be at risk of flood inundation for one or more of the nine flood scenarios included in this study. Thirty-three acres of conservation land is at risk of experiencing flood inundation for present-day water levels and 1% annual chance coastal storm events, without considering wave action. Twelve acres of conservation land would likely experience daily flood inundation during high tides for 1.5 ft of sea level rise (the "Commit to Manage" scenario for 2050). The flood exposure results for conservation land in Blue Hill is summarized in Table 3-11.

Table 3-11. Conservation Land Flood Exposure Summary

Conservation Land	1	2	3	4	5	6	7	8	9
Conservation Land (acres inundated)	12	20	25	33	38	41	47	52	69

3.2.7. Wells

We evaluated the flood risk of water wells using the water well locations from the MGS water well database (MGS, 2023). The Water Well Information Law, passed in 1987, requires that drilling companies submit information on new water wells to MGS. Data on wells drilled prior to 1987 were collected by a survey of well drillers in the 1970s and through a voluntary well driller reporting program in the mid-1980s. The database of wells drilled prior to 1987 is likely incomplete, and results from this analysis should be considered approximate. The database includes 549 well locations for the Town of Blue Hill. It has been our experience that some of the wells may not be appropriately located. Work on this project did not include verifying that the wells were appropriately located (i.e., within a parcel, near a structure, etc.).

The flood vulnerability results suggest that the location of approximately 13 private, residential water wells in Blue Hill would likely be at risk of flooding for one or more of the nine flood scenarios included in this study. Locations of wells supplying public water systems were not identified as being at risk of flood inundation for the nine flood scenarios included in this study. The flood exposure results for water wells in Blue Hill is summarized in Table 3-12. The draft GEI memo summarizing the risk of clean drinking water and drought (GEI, 2023) provides more detail on the risk of flood inundation to drinking water wells.

Table 3-12. Wells Flood Exposure Summary

Wells	1	2	3	4	5	6	7	8	9
Wells (# of locations inundated)	2	2	2	2	3	6	6	8	13

3.2.8. Additional Assets

We have included an initial list of eight additional assets in the Town of Blue Hill that would likely experience flood inundation for the flood scenarios included in this study. Several of these assets are points of water access, such as boat ramps. The assets and the flood scenarios that would likely inundate the asset locations are summarized in Table 3-13.

Table 3-13. Summary of Additional Assets at Risk of Flood Inundation (Y/N)

Asset	1	2	3	4	5	6	7	8	9
Webber's Cove Boatyard (Heard Cove) *Top of Pier*	Y	Y	Y	Y	Y	Y	Y	Y	Y
Blue Hill Town Wharf *Top of Boat Ramp*	Y	Y	Y	Y	Y	Y	Y	Y	Y
Blue Hill Town Wharf *Lower Parking*	-	Y	Y	Y	Y	Y	Y	Y	Y
Kollegewidgwok Yacht Club *Top of Boat Ramp*	-	Y	Y	Y	Y	Y	Y	Y	Y
South Blue Hill Wharf *Top of Boat Ramp/Pier*	-	-	-	Y	Y	Y	Y	Y	Y
East Blue Hill Village Playground *Top of Boat Ramp*	-	-	-	Y	Y	Y	Y	Y	Y
Peter's Brook Trail Parking *Blue Hill Heritage Trust*	-	-	-	-	-	-	Y	Y	Y

The dam downstream of the Village Bridge over Mill Stream was identified in the Final Report to the Select Board on Sea Level Rise in Blue Hill (2020) as being at risk of overtopping due to coastal storm surge. The 2020 report specifies that the dam impounds a reservoir that is used as an emergency fresh water source by the fire department. We have estimated the dam crest elevation to be approximately 5.4 ft based on topographic data, which is slightly higher than MHHW. This elevation would likely be overtopped for the nine flood scenarios included in this study, but the risk of overtopping could be refined with more information on the dam crest elevation. Information about the elevation of the dam crest is needed to evaluate the risk of overtopping due to the flood scenarios included in this study.

4. Flood Adaptation Recommendations

This report section summarizes our evaluation of adaptation options for infrastructure in the Town at risk of coastal flood inundation due to coastal storm surge and sea level rise. We have summarized general adaptation strategies for infrastructure such as roads, building, and piers; provided an overview of temporary and non-structural measures; and evaluated up to three adaptation options for assets identified as having high flood risk and/or critical to the community.

The adaptation options, such as road elevations and time horizons for flood risk, are based on the results of the flood risk analysis presented in Section 3.2. Elevations of infrastructure, such as roadways, are based on readily available LiDAR data, as outlined in Section 3.1.1.

4.1. Adaptation Options Overview

Broadly, there are four infrastructure-based adaptation approaches:

1. Protect – prevent inland propagation of water using a barrier, such as a sea wall.
2. Accommodate – reduce the impact of water by elevating structures and/or floodproofing the structure to reduce damage.
3. Retreat – move infrastructure to a new location away from the risk of flooding.
4. Do-Nothing – Leave the infrastructure as is.

In addition to infrastructure-based adaptation approaches, we have suggested several non-structural adaptation measures that the Town could take to increase the resiliency of people and infrastructure to flood inundation. We have organized this report section to provide recommendations for both infrastructure-based and non-structural adaptation strategies.

The decision around which measure to take can depend on several factors, including the overall risk of flood exposure, the sensitivity to flooding for a particular asset, and the adaptive capacity. For example, electrical equipment constitutes an asset that is highly sensitive to flooding and would likely be damaged or inoperable if exposed to flood inundation. Assets like roads can usually withstand some level of flooding without damage and so are often considered not very sensitive to flooding in a structural sense. Infrastructure that could be easily relocated, elevated, or flood-proofed would be considered to have a high adaptive capacity. Infrastructure or assets that are not easy to relocate or flood-proof are often considered to have a low adaptive capacity.

We have explored these options as they relate to infrastructure located within the Town that is vulnerable to flood inundation. We have provided a recommendation for adaptation to allow for increased vehicular access through the year 2050. For most infrastructure, it is our general recommendation to wait before adapting (i.e., elevating, relocating, etc.) for the 2090 and beyond timeframe until there is more certainty around the sea level rise projections and future storm surge values. The non-structural adaptation measures that we have suggested would likely increase resiliency to flood inundation for both near-term and long-term time horizons.

In most cases presented in this study, we have recommended an "accommodation" approach, such as elevating a roadway or asset above the height of anticipated water levels. However, in some cases, elevating the road to prevent inundation during the flood scenarios considered in this study is not practical. Instead, the Town could choose to elevate the road to a lower amount so that it would likely prevent flood inundation during typical high tides and 1% annual chance storm surge events in the near-term but would still likely experience flood inundation during the more extreme flood scenarios evaluated (1% annual chance coastal storm events in 2070/2090). Important topics such as emergency access would need to be addressed to ensure that emergency organizations have access to do their work, and to ensure that citizens can evacuate. In the future, when these more extreme flood scenarios are likely to become more common, other adaptation strategies, such as retreat, should be considered.

As a side note, FEMA community preparedness materials provide important information about the risks of driving or walking through flood waters (FEMA, 2024). It will be important, if the Town decides to "live with water," that the Town educates citizens on the risks related to flooding and to properly block off areas that are unsafe for travel or access. It is never safe to drive through flood waters as the depth of water and velocity of flow are not always obvious.

Additionally, the Town could issue evacuation or shelter in place notices to occupants of buildings that would likely be without road access when extreme coastal storm events are anticipated to occur. It is up to the public safety and emergency response agencies whether building occupants should shelter in place or attempt to drive through inundated areas and this study does not intend to usurp the responsibility of public safety emergency response agencies.

Advancing infrastructure-based adaptation strategies will require additional phases of work before the recommendations can be implemented, such as site survey, preliminary design, permitting, and final design. The vulnerability analysis and adaptation recommendations provided in this report constitute a high-level assessment of risk and an introduction to adaptation options. The recommended adaptation elevations do not include information on "freeboard," or the distance between top of flood waters and the sensitive infrastructure. Road elevation planning may warrant conversations about suitable freeboard to add a buffer to flood estimates and therefore provide additional protection. Additionally, wave action has not been considered in flood risk or adaptation recommendations. This report should be used as a guidance, but further investigation will be needed to advance engineering designs.

4.2. General Adaptation Strategies

4.2.1. Roads

Roads can be adapted to flood risk through elevation, relocation, abandonment, or protection via a sea wall system. The road infrastructure itself is often fairly resilient to flood inundation (i.e., small likelihood of infrastructure damage) – once flood waters recede, the roadway can typically be used. In some cases, floodwater can bring debris over roadways that should be cleared to allow for continued safe use of the roadway. Coastally exposed roadways that are subject to wave action have a higher likelihood of sustaining damage due to the impact of waves on the roadway infrastructure or shoreward facing revetment structure, if present.

Elevating a roadway is often the most cost-effective adaptation measure. However, in some cases, elevating may not be feasible due to topographic or regulatory constraints. In these instances, it may be worthwhile to examine relocating the roadway to avoid the area of flood inundation. Adaptation priority should be given to roads that would cut off emergency access to residents if they were inundated, such as roads that have no alternate route.

We have provided high-level concept drawings for road adaptation in the attached Figures 2 through 4. These concepts provide general cross sections of elevated roadways and roadways with sea walls.

4.2.2. Buildings

Several adaptation strategies for buildings at risk of flood inundation are provided below, including dry and wet floodproofing, conversion of the use of the first floor, elevation, and retreating.

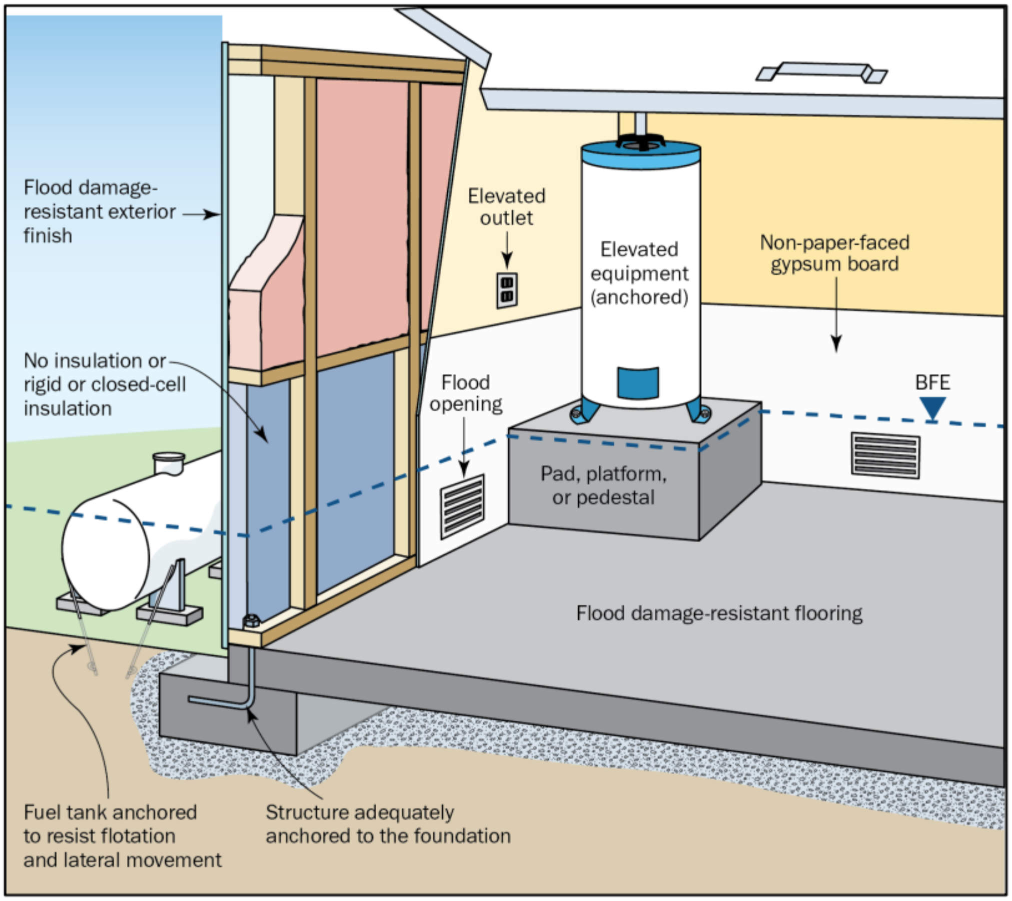
Dry Floodproofing

Dry floodproofing involves the installation of barriers and fortifying of the building structure and enclosure to limit intrusion of floodwaters. This can be accomplished by installing floodwalls or levees surrounding structures, installing temporary or permanent flood barriers in building openings, and sealing the building envelope to prevent floodwaters from entering enclosed spaces. Impervious coatings or coverings can be installed around the exterior of a building, typically to at least the height of anticipated flood risk. Dry floodproofing can require that structures be reinforced to withstand the force of water being restrained by the walls. Dry floodproofing may also require modification of building utilities such as the installation of backflow valves in sewer and drainage lines exiting buildings.

Wet Floodproofing

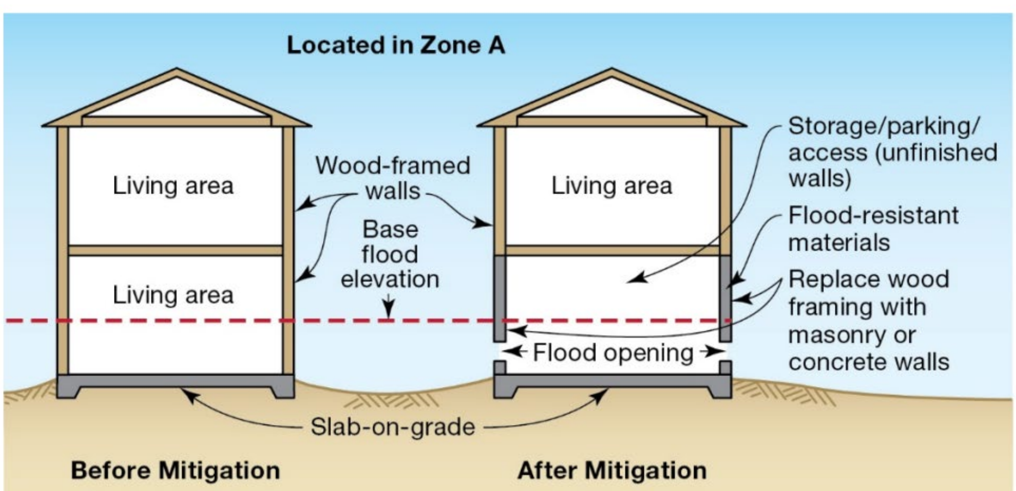
Wet floodproofing involves the adaptation of a building to accommodate exposure to floodwater while minimizing risk of damage to the structure and its contents. Refer to Figure 4-1 and Figure 4-2 for examples of wet floodproofing. Wet floodproofing measures can include providing flood openings in walls to allow water to pass into and out of the structure, elevating utilities and mechanical systems above the design flood elevation, use of flood-resistant materials for flooring and building envelope construction that minimize risk of damage if exposed to floodwaters and elevating internal building contents to minimize risk of exposure. Wet floodproofing can reduce risk of damage to buildings and contents from exposure to flooding but carries a greater risk of building serviceability and operability issues because water is able to enter structure during a flood event.

Figure 4-1. Example of Wet Floodproofing Measures



Source: FEMA (2022)

Figure 4-2. Example of Retrofitting Lowest Flood with Flood Resistant Materials and Flood Openings

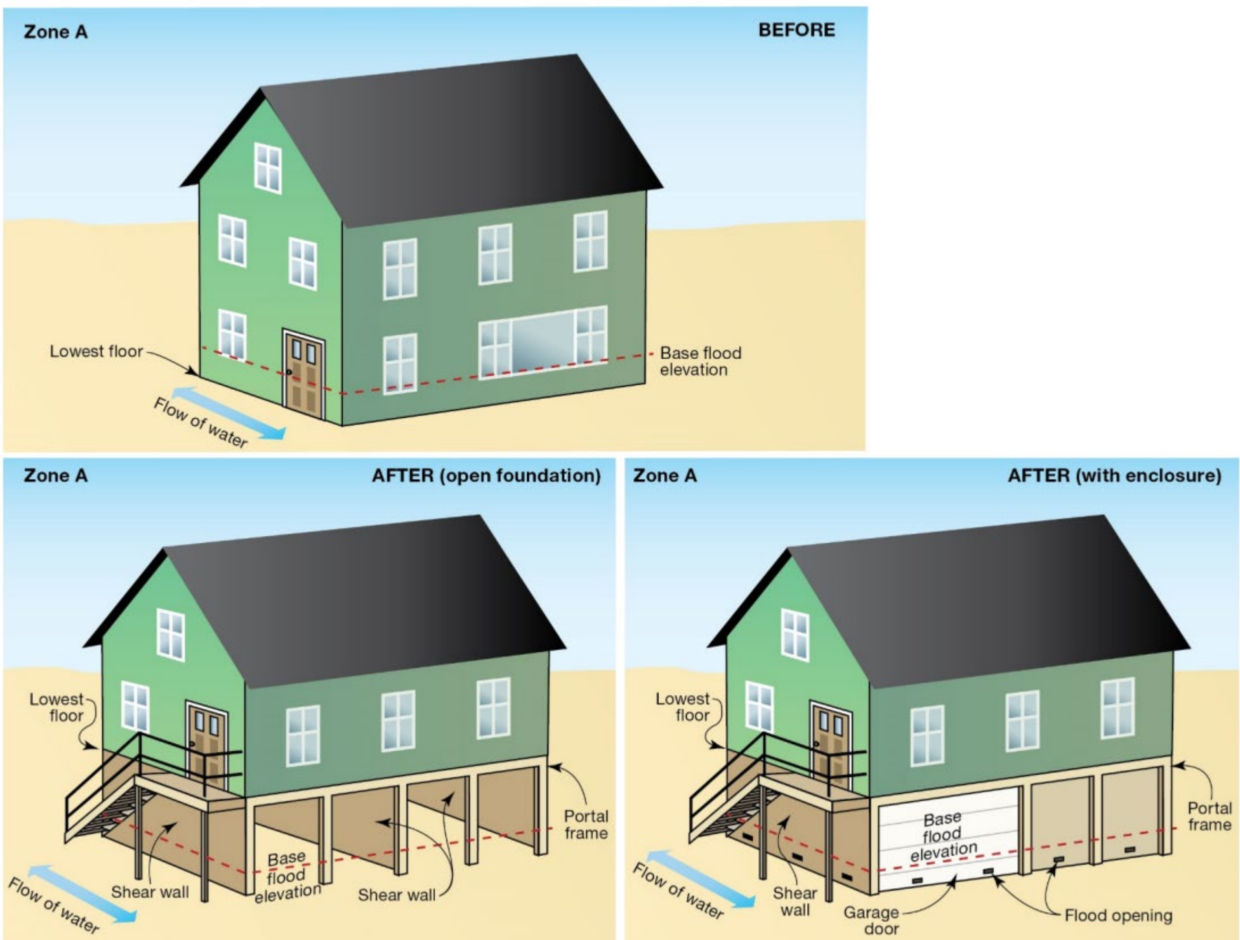


Source: FEMA (2019)

Conversion of Lowest Floor

Conversion of the lowest floor of a building from enclosed occupied space to open unoccupied space is an effective way to reduce risk of flood exposure and damage to the structure. This method is demonstrated in Figure 4-3. Using this method, the lowest floor is modified to include open, flow-through construction and the space formerly used by the first floor is converted for uses such as storage and parking. The second floor of the building becomes the lowest occupied space. The structure beneath the converted lowest floor may require reinforcement and addition/replacement of components with flood resistant materials to withstand anticipated exposure to floodwaters. While this method can be a lower impact than an entire building elevation project, it has the disadvantage of a reduction in the occupied space within the building.

Figure 4-3. Example of Lowest Floor Conversion



Source: FEMA (2019)

Elevation

One of the most effective ways to reduce risk of flooding is to elevate structures sufficiently above predicted flood elevations such that they are not impacted by water levels resulting from storm surge or sea level rise. The degree to which a building is potentially elevated would depend on the minimum code and regulatory requirements, as well as the owner's tolerance to risk, which may warrant the inclusion of additional freeboard above the minimum required values.

Retreat

In some cases, due to factors such as high risk of flood exposure, high cost of adaptation, and lack of functional dependence on a waterfront location, owners may consider retreating from locations of high flood risk. On properties with sufficient area outside of the flood zone, this can involve relocating buildings further away from the coast (often in combination with increased elevation). Retreat can also involve the removal of structures from flood-prone areas, and restoration of those properties to naturalized spaces that can be conserved in a natural form that is more resilient to flooding than developed land.

4.2.3. Piers and Wharves

Piers and wharves present a different set of issues and constraints than buildings in flood-prone areas. The elevation of piers and wharves must consider management of flood risk impacts on the structure itself and the functions it serves. While important to elevate these structures sufficiently to reduce flood risk to a tolerable level, excessive elevation can also result in functional challenges. For example, loading of gear and bait from a commercial pier is more difficult from a structure that is elevated significantly further above the water. Increased elevation for piers can also require longer ramps for loading of passengers and vehicles onto vessels. For robustly constructed piers and wharves, some amount of flood inundation can typically be tolerated provided that the risk of structural damage and the impact on facility function remain limited. As a general minimum guideline, piers are typically designed to be at minimum 4.0 feet to 6.0 feet above the Highest Astronomical Tide elevation, which would be El. 11.2 ft to El. 13.2 ft in Blue Hill. However, in many cases, higher elevations are recommended to reduce exposure to storm surge, wave action, and provide added freeboard to account for future flood elevations.

Adaptation of filled wharves can involve the installation of additional height of fill over the top of the wharf with the installation of a perimeter concrete cap to retain the additional fill. Gravel surfaced wharves subject to overtopping are typically recommended to have their surface stabilized with pavement or a concrete deck to limit erosion.

Adaptation of pile-supported wharves can involve increase in elevation of the structure to above the minimum design flood elevation. For pile-supported piers, it is recommended that the pier design include hold-downs to restrain the structure from uplift and buoyant forces, as well as lateral support to resist the exposure to wind and wave action.

4.3. Non-Structural Adaptation Measures

There are several non-structural adaptation measures that the Town could take to adapt to flood inundation. These measures would not prevent inundation from occurring but would reduce the potential impact to people during flood events. Many of these adaptation measures could be implemented in the near-term and could help reduce the impact of present-day flood events.

4.3.1. Water Level Monitoring and Alert System

Water level monitors and alert systems could be used in critical areas to alert (i.e., through a community emergency alert system) the residents of Blue Hill when water levels rise above a threshold that would cause flood inundation. During these times, the Town of Blue Hill could consider providing a shelter for residents stranded outside their home until the flood water recedes and residents can return safely to their homes.

A well-established water level monitoring company that works with municipalities is Hohonu. Hohonu provides water level monitors, installation support, a web browser to view up-to-date water levels, and alert services. Hohonu works with municipalities across the country, including with existing clients in Maine. There may also be other reliable systems the Town can consider.

Whether or not a water level monitoring system is established, the Town could implement an alert system for predicted astronomical high tides. NOAA publishes predicted high tides up to one year in advance on the “Monthly High Tide Flooding Outlook” website, specific to gage stations across the country (NOAA, 2024). Leading up to these dates, the Town could remind residents to prepare to shelter in place by making sure they have adequate food and fuel in their homes and remind them to not attempt to drive through flooded water during these times. For residents who would likely need access to medical care during these tides, the Town could suggest that they shelter elsewhere during the predicted periods of high water.

4.3.2. Road Barricades

We suggest that the Town of Blue Hill position road barricades near areas that experience flood inundation, such as East Blue Hill Road, Falls Bridge Road, and Parker Point Road. When periods of high water are anticipated, Town staff should deploy the road barricades to prevent people from attempting to drive through flooded water. In addition to the risk of the vehicle flooding and people within the vehicle becoming stranded, it can be difficult to see the road condition under the flood inundation and during periods of heavy rain and/or storm surge, culverts along the roadways may become compromised and fail or “wash out.” Driving in flooded water and/or over a section of road with a washed-out culvert is very dangerous and not advised. The Town should develop a program to educate citizens about the risks of flooding and in particular to strongly discourage vehicular travel on inundated roads.

4.3.3. High-Water Rescue Vehicle

Access to residents in Blue Hill who may be experiencing a medical emergency during periods of flood inundation could be evacuated through the use of a high-water rescue vehicle operated by emergency personnel. High-water rescue vehicles are able to travel through inundated roadways. Such a vehicle could be owned and operated by local or regional emergency response personnel.

4.4. Site-Specific Adaptation

We have provided site-specific adaptation recommendations for nine sites in the Town, identified from the flood vulnerability assessment. The nine sites included are:

- East Blue Hill Road (Route 176)
- Parker Point Road
- Salt Pond Road
- Blue Hill Village Wharf
- South Blue Hill Wharf
- Falls Bridge Road (Route 175)
- Jay Carter Road
- KYC Lane
- Blue Hill Village Wharf
- Blue Hill Wastewater Treatment Facility

Information about road vulnerability refers to linear feet of road inundation, in the direction of travel. Additionally, the Town identified Curtis Cove Road as a Pilot Project for concept-level adaptation design. A separate report summarizes adaptation recommendations for Curtis Cove Road (GEI, 2024).

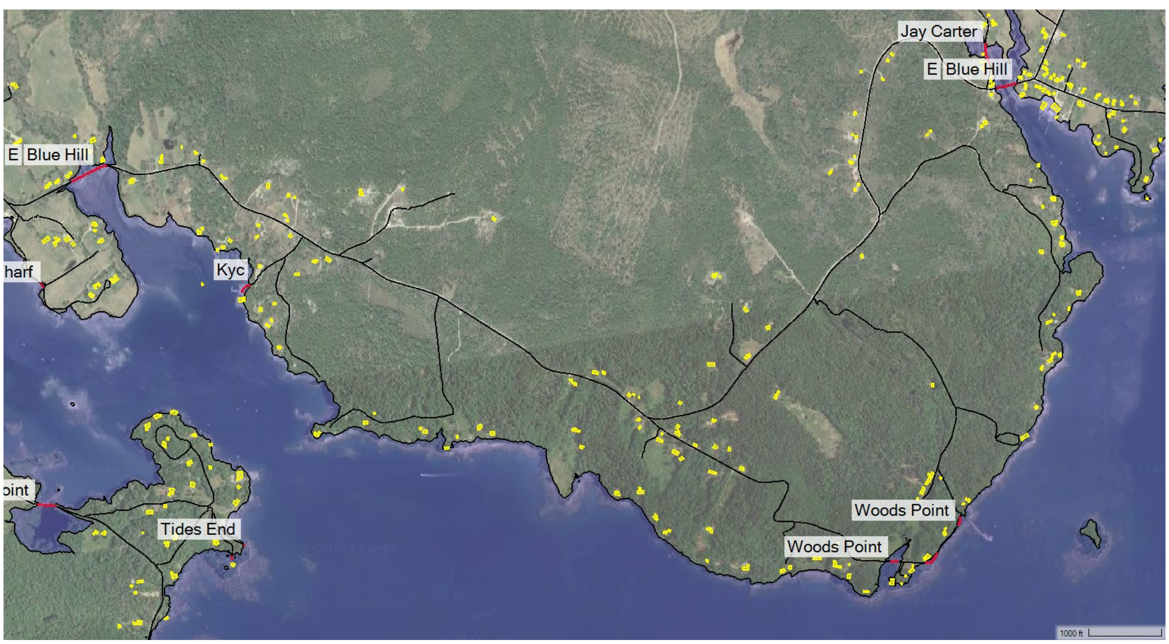
The following report sections summarize our adaptation recommendations for the above assets. In most cases, we recommend adapting to address near-term flood risk, i.e. flooding likely to occur during 1% annual chance coastal events for the present-day timeframe or by 2050. There is more uncertainty around sea level rise projections for future time horizons, such as 2070 and beyond. We will have a better understanding of adaptation design elevations as we approach that timeframe.

Following the recommendations is a summary table with cost estimates for proposed adaptation methods.

4.4.1. Roads

4.4.1.1. East Blue Hill Road (Rt 176)

Figure 4-4. East Blue Hill Road Inundation Locations



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

By 2050, approximately 165 ft of East Blue Hill Road would likely be inundated during 1% annual chance coastal storm events, considering 1.5 ft of sea level rise ("commit to manage"). Two areas of East Blue Hill Road would likely be inundated: the eastern section of East Blue Hill Road where it crosses over East Blue Hill Bridge and the western section of East Blue Hill Road near Peters Cove, approximately 0.6 miles east of the intersection with Main Street.

The East Blue Hill Bridge is listed in the Maine DOT 2024-2025-2026 work plan (Maine DOT, 2024a). The scope of work includes "Bridge Replacement – PE Only." Details of the goals of this project were not readily known at the time this report was written.

The western, and lower, section of the road would likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 0.8 ft during the peak high tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2070, approximately 424 ft of East Blue Hill Road, split between two sections, would likely be inundated during 1% annual chance coastal storm events, considering 2.4 ft of sea level rise ("commit to manage"). The road would likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 1.7 ft during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2090, approximately 24 ft of East Blue Hill Road, split between two sections, would likely be inundated during high tide considering 5.0 ft of sea level rise ("prepare to manage"), and would be inundated by up to 0.2 ft during peak high tide.

There are approximately 157 buildings in between these two sections that would likely be inaccessible during periods when both ends of the road are inundated. If both sections become impassible due to flood inundation, the 157 buildings would be inaccessible to emergency vehicles and building occupants would not be able to evacuate to either Main Street or Morgan Bay Road (Rt 176). If only the western section becomes impassible, emergency vehicles originating from Blue Hill would be required to take a detour of up to 16.5 miles via Ellsworth Road (Rt 172) and Morgan Bay Road (Rt 176) to reach buildings on East Blue Hill Road. Approximately four buildings would still be inaccessible in this situation.

The estimated length of inundation along this roadway for the other flood scenarios is summarized in Table 3-4 within this report and in Appendix B.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation during 1% annual chance coastal events by 2050 and during high tides by 2090. During times of inundation, the 157 buildings impacted would likely be inaccessible. We would encourage users of this roadway to plan travel around predicted periods of high tide and avoid travel during anticipated coastal storm events. Vulnerable populations who rely on emergency services should consider temporarily moving to a more accessible location during anticipated coastal storm events or periods of extreme high tides.

Adaptation Option 2: Elevate the Road

Elevating East Blue Hill Road above elevation 11.7 ft (approximately 1.7 ft above the low point of the western section of the road and 1.0 ft above the low point on the East Blue Hill Bridge) would likely prevent flood inundation due to stillwater conditions during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage"), and during high tides by 2090. These elevation suggestions do not include considerations around "freeboard" between the road and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential road low spot. The road would still likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 0.6 ft and 2.6 ft during 1% annual chance coastal storm events considering 3.0 and 5.0 ft of sea level rise ("prepare to manage") by 2070 and 2090, respectively. During periods of wave action, inundation depths would likely be higher.

Elevating the road above elevation 14.3 ft (approximately 4.3 ft above the low point of the western section of the road and 3.6 ft above the low point on the East Blue Hill Bridge) would likely prevent flood inundation due to standing water during 1% annual chance coastal storm events by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

Adaptation Option 3: Re-route the Road

Rerouting the western section of the road inland of its current alignment approximately 200 ft or by connecting East Blue Hill Road, east of the area at risk of flooding, with Ellsworth Road (Route 172) would reduce the likelihood of flood inundation at this location.

Similarly, connecting Jay Carter Road with Morgan Bay Road, north of the area of likely inundation, would allow for a vehicular bypass of the East Blue Hill Bridge during periods when it is overtopped. However, Jay Carter Road is likely at risk of flood inundation during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage"), which would likely make this bypass impassible during these conditions, unless Jay Carter Road were elevated.

Constructing a new road is usually subject to additional regulatory constraints and right of way limitations. It is often a more costly option than elevating a roadway in its existing alignment.

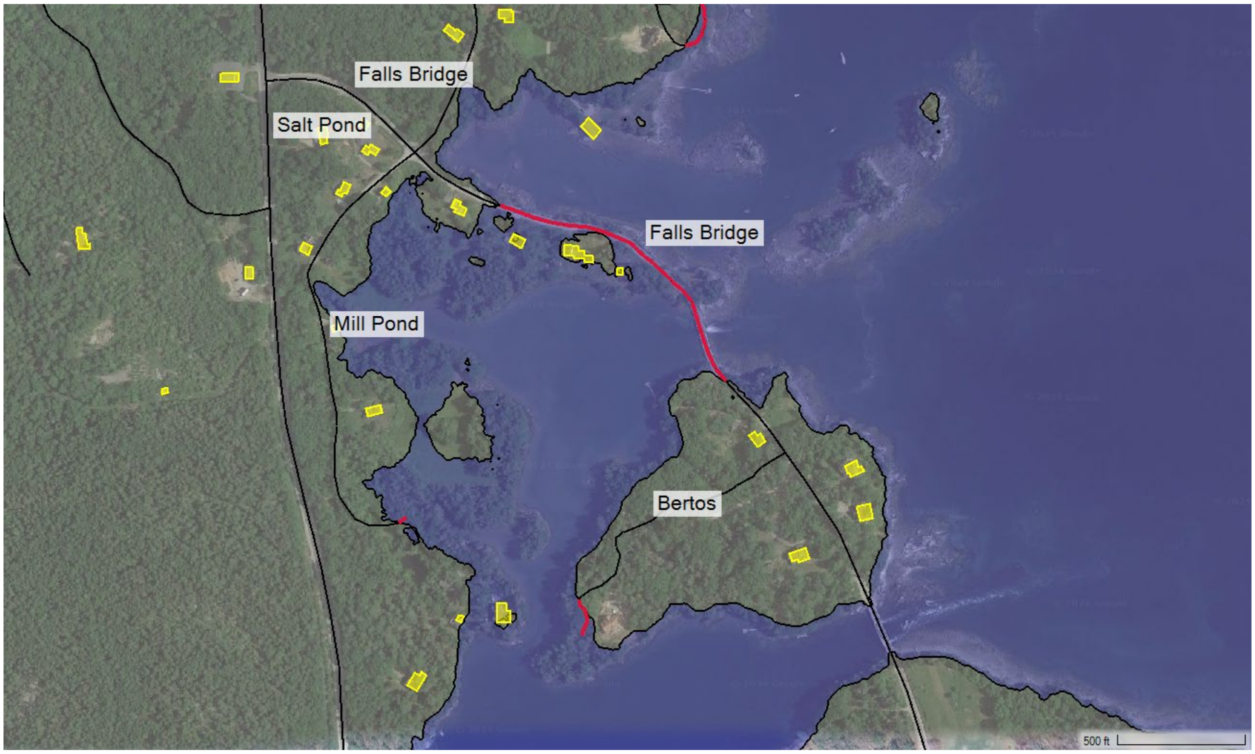
Recommendation

We recommend elevating one of the at-risk sections of this road to a minimum elevation of 11.7 ft by 2050 (approximately 1.7 ft above the low point of the road near Peters Cove) to increase the likelihood for continued vehicular access during 1% annual chance storm events by 2070. By 2070, there will be less uncertainty of sea level rise in the 2090 timeframe and better data may be available for future years. With more information on flood risk, the Town may wish to elevate the road further to support vehicular access along the roadway.

A summary of flood risk, number of impacted buildings, adaptation options, and estimated costs is provided in the attached Table 1. Additionally, estimated costs for elevating the roadway are summarized in Section 4.5 of this report.

4.4.1.2. Falls Bridge Road (Rt 175)

Figure 4-5. Falls Bridge Road Inundation Locations



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

This section of the report is about Falls Bridge Road north of Mill Island. The section of Falls Bridge Road south of Mill Island includes the Blue Hill Falls Bridge, which was reconstructed in May 2024 to an elevation approximately 4.0 ft higher than the previous elevation. The updated low point elevation of this bridge after construction is approximately 17.7 ft. The newly constructed bridge would be unlikely to be overtopped for the flood scenarios included in this study.

Maine DOT has noted that Route 175 in Blue Hill is one of seven segments of road in the state that is particularly vulnerable to flooding during storm surge events and/or sea level rise (MaineDOT, 2024b).

By 2050, approximately 311 ft of Falls Bridge Road, at a location about 0.4 miles southeast of its intersection with South Street and Salt Pond Road, would likely be inundated during 1% annual chance coastal storm events, considering 1.5 ft of sea level rise ("commit to manage"). The road would likely be inundated by up to 1.3 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2070, approximately 540 ft of Falls Bridge Road would likely be inundated during 1% annual chance coastal storm events, considering 2.4 ft of sea level rise ("commit to manage"). The road would likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 2.2 ft during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2090, approximately 197 ft of Falls Bridge Road would likely be inundated during high tides considering 5.0 ft of sea level rise ("prepare to manage"). Under this scenario, the road would likely be inundated by up to 0.7 ft during peak high tide.

There are approximately 217 buildings that would likely be inaccessible during periods of inundation. Potential detours or evacuation routes of Hales Hill Road in Brooklin or Reach Road in Sedgwick would also likely be vulnerable to inundation. Hales Hill Road would likely be inundated during 1% annual chance coastal storms for present-day sea levels. Reach Road in Sedwick would likely be inundated during 1% annual chance coastal storms by 2050 considering 1.5 ft of sea level rise ("commit to manage"). If the road becomes impassible due to flood inundation, the 217 buildings would be inaccessible to emergency vehicles and building occupants would not be able to evacuate to South Street. Potential buildings impacted due to flood inundation along the roadway in the Towns of Brooklin and Sedgwick have not been included in these numbers.

The estimated length of inundation along this roadway for the other flood scenarios is summarized in Table 3-4 within this report and in Appendix B.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation during 1% annual chance coastal storm events by 2050 and during high tides by 2090. During times of inundation, the 217 buildings impacted would likely be inaccessible. We would encourage users of this roadway to plan travel around predicted periods of high tide and avoid travel during anticipated coastal storm events. Vulnerable populations who rely on emergency services should consider temporarily moving to a more accessible location during anticipated coastal storm events or periods of extreme high tides.

Adaptation Option 2: Elevate the Road

Elevating Falls Bridge Road above elevation 11.7 ft (approximately 2.2 ft above the low point of the road) would likely prevent flood inundation during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage"), and during high tides by 2090. These elevation suggestions do not include considerations around "freeboard" between the road and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential road low spot. The road would still likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 0.6 ft and 2.6 ft during 1% annual chance coastal storms event considering 3.0 and 5.0 ft of sea level rise ("prepare to manage") by 2070 and 2090, respectively. During periods of wave action, inundation depths would likely be higher.

Elevating Falls Bridge Road above elevation 14.3 ft (approximately 4.8 ft above the low point of the road), would likely prevent standing water flood inundation during 1% annual chance coastal storm events by 2090, considering 5.0 ft of sea level rise ("prepare to manage"). During periods of wave action, inundation depths would likely be higher.

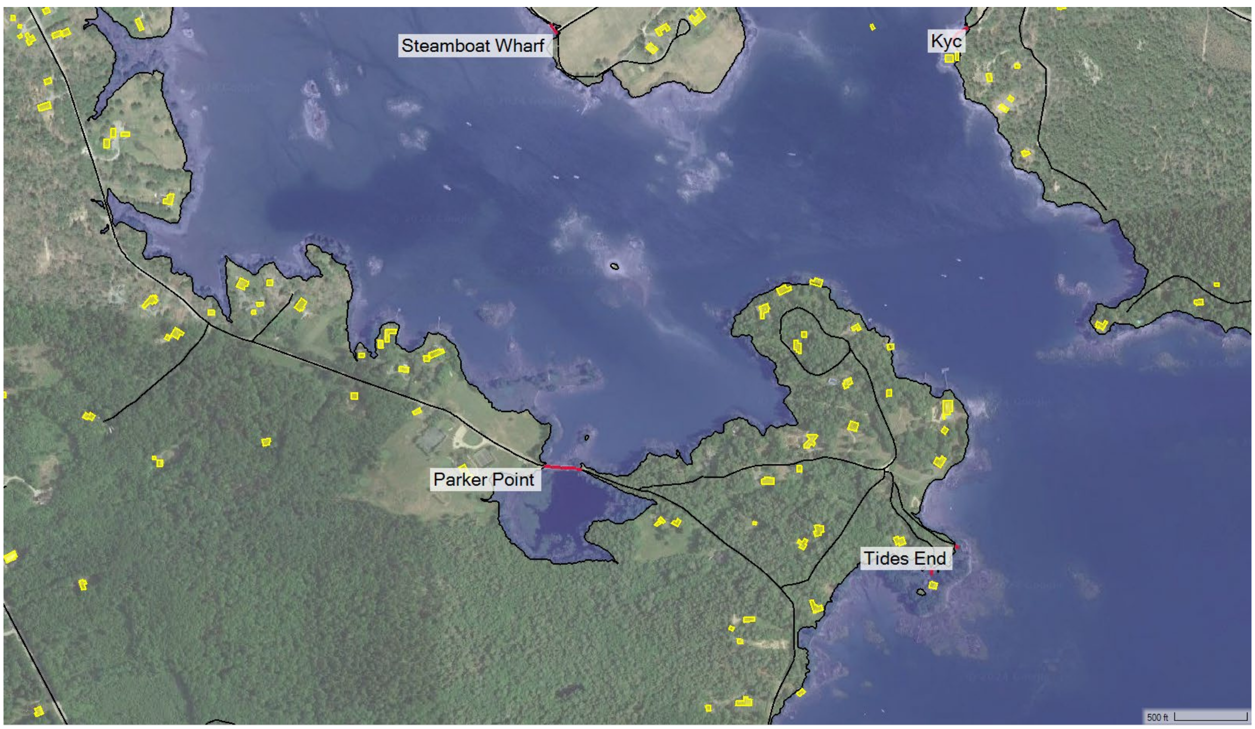
Recommendation

We recommend elevating the vulnerable section of this road to a minimum elevation of 11.7 ft by 2050 to increase the likelihood for continued vehicular access during 1% annual chance coastal storm events by 2070.

A summary of flood risk, number of impacted buildings, adaptation options, and estimated costs is provided in the attached Table 1. Additionally, estimate costs for elevating the roadway are summarized in Section 4.5 of this report.

4.4.1.3. Parker Point Road

Figure 4-6. Parker Point Road Inundation



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

By 2050, approximately 76 ft of Parker Point Road, at a location about 500 ft west of its intersection with Parker Lane, would likely be inundated during 1% annual chance coastal storm events, considering 1.5 ft of sea level rise (“commit to manage”). The road would likely be inundated by up to 0.4 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2070, approximately 148 ft of Parker Point Road would likely be inundated during 1% annual chance coastal storm events, considering 2.4 ft of sea level rise (“commit to manage”). The road would likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 1.3 ft during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2090, approximately 323 ft of Parker Point Road would likely be inundated during 1% annual chance coastal storm events, considering 5.0 ft of sea level rise ("prepare to manage"). The road would likely be inundated due to stillwater conditions (i.e., without considering wave action) by up to 3.9 ft during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

There are approximately 48 buildings that would be impacted during periods of inundation. An alternate route of up to 5.0 miles is available in Blue Hill via EP Lane, South Street, and Main Street. However, roads along this detour would likely be at risk of flood inundation by 2090 during 1% annual chance coastal storm events, considering 5.0 ft of sea level rise ("prepare to manage"). If the detour becomes impassible due to flood inundation, the 48 buildings would be inaccessible to emergency vehicles and building occupants would not be able to evacuate to South Street or Main Street.

The estimated length of inundation along this roadway for the other flood scenarios is summarized in Table 3-4 within this report and in Appendix B.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation during 1% annual chance coastal storm events by 2050. During times of inundation for the 2050 and 2070 timeframes, the 48 buildings impacted could likely be accessed via an alternate route. By 2090, the 48 impacted buildings would likely be inaccessible during periods of roadway inundation. We would encourage users of this roadway to plan travel around predicted periods of high tide and avoid travel during anticipated coastal storm events. Vulnerable populations who rely on emergency services should consider temporarily moving to a more accessible location during anticipated coastal storm events or periods of extreme high tides.

Adaptation Option 2: Elevate the Road

Elevating Parker Point Road above elevation 11.7 ft (approximately 1.3 ft above the low point of the road) would likely prevent flood inundation due to stillwater conditions (i.e., without considering wave action) during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage"). These elevation suggestions do not include considerations around "freeboard" between the road and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential road low spot. The road would still likely be inundated due to stillwater conditions by up to 0.6 ft and 2.6 ft during a 1% annual chance coastal storm event considering 3.0 and 5.0 ft of sea level rise ("prepare to manage") by 2070 and 2090, respectively. During periods of wave action, inundation depths would likely be higher.

Elevating the road above elevation 14.3 ft (approximately 3.9 ft above the low point of the road) would likely prevent flood inundation due to standing water during a 1% annual chance coastal storm event by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

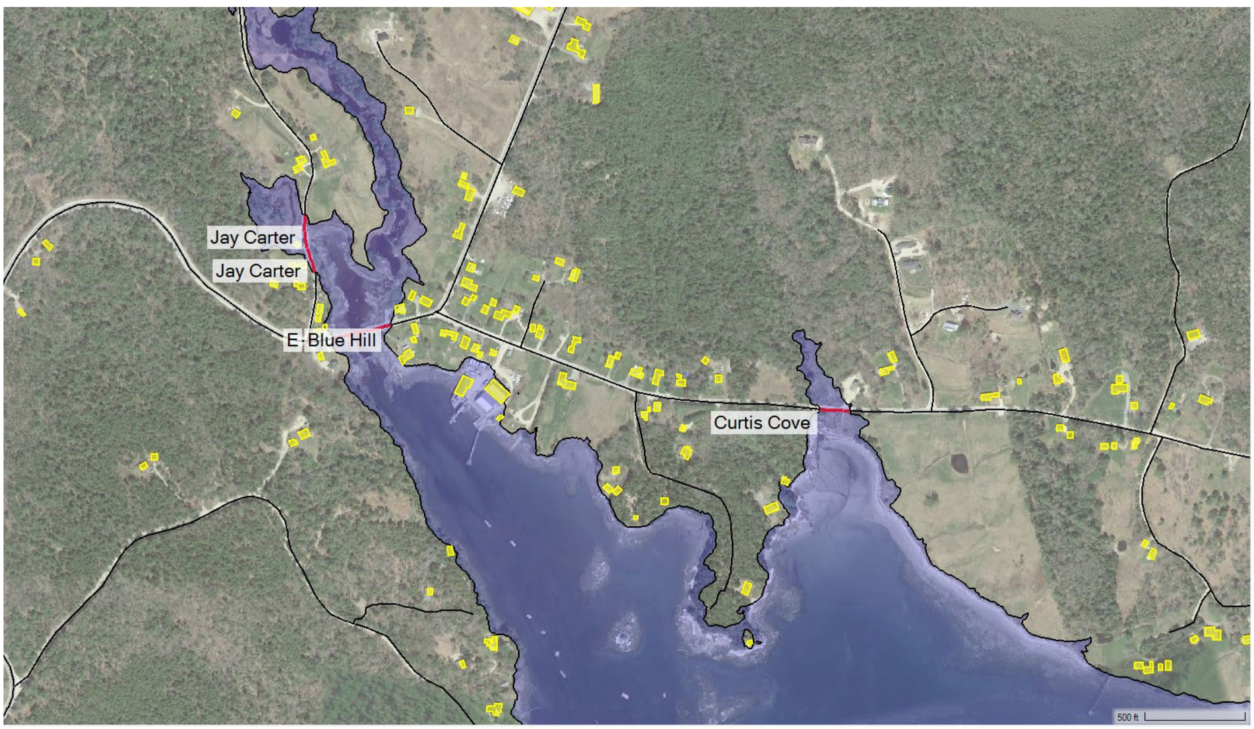
Recommendation

We recommend elevating the vulnerable section of this road by a minimum of 1.3 ft above the low point to a minimum elevation of 11.7 ft by 2050 to increase the likelihood for continued vehicular access during 1% annual chance storm events by 2070.

A summary of flood risk, number of impacted buildings, adaptation options, and estimated costs is provided in the attached Table 1. Additionally, estimate costs for elevating the roadway are summarized in Section 4.5 of this report.

4.4.1.4. Jay Carter Road

Figure 4-7. Jay Carter Road Inundation



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

By 2070, approximately 147 ft of Jay Carter Road, at a location about 450 ft north of its intersection Blue Hill Road, would likely be inundated during 1% annual chance coastal storm events, considering 2.4 ft of sea level rise (“commit to manage”). The road would likely be inundated by up to 0.3 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2090, approximately 289 ft of Jay Carter Road would likely be inundated during 1% annual chance coastal storm events, considering 5.0 ft of sea level rise (“prepare to manage”). The road would likely be inundated by up to 2.9 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

There are approximately 40 buildings that would be inaccessible during periods of inundation. If the road becomes impassible due to flood inundation, the 40 buildings would be inaccessible to emergency vehicles and building occupants would be unable to evacuate to East Blue Hill Road (Route 176).

The estimated length of inundation along this roadway for the other flood scenarios is summarized in Table 3-4 within this report and in Appendix B.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation during 1% annual chance coastal storm events by 2070. During times of inundation, the 40 buildings impacted would likely be inaccessible. We would encourage users of this roadway to plan travel around predicted periods of high tide and avoid travel during anticipated coastal storm events. Vulnerable populations who rely on emergency services should consider temporarily moving to a more accessible location during anticipated coastal storm events or periods of extreme high tides.

Adaptation Option 2: Elevate the Road

Elevating Jay Carter Road above elevation 12.3 ft (approximately 0.9 ft above the low point of the road) would likely prevent flood inundation during high tides by 2090, considering 5.0 ft of sea level rise ("prepare to manage"), and due to stillwater conditions during 1% annual chance coastal storm events through 2070, considering 3.0 ft of sea level rise ("prepare to manage"). These elevation suggestions do not include considerations around "freeboard" between the road and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential road low spot. The road would still likely be inundated by up to 2.0 ft due to stillwater conditions during 1% annual chance coastal storm events by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

Elevating the road above elevation 14.3 ft (approximately 2.9 ft above the low point of the road) would likely prevent flood inundation due to stillwater conditions during 1% annual chance coastal storm events by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

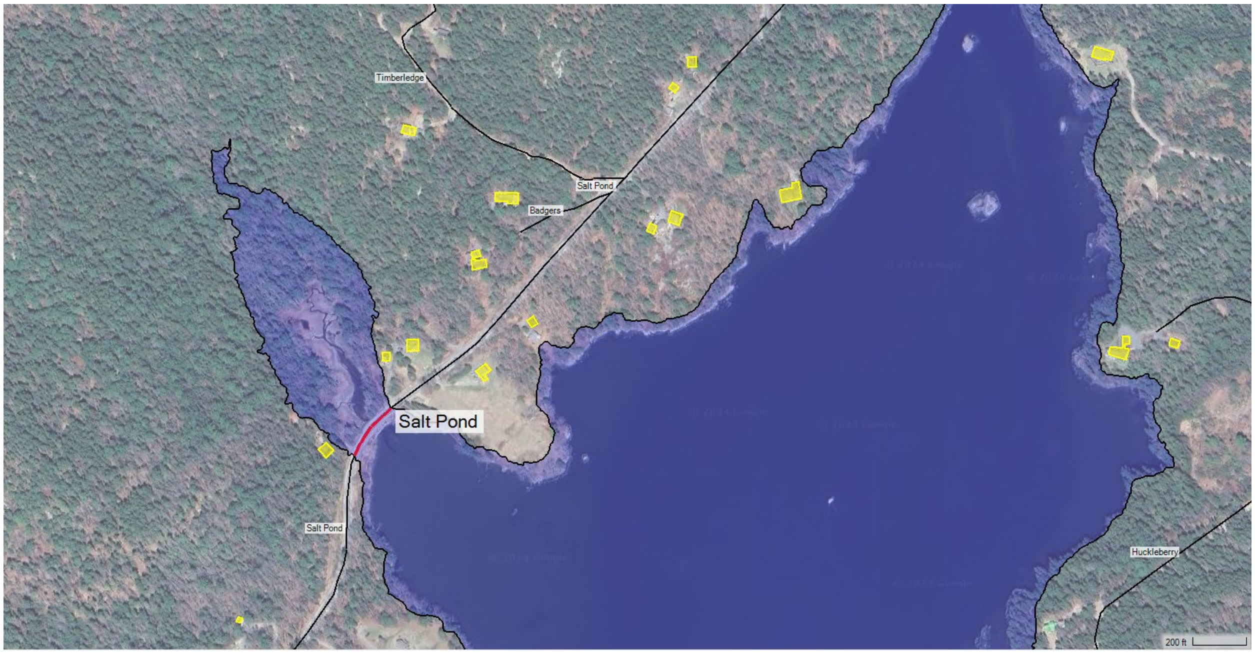
Recommendation

We would recommend considering elevating the vulnerable section of this road to a minimum elevation of 12.3 ft (approximately 0.9 ft above the low point of the road) by 2070 to increase the likelihood for continued vehicular access during 1% annual chance storm events by 2070 and during high tide by 2090.

A table summarizing flood risk, number of impacted buildings, adaptation options, and estimated costs is provided in the attached Table 1. Additionally, estimate costs for elevating the roadway are summarized in Section 4.5 of this report.

4.4.1.5. Salt Pond Road

Figure 4-8. Salt Pond Road Inundation



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

By 2050, approximately 111 ft of Salt Pond Road, at a location about 1.4 miles south of its intersection with South Street, would likely be inundated during 1% annual chance coastal storm events, considering 1.5 ft of sea level rise ("commit to manage"). The road would likely be inundated by up to 1.2 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2070, approximately 151 ft of Salt Pond Road would likely be inundated during 1% annual chance coastal storm events, considering 2.4 ft of sea level rise ("commit to manage"). The road would likely be inundated by up to 2.1 ft, due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2090, approximately 78 ft of Salt Pond Road would likely be inundated during high tide, considering 5.0 ft of sea level rise ("prepare to manage"). The inundated road section would likely be inundated by up to 0.6 during peak high tide.

During periods of roadway inundation, roadway users can travel along alternate routes stemming from Route 172, such as Sedgwick Ridge Road in Sedgwick. Alternate routes could add up to 12.1 miles to the total travel distance.

The estimated length of inundation along this roadway for the other flood scenarios is summarized in Table 3-4 within this report and in Appendix B.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation during 1% annual chance coastal storm events by 2050 and during high tides by 2090. During times of inundation, impacted buildings could be accessed via alternate routes. We would encourage users of this roadway to plan travel around predicted periods of high tide and avoid travel during anticipated coastal storm events. Vulnerable populations who rely on emergency services should consider temporarily moving to a more accessible location during anticipated coastal storm events or periods of extreme high tides.

Adaptation Option 2: Elevate the Road

Elevating Salt Pond Road above elevation 11.7 ft (approximately 2.1 ft above the low point of the road) would likely prevent flood inundation due to stillwater conditions (i.e., without considering wave action) during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage"). These elevation suggestions do not include considerations around "freeboard" between the road and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential road low spot. The road would still likely be inundated due to stillwater conditions by up to 0.6 ft and 2.6 ft during a 1% annual chance coastal storm event considering 3.0 and 5.0 ft of sea level rise ("prepare to manage") by 2070 and 2090, respectively. During periods of wave action, inundation depths would likely be higher.

Elevating the road above elevation 14.3 ft (approximately 4.7 ft above the low point of the road) would likely prevent flood inundation due to stillwater conditions during 1% annual chance coastal storm events by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

Recommendation

We recommend elevating the vulnerable section of this road to a minimum elevation of 11.7 ft by 2050 to increase the likelihood for continued vehicular access during 1% annual chance storm events in 2050 and 2070.

A summary of flood risk, number of impacted buildings, adaptation options, and estimated costs is provided in the attached Table 1. Additionally, estimate costs for elevating the roadway are summarized in Section 4.5 of this report.

4.4.1.6. KYC Lane

Figure 4-9. KYC Lane Inundation

Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

For present day sea levels, approximately 101 ft of KYC Lane at its terminus would likely be inundated during 1% annual chance coastal storm events. The road would likely be inundated by up to 1.3 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2050, approximately 140 ft of KYC Lane would likely be inundated during 1% annual chance coastal storm events, considering 1.5 ft of sea level rise ("commit to manage"). The road would likely be inundated by up to 2.7 ft due to stillwater conditions (i.e., without considering wave action) during the peak tide of the storm event. During periods of wave action, inundation depths would likely be higher.

By 2070, approximately 37 ft of KYC Lane would likely be inundated during high tide, considering 3.0 ft of sea level rise ("prepare to manage"), and would be inundated by up to 0.1 ft during peak high tide.

By 2090, approximately 131 ft of KYC Lane would likely be inundated during high tide, considering 5.0 ft of sea level rise ("prepare to manage"), and would be inundated by up to 2.1 ft during peak high tide.

Kollegewidgwok Yacht Club (KYC) would likely be inaccessible during periods of inundation, which would make it difficult for emergency vehicles to access the building and for building occupants to evacuate.

The estimated length of inundation along this roadway for the other flood scenarios is summarized in Table 3-4 within this report and in Appendix B.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation during 1% annual chance coastal storm events in present day and during high tides by 2070. During times of inundation, Kollegewidgwok Yacht Club would likely be inaccessible. We would encourage users of this roadway to plan travel around predicted periods of high tide and avoid travel during anticipated coastal storm events. Vulnerable populations who rely on emergency services should consider temporarily moving to a more accessible location during anticipated coastal storm events or periods of extreme high tides.

Adaptation Option 2: Elevate the Road

Elevating KYC Lane above elevation 10.8 ft (approximately 2.7 ft above the low point of the road) would likely prevent flood inundation due to stillwater conditions (i.e., without considering wave action) during 1% annual chance coastal storm events by 2050, considering 1.5 ft of sea level rise ("commit to manage"), and during high tide by 2090, considering 5.0 ft of sea level rise ("prepare to manage"). These elevation suggestions do not include considerations around "freeboard" between the road and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential road low spot. The road would still likely be inundated due to stillwater conditions by up to 0.9 ft and 1.5 ft during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage") and 3.0 ft of sea level rise ("prepare to manage"), respectively, and by up to 3.5 ft by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

Elevating the road further would present topographic constraints given the existing elevation of the parking lot and surrounding infrastructure. Further elevation of the road would need to consider elevating the facility.

Adaptation Option 3: Re-route the Road

KYC Lane could be re-routed farther inland, such that it approaches the Kolledgewidgwok Yacht Club building from the east as opposed to the north. This adaptation alternative would not address flood inundation that may occur at the facility, such as in the parking area, unless that was elevated and/or relocated.

Recommendation

We recommend that the owners of this facility consider flood adaptation of the road and surrounding infrastructure in the near term to prevent damage to the infrastructure (i.e., parking lot, shoreline revetment, buildings, float system, and boat ramp) and damage to other property (i.e., cars and boats) of participating citizens.

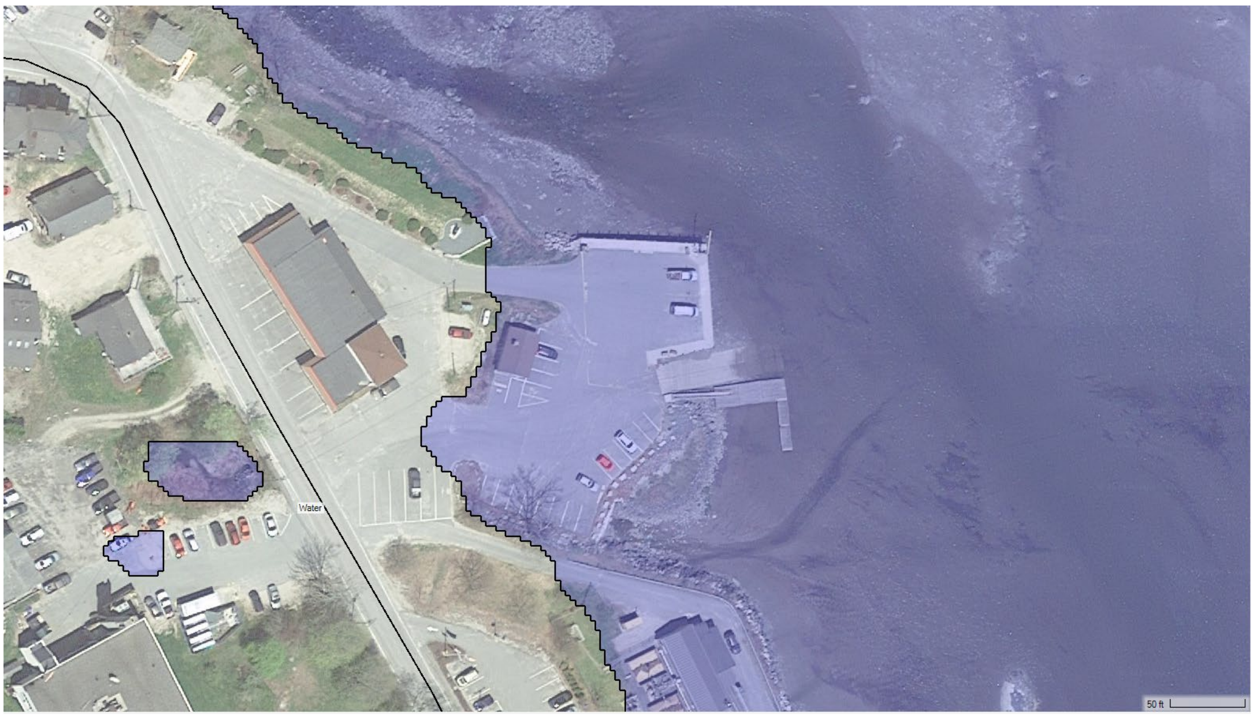
A summary of flood risk, number of impacted buildings, adaptation options, and estimated costs is provided in the attached Table 1. Additionally, estimate costs for elevating the roadway are summarized in Section 4.5 of this report.

4.4.2. Wharves

The Town received a Maine Coastal Program Shore and Harbor Planning Grant in 2024 to undertake 30% design for flood adaptation at the Blue Hill "Village Wharf" and the South Blue Hill Wharf. The upcoming project will focus on planning and adaptation at these two facilities. An overview of the flood risk and preliminary adaptation options are explored below as part of this study. Adaptation options and recommendations will be explored more in-depth as part of that forthcoming study and design process.

4.4.2.1. Blue Hill Village Wharf

Figure 4-10. Blue Hill Village Wharf Inundation



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

The Blue Hill "Village Wharf" is located at the head of the Blue Hill harbor in the central village district. This wharf is accessed from Water Street and is located behind the Blue Hill Fire Department. The wharf serves as a public landing and includes a parking lot, boat ramp, and a float system.

For present day sea levels, the parking area of the wharf will likely be inundated due to stillwater conditions during 1% annual chance coastal storm events by up to 2.1 feet. The depths of flooding would likely increase during periods of wave action.

By 2070, the parking area of the wharf will likely be inundated during high tide, considering 2.4 ft of sea level rise ("commit to manage"). Inundation depths of approximately 0.3 ft would likely occur during high tide.

Adaptation Option 1: Do Nothing

If the Village Wharf remains as is, it would likely be subject to flood inundation due to stillwater conditions (i.e., without wave action) during 1% annual chance coastal storm events for present-day sea levels and during typical daily high tides by 2050. Use of the wharf would be limited during times of inundation. Standing flood water would likely have minimal damage to the wharf itself, but flood inundation may damage surrounding buildings and electrical features. Wave action would increase the likelihood of infrastructure damage at this location.

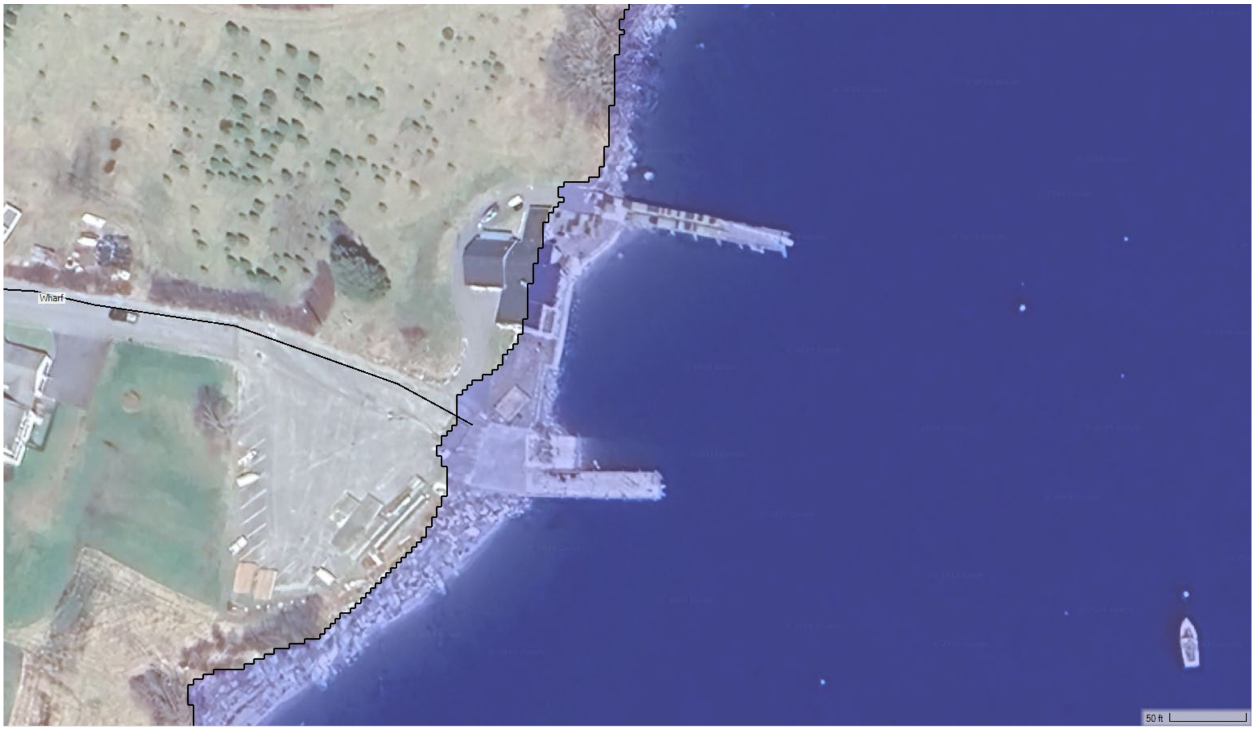
Adaptation Option 2: Elevate the Wharf

Elevating the Village Wharf above elevation 10.2 ft (approximately 2.9 ft above the elevation of the parking area of the wharf) would reduce the risk of flood inundation due to high tides by 2090 considering 5.0 feet of sea level rise ("prepare to manage"). These elevation suggestions do not include considerations around "freeboard" between the wharf and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential wharf low spot. The wharf would still likely be inundated due to stillwater conditions by up to 0.6 ft during 1% annual chance coastal storm events by 2050 considering 1.5 ft of sea level rise ("commit to manage") and by up to 1.5 ft and 2.1 ft during 1% annual chance coastal storm events by 2070, considering 2.4 ft of sea level rise ("commit to manage") and 3.0 ft of sea level rise ("prepare to manage").

Elevating the wharf above elevation 12.3 ft (approximately 5.0 ft above the elevation of the parking area of the wharf) would likely prevent flood inundation due to stillwater conditions during 1% annual chance coastal storm events by 2070, considering 3.0 ft of sea level rise ("prepare to manage"). The wharf would still likely be inundated due to stillwater conditions by up to 2.0 ft during 1% annual chance coastal storm events by 2090, considering 5.0 ft of sea level rise ("prepare to manage").

4.4.2.2. South Blue Hill Wharf

Figure 4-11. South Blue Hill Wharf Inundation



Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

The South Blue Hill wharf includes a parking lot, a boat access ramp, a pier with gangway and floats, and floats used for dinghy tie-ups. The facility is used for recreational boaters and commercial fishing.

For present-day sea levels, the wharf would likely be inundated due to stillwater conditions (i.e., no wave action) during 1% annual chance coastal storm events by up to 0.9 feet. Inundation depths would increase during periods of wave action.

By 2090, with 5.0 ft of sea level rise ("prepare to manage"), the wharf would likely be inundated daily during high tide by up to 1.7 feet.

Adaptation Option 1: Do Nothing

If the wharf remains as is, it would likely be subject to flood inundation during 1% annual chance coastal storm events in present day and during high tide by 2090. Use of the wharf would be limited during times of inundation. Standing flood water would likely have minimal damage to the wharf itself, but flood inundation may damage surrounding buildings, equipment, property, and electrical features. Wave action would increase the likelihood of infrastructure damage at this location.

Adaptation Option 2: Elevate

Elevating the facility above elevation 10.8 ft (approximately 2.3 ft above its low point) would likely reduce the risk of flood inundation at the facility by 2050 due to stillwater conditions during 1% annual chance coastal events, considering 1.5 ft of sea level rise ("commit to manage"), and during high tide by 2090 considering 5.0 ft of sea level rise ("prepare to manage). These elevation suggestions do not include considerations around "freeboard" between the wharf and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential wharf low spot. However, flooding due to 1% annual chance coastal storm events by 2070 would still be likely. Wave action would also increase the chance of flood inundation at the facility and should be considered as adaptation options advance.

4.4.3. Blue Hill Wastewater Treatment Facility

Figure 4-12. Blue Hill Wastewater Treatment Facility Inundation

Notes: Flood inundation boundary shown represents Flood Scenario Number 9 (Table 3-3): stillwater flooding during a 1% annual chance coastal storm event with 5.0 ft of sea level rise (2090, prepare to manage). Red lines represent likely inundated roadway sections. Yellow buildings based on GIS buildings data (Microsoft, 2018).

The Blue Hill wastewater treatment facility is located at 48 Water Street next to the Village Wharf. The facility has experienced difficulties with operations during high tide. On occasion, water has risen above the pipe that discharges effluent from the facility, causing backups in the chlorine tank and straining the filtration system (Genter, 2022). It is likely that this issue will occur more frequently as sea levels rise.

The Town is working with Olver Associates on a plan for facility upgrades and short-term and long-term capital improvement plants. Olver Associates has provided preliminary cost estimates on the construction of a sea wall as part of long-term capital improvement needs (Olver, 2021).

A detailed wave modeling analysis would be beneficial in understanding flood risk due to wave runup and splash over at the facility. In lieu of a more detailed flood risk analysis and impact of alternatives of wave runup, we have outlined some high-level adaptation alternatives below. Our evaluation does not include information on the potential impact that salt water, the rise and fall of higher tides, or potential wave action may have on the outfall pipe or other components of the treatment facility.

Adaptation Option 1: Do Nothing

If the wastewater treatment facility remains as is, it would likely be subject to flood inundation under the scenarios described above. Flood water may damage the structure, property, electrical features, and other equipment. Inundation could interfere with or interrupt operations, increasing the risk of cessation of services to the facility's service area, which could be a public health hazard.

Adaptation Option 2: Build a Flood Barrier

A flood barrier, such as a sea wall, could be used to reduce the risk of flood inundation due to storm surge and sea level rise. A sea wall with a crest elevation above 10.8 ft (approximately 1.3 ft above the low point at the site) would likely prevent flood inundation at the facility by 2050 due to stillwater during 1% annual chance coastal storms by 2050 and 1.5 ft of sea level rise ("commit to manage"). Wave action has the potential to cause overtopping of a sea wall. The final design height of the seawall should be selected based on a coastal modeling analysis to limit the amount of overtopping. These elevation suggestions do not include considerations around "freeboard" between the structure and the water surface. For this planning-level study, we have assumed the peak water surface would be at the potential structure low spot.

A sea wall with a crest elevation above 14.3 ft (approximately 4.8 ft above the low point at the site) would likely prevent flood inundation at the facility by 2090 due to stillwater during 1% annual chance coastal storms and 5.0 ft of sea level rise ("prepare to manage"). Wave action has the potential to cause overtopping of a sea wall. The final design height of the seawall should be selected based on a coastal modeling analysis to limit the amount of overtopping.

Design heights should be considered in conjunction with the design life of the facility.

4.5. Cost Estimates

We have prepared a cost estimate for road elevation adaptation options that were discussed in this report. Estimates were not provided for rerouting roadways due to the complexity of right of way access. It is recommended that a more detailed alternatives analysis be performed for individual road segments to evaluate road elevation versus road rerouting. We did not provide a cost estimate for adaptation of the Town Wharves or Wastewater Treatment Facility. These assets are undergoing more detailed evaluations separate from this project.

Estimated costs associated with the elevation scenarios described in the earlier sections of this report are summarized in Table 4-1 below. These cost estimates represent design, permitting, construction, and construction oversight costs. The costs are based on 2024 dollars and should be considered approximate, ranging in accuracy by approximately +/- 30%. There are also costs associated with "no action" or not adapting infrastructure for increased flood risk. The National Institute of Building Sciences reported that every $1 invested in pre-disaster risk reduction results in $6 of avoided disaster damage (MCC, 2020a).

Table 4-1. Summary of Road Adaptation Cost Estimates

Road	Elevation Amount (ft)	Recommended Elevation (ft)	Reduces Storm Surge Flooding By:	Reduces High Tide Flooding By:	Approximate Segment Length for Adaptation (ft)	Approximate Total Cost[2]	Estimated Costs to Elevate Roadbed[3] (per linear ft)
East Blue Hill Road (Rt 176)[1]	1.7	11.7	2070	2090	251	$440,000	$1,700
	4.3	14.3	2090	2090	529	$1,200,000	$2,200
Falls Bridge Road (Rt 175)[4]	2.2	11.7	2070	2090	290	$750,000	$2,600
	4.8	14.3	2070	2090	1,220	$3,500,000	$2,900
Parker Point Road	1.3	11.7	2070	2090	155	$270,000	$1,700
	3.9	14.3	2090	2090	256	$590,000	$2,300
Jay Carter Road	0.9	12.3	2070	2090	208	$340,000	$1,600
	2.9	14.3	2090	2090	298	$610,000	$2,000
Salt Pond Road	2.1	11.7	2070	2090	150	$280,000	$1,800
	4.7	14.3	2090	2090	228	$560,000	$2,400
KYC Lane	2.7	10.8	2050	2090	141	$230,000	$1,600

Notes:
1. Elevation of western section of road only; this does not include costs to elevate the East Blue Hill Bridge.
2. Total costs are rounded to the nearest $10,000.
3. Linear foot costs are rounded to the nearest $100.
4. Cost estimates for the causeway section of Falls Bridge Road could vary considerably depending on the final design. The estimates provided are approximate and include a large contingency. For comparison, Maine DOT has estimated that the Deer Isle and Stonington Causeway project, which is approximately 2,000 ft in length, could cost over $10 million (Maine DOT, 2023)

4.6. Permitting Considerations

Infrastructure projects within the Town of Blue Hill will likely be subject to a local, state, and/or federal regulatory process. In some cases, multiple permits may be required for a specific project. We have summarized some of the local, state, and federal permits that may be required for coastal adaptation projects in the Town of Blue Hill. More detailed analysis and design would need to be developed to fully identify all permitting requirements.

Town of Blue Hill

The Town of Blue Hill participates in the National Flood Insurance Program and as such requires a Flood Hazard Development Permit for projects within Special Flood Hazard Areas (SFHAs). Improvements on wharves, piers, and bridges would fall within the Flood Hazard Development Permits for Minor Development or may be exempt depending on the scope of work proposed.

The Town of Blue Hill's Shoreland Zoning Ordinance applies to all land areas within 250 feet of the normal high-water line of any great pond or river, upland edge of a coastal wetland, or upland edge of a freshwater wetland and all land areas within 75 feet of the normal high-water line of a stream. Projects involving road construction, earthwork, and structures extending over or below the normal high-water line or within a wetland typically require a shoreland zoning permit issued by the Code Enforcement Officer and/or Planning Board. Table 1 of the Town of Blue Hill's Shoreland Zoning Ordinance outlines common land uses and the level of review required (i.e. CEO, Planning Board, or no review).

State of Maine

Under the Natural Resources Protection Act (NRPA), the Maine Department of Environmental Protection (MEDEP) regulates activities in, on, over protected natural resources that include coastal sand dune systems, coastal wetlands, significant wildlife habitat, fragile mountain areas, freshwater wetlands, great ponds, and rivers, stream, or brooks. In addition, activities within 75 feet of a coastal wetland, great pond, river, stream or brook, and specific freshwater wetlands area also subject to the NRPA. The goal of the NRPA is to avoid and minimize impacts to protected natural resources by regulating activities in, on, or adjacent to the resources.

In general, there are two permitting options for projects subject to the NRPA: a Permit-by-Rule (PBR) or an Individual NRPA permit. A PBR is an expedited permit review that applies to certain small, low-impact projects that present minimal risk of impact to environmental resources and must meet specific design standards. An Individual NRPA Permit is required for projects that do not meet PBR standards. This includes most projects that directly impact a coastal wetland, including upland areas with 25 feet of the highest annual tide line. The NRPA Individual permit application process requires that the natural resources impacted by the project be characterized, that the purpose for the project be demonstrated, and that an alternatives analysis be undertaken to document that the option being proposed is the least impactful practical option that achieves the project objectives.

Depending on the amount of impact and type of protected natural resource, the MEDEP may require a functional assessment to determine if the project is anticipated to impact the functions and values of the resource. If so, the MEDEP may require mitigation for lost resource functions and values. For projects that impact less than 500 square feet of a coastal wetland, a functional assessment and/or compensation may not be required. For projects with greater impact, mitigation may be required in the form of in lieu fee (ILF), an on-site compensation project, or an off-site compensation project. For projects located within a mapped coastal sand dune, an Individual Coastal Sand Dune permit may be required. The timeframe for approval of applications under the NRPA is 2 weeks for PBR, and 4 -6 months for an Individual NRPA permit and Coastal Sand Dune application. Public notice is required for an Individual NRPA permit and Coastal Sand Dune application and projects subject to mitigation require a pre-application meeting with the DEP and a public information meeting prior to the submission of an application.

As a matter of consideration, certain projects may be eligible for a statutory exemption under the NRPA and may not require any permit. This can include maintenance and repair to less than 50% of an existing structure, including piers, wharves, and docks, public works projects, or the repair and maintenance or replacement of an existing crossing.

Federal

Under Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers (USACE) regulates waters of the U.S., and, under Section 10 of the Rivers and Harbors Act, the USACE regulates navigable waters of the U.S. Projects that are subject to these regulations require a Maine General Permit. Similar to the MEDEP, there are generally two permit options: a Self-Verification Notification Form (SVNF) or a Pre-Construction Notification (PCN), depending on the scope of the project. In some cases, provided all proposed work is landward of the high tide line, these permits can be avoided. As an example, utilizing a vertical wall stabilization instead of a riprap slope may avoid structures below the high tide line. However, this activity may require MEDEP review and consideration needs to be given to the NRPA regulations. If a U.S. Army Corps of Engineers permit is required, several federal agencies will be involved in the review, including: US Fish & Wildlife (USFWS), the Environmental Protection Agency (EPA), and National Marine Fisheries (NMFS). Additionally, for either a SVNF or PCN, notification of the project must be submitted to the Maine Historic Preservation Commission (MHPC) and the five federally recognized tribes in the State of Maine. In cases where both an NRPA individual permit and Army Corps permit are required, an application can be made using the joint application form to both agencies; however, this process may be phased out in 2025 when the new USACE Maine General Permit is released.

For bridges in coastal locations, the lead agency for federal permitting is the U.S. Coast Guard. The locations considered in this study do not involve crossings of navigable waterways, so it is anticipated that the scope of US Coast Guard permitting would likely be limited to Advance Approval for small crossings over tidal waters.

4.7. Funding Opportunities

There are several state and federal funding opportunities that coastal adaptation projects would be well suited for. These opportunities evolve over the years and new opportunities may become available in future years. Each funding source has different eligibility requirements, match requirements, and deadlines for funding. We have provided a list of some of the relevant grant programs, but this list should not be considered comprehensive as new grant funds are created frequently. A list of some of the grant programs available for coastal infrastructure projects in Maine is provided in Table 4-2.

Table 4-2. Flood Adaptation Grant Programs in Maine

Grantor	Grant Name	Description of Qualifying Grant Uses
Maine Coastal Program	Shore and Harbor Planning Grant	Shoreline access planning, waterfront and harbor planning, identification and resolution of waterfront use conflicts, and planning, feasibility, and design efforts for waterfront infrastructure.
Maine Department of Agriculture, Conservation, and Forestry	Coastal Communities Grant	Improve water quality, increase adaptation to erosion and flooding, restore coastal habitats, promote sustainable development, and enhance the coastal-dependent economy while preserving coastal natural resources within Maine’s coastal zone.

Grantor	Grant Name	Description of Qualifying Grant Uses
Governor's Office of Policy Innovation and the Future (GOPIF)	Community Action Grants	Work supporting the List of Community Actions, which fall into the categories of: Embracing the Future of Transportation, Modernizing Maine's Buildings, Reducing Emissions through Clean Energy Innovation, Grow Jobs and Protect Natural Resource Industries, Protect the Environment & Promote Natural Climate Solutions, Build Healthy & Resilient Communities, Invest in Climate-Ready Infrastructure, and Engage Maine People.
Maine DOT	Small Harbor Improvement Program (SHIP)	Projects promoting economic development, public access, improved commercial fishing opportunities and works to preserve and create infrastructure at facilities in tidewater and coastal communities.
Maine DOT	Boating Infrastructure Grant (BIG)	Projects to construct, renovate, and maintain tie-up facilities with features for transient boaters in vessel 26 feet or more in length.
Maine DOT	Maine Infrastructure Adaptation Fund	Scoping, design, and/or construction of adaptation projects to adapt critical infrastructure to reduce vulnerability to climate change, specifically storm and flooding impacts.
Maine DOT	Municipal Stream Crossing Grant	Upgrading of municipal culverts at stream crossing, with the goal of creating infrastructure that is resilient to future climate conditions and that provides community, economic, and environmental benefits.
Northern Border Regional Commission	Catalyst Program	Economic development initiatives, such as: modernizing and expanding access to public water and wastewater services, revitalizing transportation infrastructure, establishing workforce development programs and facilities, growing outdoor recreation economy, and providing access to new childcare and healthcare facilities.
FEMA	Building Resilient Infrastructure in Communities (BRIC)	Hazard mitigation projects.
FEMA	Flood Mitigation Assistance (FMA)	Reduce or eliminate the risk of repetitive flood damage to buildings and structures insured under the National Flood Insurance Program.
FEMA	Hazard Mitigation Grant Program (HMGP)	Post-disaster grants to reduce disaster losses and protect life and property from future disaster damages in communities that have already experienced significant damages from a major natural disaster.
U.S. DOT	Bipartisan Infrastructure Law Grants	Several funding opportunities related to the transportation sector and improving public safety and climate resilience.
National Fish and Wildlife Foundation	Coastal Resilience Fund	Conservation projects that restore or expand natural features such as coastal marshes and wetlands, dune and beach systems, oyster and coral reefs, forests, coastal rivers and floodplains, and barrier islands that minimize the impacts of storms and other naturally occurring events on nearby communities.
U.S. Department of Agriculture	Community Facilities Direct Loan & Grant Program	Development of essential community facilities in rural areas, such as: health care facilities, public facilities, community support services, public safety services, and utility services.
Maine DEP	Municipal Wastewater Grants and SRF Loans	Multiple grant programs, such as: Clean Water State Revolving fund to plan, design, and construct wastewater infrastructure projects; and the State Municipal Wastewater Grant Program for design of wastewater infrastructure projects.

5. Next Steps for Adaptation

This report presents the findings and recommendations for coastal flood risk and adaptation in the Town of Blue Hill. The analysis included gathering of background information, assessment of flood risk to assets within the Town based on nine flood scenarios, identification of critical assets for adaptation prioritization, an introduction of adaptation options, preliminary cost estimates for road elevation adaptation options, and an overview of funding options and permitting considerations. This was a high-level, planning-based study.

The vulnerabilities identified in this phase of study vary in severity and urgency for adaptation. For some assets, a phased implementation strategy is likely to be the most effective approach to completing priority projects while aligning with available grant funding programs. Adaptation projects could take years to fully implement.

We recommend that the Town of Blue Hill continue with regional collaboration in order to leverage grant funding opportunities and increase overall resiliency to climate risk. While in some instances climate risk such as wave runup and overtopping is specific to one site, in many instances climate risk are best approached from a regional level. The impact of one closed roadway on the Blue Hill Peninsula could likely be felt by many surrounding communities. Approaching climate risk regionally is especially important in more rural areas throughout our state, such as the Blue Hill Peninsula, where there is a lack in capacity of Town staff to undertake planning efforts around climate risk. A regional collaboration would be in line with the Maine Climate Action Plan Strategy F: Build Healthy and Resilient Communities (MCC, 2020b).

We have provided a summary of recommended next steps in order for the Town to advance infrastructure-related adaptation to coastal flood risk:

- **Decide on adaptation projects to pursue.** This decision should be based on the risk of exposure to flooding as well as the impacts (i.e., consequences) that would likely occur if the area or infrastructure becomes inundated. The Town should consider their tolerance to “living with water” when making decisions. Infrastructure-based adaptation methods (i.e., elevating a roadway) could be supplemented with non-infrastructure-based adaptation methods (i.e., alert systems or road barriers) to increase the overall resiliency to flood risk. Furthermore, an understanding of the likelihood of inundation vs consequences (i.e., economic costs of damage such as those based on depth-damage functions) would help build a risk framework and guide prioritization of mitigation projects.
- **Pursue relevant funding options.** This could include a funding package that leverages grant awards as a match requirement for a separate grant award. Funding could be pursued regionally or for a particular piece of infrastructure. The Town should continue to explore grant opportunities focused on implementation of flood adaptation measures. Adapting a single piece of infrastructure through constructure may require support from multiple grants, over multiple funding cycles, to complete.

- **Contract with a consultant to develop preliminary and final designs, procure the necessary permits, and oversee construction.** Once assets have been identified for adaptation and funding has been received, we recommend contracting with one or more consultants to develop adaptation designs for the selected infrastructure and oversee construction. The consultant(s) should be responsible for several tasks. These tasks could be part of separate contracts, funded through various grant programs, and take several years to complete. The tasks that the consultant(s) could be responsible for include:
    - **Conducting field investigations.** This would include scope items such as coordinating surveys of areas, performing wetland delineation, and carrying out a geotechnical investigation, as applicable.
    - **Refining flood risk through a coastal and/or hydrologic and hydraulic analysis.** We recommend performing a site-specific coastal flood modeling analysis to understand wave conditions, such as wave runup heights, for assets that would likely be exposed to wave action. For infrastructure such as roadways with culverts, culverts themselves, or other drainage features, we recommend performing a hydrologic and hydraulic analysis to understand opening sizes that could adequately convey design flows following guidance from Maine DOT, the Federal Highway Administration, the CoastWise approach (Maine Coastal Program, 2023), or other applicable agencies and guidance manuals.
    - **Develop preliminary and final designs.** The adaptation measures identified would need to be advanced through preliminary and final phases of design development.
    - **Procure permits.** The consultant would help prepare and submit regulatory permits required for the selected design.
    - **Prepare construction bid documents.** The consultant could help prepare construction plans and bid documents and assist in the selection of a contractor for the construction of the project.
    - **Oversee construction.** The consultant could oversee the construction of the project.

Beyond infrastructure projects, it is imperative that the Town develop a plan for emergency preparedness around flooding. This might include, for example, developing forecasting methods and an emergency alert system, operating procedures for deploying road barricades in advance of major storm events, a program to educate the public about the dangers of flooding, and procedures for local emergency organizations to respond to emergencies during periods of inundation. A possible model to follow could be voluntary signup to receive text messages on cell phones or via email for significant events with the potential to cause flooding.

Emergency responders and public works officials should closely follow weather forecasts and extreme tides, separately and combined, and plan for road closures during significant events that pose a risk to roads. Residents who rely on stretches of road to travel to and from their home that are likely to inundate will need to be mindful of high tides and weather forecasts of significant events when planning for travel outside their home. Vulnerable populations who rely on emergency services may want to consider temporarily moving to a more accessible location during anticipated coastal storm events. Addressing inundation will require education by the Town, warnings about advancing storm events, and the development of, for example, emergency alert systems such as the Maine Citizen Alert System.

6. Limitations

This report summarizes our work for the Town of Blue Hill. The project did not include field data collection and relied on readily available online information, published references, data gathered during the community mapping event, and our professional judgement. The purpose of this flood vulnerability and adaptation assessment was to identify areas and infrastructure at risk of flood inundation, prioritize infrastructure, and provide adaptation options.

The GIS data included in this study represent a snapshot in time of locations and configurations for assets, such as roads, parcels, and building footprints. Infrastructure not included in an existing GIS database, such as town-owned culverts, were not included in this study.

The flood extents were based on still water elevations representing 1% annual chance storm surge and MHHW elevations for present-day and future conditions for four values of sea level rise. The sea level rise values used were recommended by the Maine Climate Council (2024a) and the 1% annual chance storm surge SWEL was based on the FEMA coastal analysis for Hancock County (FEMA, 2016). There is no indicator for when FEMA will revise the coastal analysis for Hancock County to revise the 2016 maps. The previous coastal analyses and flood maps for Hancock County were completed and instated between the years 1987 and 1991. Actual storm surge elevations and rates of sea level rise will vary from what has been presented in this report. The numbers and cost estimates included in this study should be considered approximate. Additionally, the flood extents presented in this report do not include the effect of wave action. Wave runup and overtopping on coastal infrastructure would likely increase the flood extents and depths and may contribute to damage of coastal infrastructure.

This study does not include an evaluation of the structural integrity of roadways, culverts, bridges, dams, and other appurtenances. We recommend site survey and site-specific design be completed for any infrastructure projects the Town pursues. Because the methods, procedures, and assumptions used to develop the analysis are approximate, the results should be used only as guidance.

Reuse of this report for any purposes, in part or in whole, is at the sole risk of the user.

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Tables

Table 1. Blue Hill Road Adaptation Summary

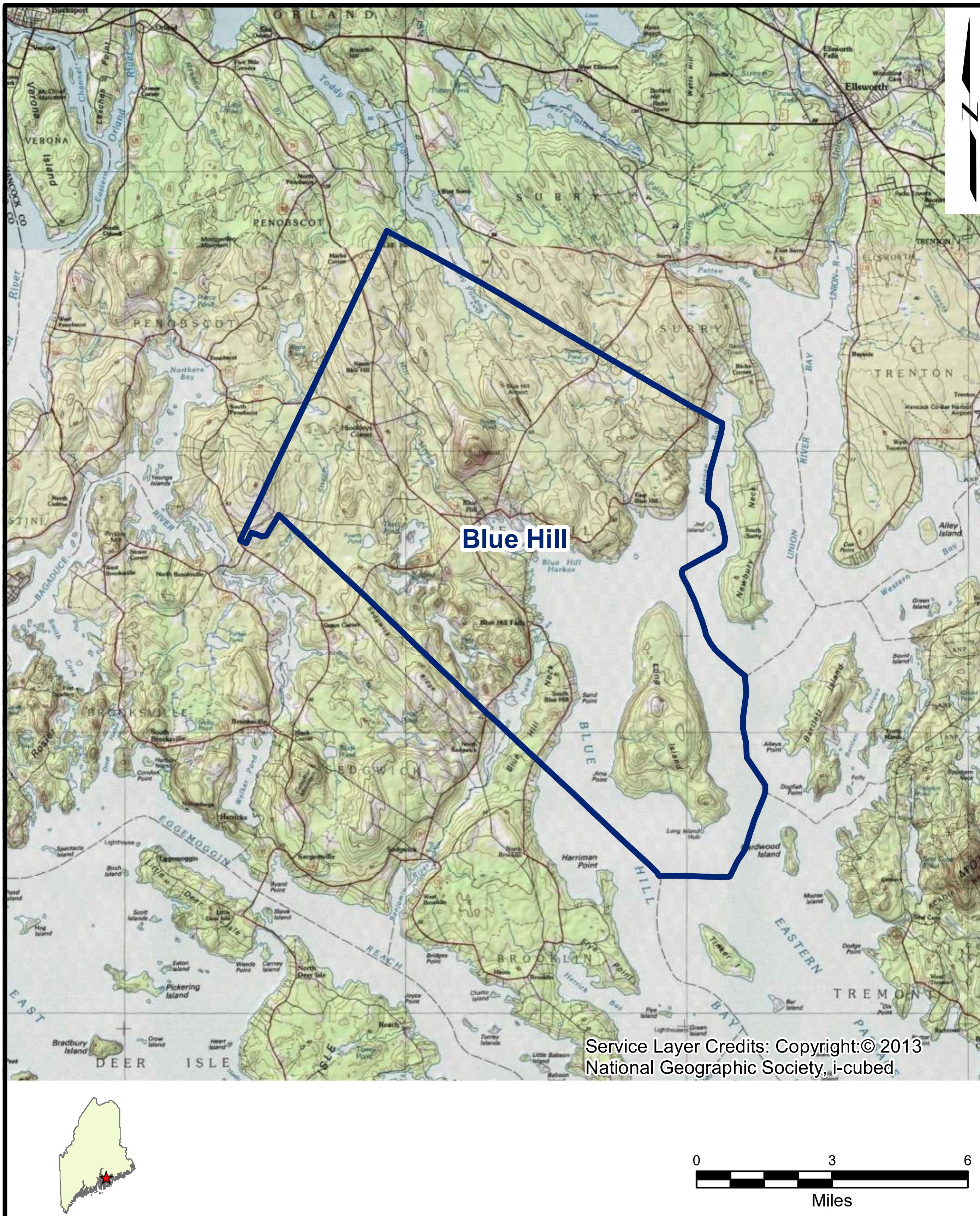
Table 1. Blue Hill Road Adaptation Summary

Road	Approximate # of Buildings Impacted	Detour Length (mi)	Low Point Elevation of Road (ft)	Flood event that will cause standing water flooding in:				Adaptation Comparison						
				Present Day	20501 (1.5 ft SLR)	2070 (2.4 ft SLR)	2090 (5.0 ft SLR)	Elevation Amount (ft)	Recommended Elevation (ft NAVD88)	Reduces Storm Surge Flooding By:	Reduces High Tide Flooding By:	Approximate Segment Length for Adaptation (ft)	Approximate Total Cost[1]	Estimated Costs to Elevated Roadbed[2] (per linear foot)
East Blue Hill Road (Rt 176)[3]	157	17 [4]	10	NA	100-yr Storm	100-yr Storm	High Tide	1.7	11.7	2070	2090	251	$440,000	$1,700
								4.3	14.3	2090	2090	529	$1,200,000	$2,200
Falls Bridge Road (Rt 175)[5]	217 [6]	No Detour Available	9.5	NA	100-yr Storm	100-yr Storm	High Tide	2.2	11.7	2070	2090	290	$750,000	$2,600
								4.8	14.3	2070	2090	1,219	$3,500,000	$2,900
Parker Point Road	48	5 [7]	10.4	NA	100-yr Storm	100-yr Storm	100-yr Storm	1.3	11.7	2070	2090	155	$270,000	$1,700
								3.9	14.3	2090	2090	256	$590,000	$2,300
Jay Carter Road	40	No Detour Available	11.4	NA	NA	100-yr Storm	100-yr Storm	0.9	12.3	2070	2090	208	$340,000	$1,600
								2.9	14.3	2090	2090	298	$620,000	$2,100
Salt Pond Road	NA	12.1	9.6	NA	100-yr Storm	100-yr Storm	High Tide	2.1	11.7	2070	2090	150	$280,000	$1,900
								4.7	14.3	2090	2090	228	$560,000	$2,400
KYC Lane	2	No Detour Available	8.1	100-yr	100-yr Storm	100-yr Storm[8]	High Tide	2.7	10.8	2050	2090	141	$230,000	$1,600

Notes:

1. Total costs are rounded to the nearest $10,000.
2. Linear foot costs are rounded to the nearest $100.
3. Elevation of western section of road only; this does not incldue costs to elevate the East Blue Hill Bridge.
4. No detour available during Flood Scenario 7 and beyond.
5. Cost estimates for the causeway section of Falls Bridge Road could vary considerably depending on the final design. The estimates provided are approximate and include a large contingency.
6. This number does not include buildings impacted in neighboring Towns, such as Brooklin or Sedgwick.
7. No detour available during Flood Scenario 9 and beyond.
8. 3.0 ft of SLR.

Figures



Blue Hill Climate Vulnerability Assessment
Blue Hill, Maine

Town of Blue Hill, Maine

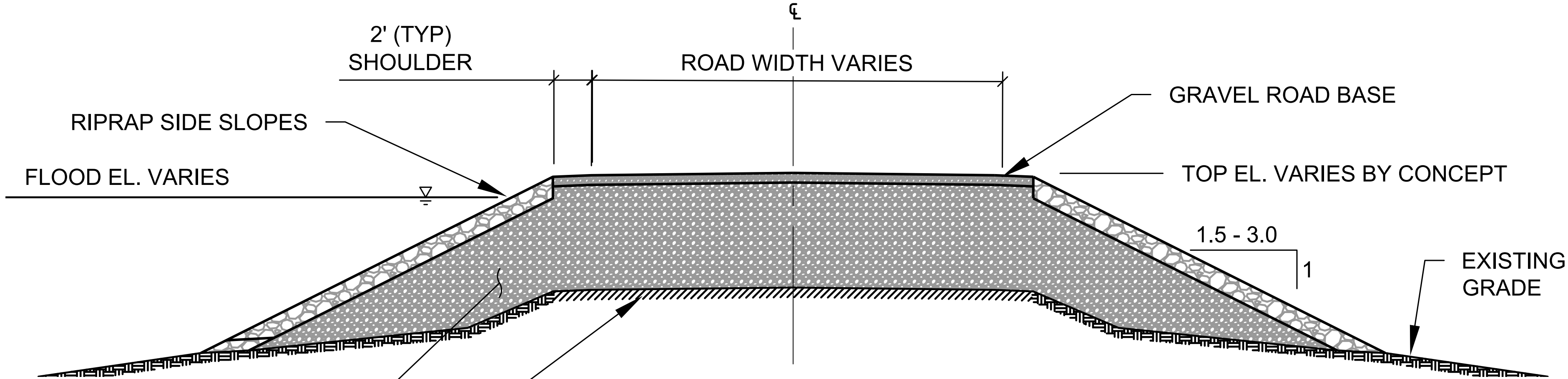
GEI Consultants

Project 2303435

TOWN BOUNDARY

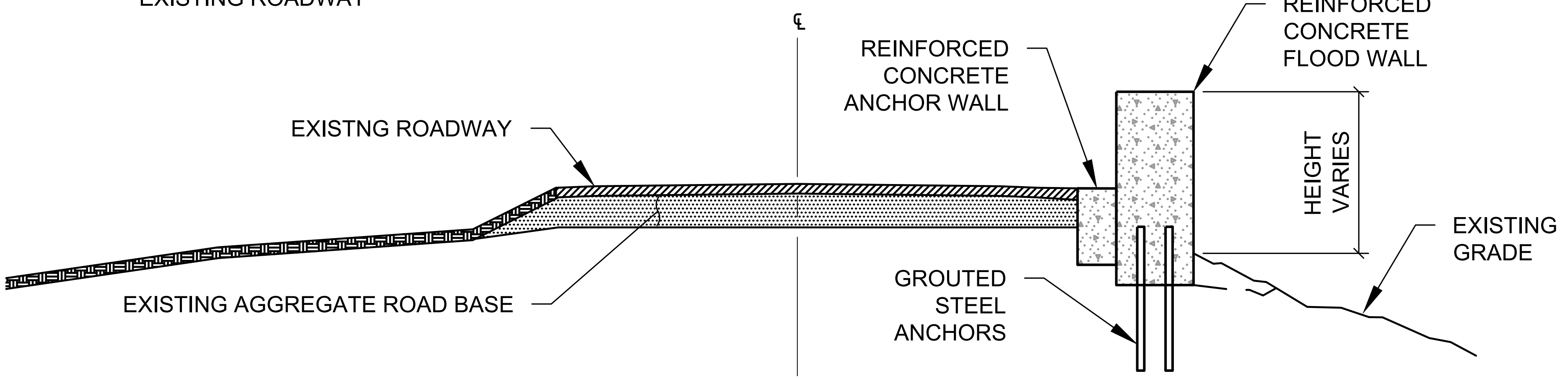
November 2024 | Fig. 1

\\geiconsultants.com\data\Data_Storage\Working\BLUE HILL ME, TOWN OF\2303435 Three Towns Climate Vulnerability Assessment\GIS\Figs\Fig 1_Town Boundary_Blue Hill.mxd



ROAD ADAPTATION CONCEPT A:
RAISED ROADWAY

NOT TO SCALE

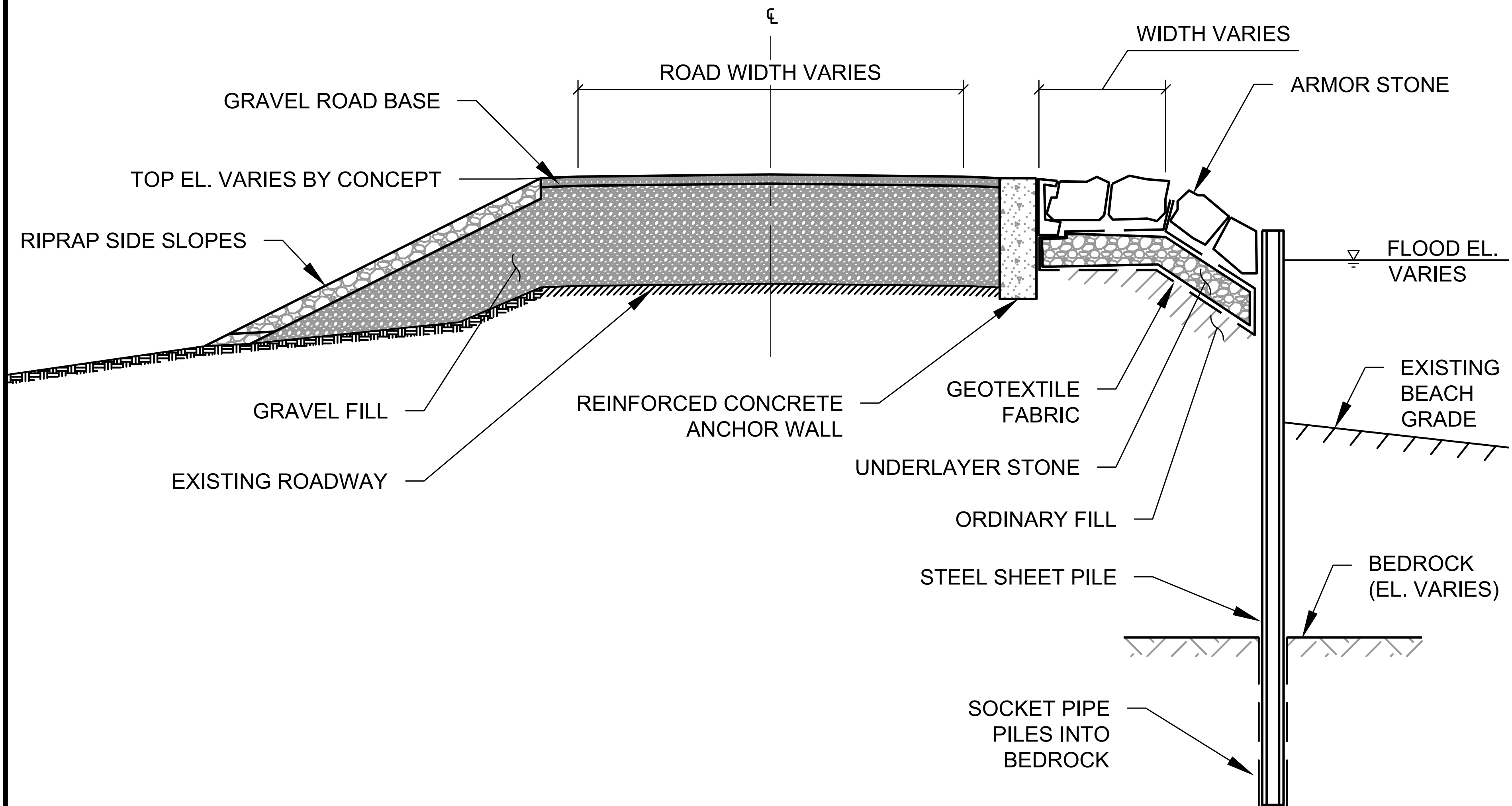


ROAD ADAPTATION CONCEPT B:
CONCRETE FLOODWALL

NOT TO SCALE

Blue Hill Climate Vulnerability Assessment Blue Hill, Maine	GEI Consultants	ROAD ADAPTATION CONCEPTS A & B
Town of Blue Hill, Maine	Project 2303435	November 2024 Fig. 2

---- B:\Working\BLUE HILL ME, TOWN OF\2303435 Three Towns Climate Vulnerability Assessment\00_CAD\Design\Working\RoadSections - Copy.dwg - 9/30/2024

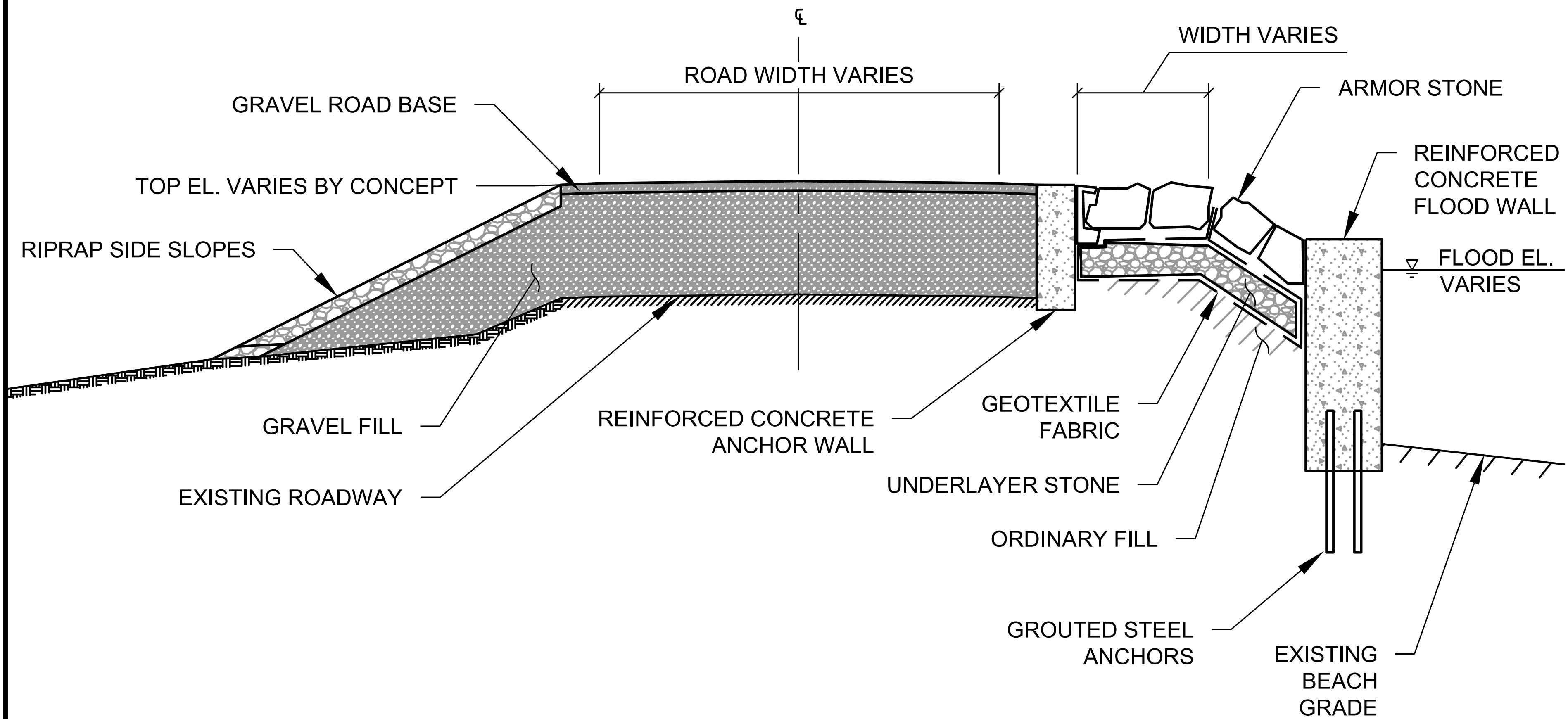


ROAD ADAPTATION CONCEPT C:
RAISED ROADWAY & SHEET PILE FLOODWALL

NOT TO SCALE

Blue Hill Climate Vulnerability Assessment Blue Hill, Maine	GEI Consultants	ROAD ADAPTATION CONCEPT C
Town of Blue Hill, Maine	Project 2303435	November 2024 Fig. 3

---- B:\Working\BLUE HILL ME, TOWN OF\2303435 Three Towns Climate Vulnerability Assessment\00_CAD\Design\Working\RoadSections - Copy.dwg - 9/30/2024



ROAD ADAPTATION CONCEPT D: RAISED ROADWAY & CONCRETE FLOODWALL

NOT TO SCALE

Blue Hill Climate Vulnerability Assessment Blue Hill, Maine	GEI Consultants	ROAD ADAPTATION CONCEPT D
Town of Blue Hill, Maine	Project 2303435	November 2024 Fig. 4

---- B:\Working\BLUE HILL ME, TOWN OF\2303435 Three Towns Climate Vulnerability Assessment\00_CAD\Design\Working\RoadSections - Copy.dwg - 9/30/2024

Appendix A GIS Data Sources

Asset Name	Shapefile Name	Accessed
Roads	Maine_E911_NG_ROADS.shp	8/11/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/arcgis/rest/services/Maine_E911_Roads_Feature/FeatureServer	
Evacuation routes	Hurricane_Evacuation_Network	8/15/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/arcgis/rest/services/Hurricane_Evacuation_Network/FeatureServer	
Parcels	Parcels_Blue_Hill, Parcels_Brooksville, Parcels_Surry	8/11/2023
source:	https://www.maine.gov/geolib/download_parcel_by_town.html	
Conservation parcels	Maine_Conserved_Lands*	10/17/2023
source:	https://gis.maine.gov/arcgis/rest/services/acf/Conserved_Lands/MapServer/0	
Building footrprints	Maine.geojson	8/11/2023
source:	https://github.com/Microsoft/USBuildingFootprints	
Critical facilities:		
-Hospitals	Maine_E911_Addresses_Feature_Hospitals	8/11/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/arcgis/rest/services/Maine_E911_Addresses_Feature_Hospitals/FeatureServer	
-Government buildings	Maine_E911_Addresses_Feature_Government_Buildings	8/11/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/arcgis/rest/services/Maine_E911_Addresses_Feature_Government_Buildings/FeatureServer	
-Fire stations	Maine_E911_Addresses_Feature_Fire_Stations	8/11/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/arcgis/rest/services/Maine_E911_Addresses_Feature_Fire_Stations/FeatureServer	
-Schools	Maine_Schools_Geolibrary	8/11/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/ArcGIS/rest/services/Maine_GeoLibrary_Structure/FeatureServer/8	
Cemeteries	Cemeteries	9/6/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/arcgis/rest/services/MaineSociety/FeatureServer	
Boat launches	Maine_Boat_Launches_GeoLibrary	8/11/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/ArcGIS/rest/services/Maine_GeoLibrary_Structure/FeatureServer/1	
Large culverts	MaineDOT_Large_Culverts	8/11/2023
source:	https://gis.maine.gov/arcgis/rest/services/dot/MaineDOT_OpenData/MapServer/1	
Cross culverts	MaineDOT_Cross_Culverts	8/11/2023
source:	https://gis.maine.gov/arcgis/rest/services/dot/MaineDOT_OpenData/MapServer/54	
Wells	MGS_Wells	11/3/2023
source:	https://services1.arcgis.com/RbMX0mRVOFNTdLzd/ArcGIS/rest/services/MGS_Wells_Database/FeatureServer	

Appendix B Flood Scenario and Results Tables

Flood Scenario Numbers

Flood Scenario Description	Water Surface Elevation (NAVD88, ft)	Flood Scenario Number
2050, High Tide, Commit to Manage (1.5 ft SLR)	6.7	**1**
2070, High Tide, Commit to Manage (2.4 ft SLR)	7.6	**2**
2070, High Tide, Prepare to Manage (3.0 ft SLR)	8.2	**3**
Present Day, 100-year Storm	9.4	**4**
2090, High Tide, Prepare to Manage SLR (5.0 ft SLR)	10.2	**5**
2050, 100-year Storm, Commit to Manage (1.5 ft SLR)	10.8	**6**
2070, 100-year Storm, Commit to Manage (2.4 ft SLR)	11.7	**7**
2070, 100-year Storm, Prepare to Manage (3.0 ft SLR)	12.3	**8**
2090, 100-year Storm, Prepare to Manage (5.0 ft SLR)	14.3	**9**

Roads Flood Risk Exposure Summary, Length of Inundation (ft)

Road Name	Ownership	1	2	3	4	5	6	7	8	9
High Priority Roads										
E Blue Hill Rd	State	-	-	-	-	24	165	424	522	821
Falls Bridge Rd	State	-	-	-	-	197	311	540	658	1,204
Parker Point Rd	Town	-	-	-	-	-	76	148	181	323
Jay Carter Rd	Town	-	-	-	-	-	-	147	202	289
Medium Priority Roads										
Kyc Ln	Town	-	-	37	101	131	140	153	156	175
Salt Pond Rd	State	-	-	-	-	78	111	151	169	223
Leveque Ln	Town	-	-	-	-	-	36	147	171	208
Curtis Cove Rd	Town	-	-	-	-	-	-	-	-	145
Low Priority Roads										
Steamboat Wharf Rd	Town	-	-	-	-	-	-	13	30	81
Shady Ln	Town	-	-	-	-	-	-	4	14	28
Allen Point Ln	Town	-	-	-	-	-	-	-	56	237
Osprey Ln	Town	-	-	-	-	-	-	-	-	13
SC Ln	Town	-	-	-	-	-	-	-	-	159
Seal Ledge Ln	Town	-	-	-	-	-	-	-	-	47
Tides End Ln	Town	-	-	-	-	-	-	-	-	34
Woods Point Rd	Town	-	-	-	-	-	-	-	-	477

Maine DOT Culverts Flood Exposure Summary (Y/N)

Culvert Location	1	2	3	4	5	6	7	8	9
Large Culverts									
E Blue Hill Rd *near Peter's Cove*	-	-	-	-	-	Y	Y	Y	Y
Cross Culverts									
Salt Pond Rd *near Lone Cove before pole # 107 near Lone Cove*	-	-	-	-	Y	Y	Y	Y	Y
Falls Bridge Rd* *Approx. 0.25 miles NW of Blue Hill Falls Bridge on the Mill Island Causeway*	-	-	-	-	Y	Y	Y	Y	Y
Falls Bridge Rd *Approx. 580 ft SE of intersection with Parker Point Rd.*	-	-	-	-	-	Y	Y	Y	Y
Falls Bridge Rd *Approx. 740 ft SE of intersection with Parker Point Rd.*	-	-	-	-	-	-	-	-	Y

Note: MaineDOT in some instances refers to the culvert along Falls Bridge Rd on the Mill Island Causeway as the “Mill Island Bridge.”

Maine DOT Bridges Flood Exposure Summary (Y/N)

Bridge Name	1	2	3	4	5	6	7	8	9
East Blue Hill Bridge[1]	-	-	-	-	Y	Y	Y	Y	Y
Mill Island Bridge[2]	-	-	-	-	Y	Y	Y	Y	Y
Peter's Brook Bridge	-	-	-	-	-	-	-	-	Y
Blue Hill Falls Bridge[3]	-	-	-	-	-	-	-	-	-

Note:
1. The East Blue Hill Bridge is included in the Maine DOT 2024-2025-2026 work plan for Blue Hill (Maine DOT, 2024a).
2. The Mill Island bridge is a culvert and is also included in the culvert section of this memo.
3. The results are based on the low point EL. 17.66 ft of the bridge reconstructed in 2024 (Maine DOT, 2021).

Buildings Flood Exposure Summary

Buildings	1	2	3	4	5	6	7	8	9
# Impacted	10	14	16	19	24	25	28	32	50
% Impacted (%)	0.4	0.6	0.7	0.8	1.1	1.1	1.2	1.4	2.2

Critical Facilities Flood Exposure Summary

Critical Buildings	1	2	3	4	5	6	7	8	9
Blacksmith Shop (on Village Wharf)	-	-	-	Y	Y	Y	Y	Y	Y
Wastewater Treatment Facility	-	-	-	-	Y	Y	Y	Y	Y
Fire Station	-	-	-	-	-	-	-	-	-
Stavola House	-	-	-	-	-	-	-	-	-
Northern Light Blue Hill Hospital	-	-	-	-	-	-	-	-	-

Parcels Flood Exposure Summary

Parcels	1	2	3	4	5	6	7	8	9
# of Parcels Partially or Fully Inundated	349	353	357	365	367	368	372	376	391
% of Total Parcels Partially or Fully Inundated (%)	16.5	16.7	16.9	17.3	17.4	17.4	17.6	17.8	18.5
Area of Parcels Inundated (acre)	35	56	69	97	115	130	155	174	244
% of Total Parcel Area Inundated (%)	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.6

Cemeteries Flood Exposure Summary (Y/N)

Cemetery	1	2	3	4	5	6	7	8	9
Curtis	Y	Y	Y	Y	Y	Y	Y	Y	Y
Long Island	Y	Y	Y	Y	Y	Y	Y	Y	Y
Seaside	Y	Y	Y	Y	Y	Y	Y	Y	Y

Conservation Land Flood Exposure Summary

Conservation Land	1	2	3	4	5	6	7	8	9
Conservation Land (acres inundated)	12	20	25	33	38	41	47	52	69

Wells Flood Exposure Summary

Wells	1	2	3	4	5	6	7	8	9
Wells (# of locations inundated)	2	2	2	2	3	6	6	8	13

Summary of Additional Assets at Risk of Flood Inundation (Y/N)

Asset	1	2	3	4	5	6	7	8	9
Webber's Cove Boatyard (Heard Cove) *Top of Pier*	Y	Y	Y	Y	Y	Y	Y	Y	Y
Blue Hill Town Wharf *Top of Boat Ramp*	Y	Y	Y	Y	Y	Y	Y	Y	Y
Blue Hill Town Wharf *Lower Parking*	-	Y	Y	Y	Y	Y	Y	Y	Y
Kollegewidgwok Yacht Club *Top of Boat Ramp*	-	Y	Y	Y	Y	Y	Y	Y	Y
South Blue Hill Wharf *Top of Boat Ramp/Pier*	-	-	-	Y	Y	Y	Y	Y	Y
East Blue Hill Village Playground *Top of Boat Ramp*	-	-	-	Y	Y	Y	Y	Y	Y
Peter's Brook Trail Parking *Blue Hill Heritage Trust*	-	-	-	-	-	-	Y	Y	Y

Appendix C Maine DOT 2024-2025-2026 Work Plan Blue Hill

Blue Hill

This report shows the 2024-2026 Work Plan entries for Blue Hill. The costs listed are the total cost of these projects – some of which may extend into neighboring towns. It also shows a listing of maintenance work specifically recorded to Blue Hill, as well as Local Road Assistance payments. Activities that are managed on a larger scale, such as snow & ice control, and maintenance work done by contract are not listed. The maintenance accomplishments may also extend into neighboring towns but are listed in the first town where the work was reported. Finally, any capital projects that were completed in 2023 are also listed.

Planned Capital and Maintenance Work 2024-2026

Work Plan Year: **2024**
Municipalities(s): **Blue Hill**

Asset(s): **Route 15**

Description: Village Bridge (#2893) over Mill Stream. Located 0.04 of a mile northeast of Water Street.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
018728.00	Highway-Minor Spans Bridge Superstructure Replacement - PE Only	HCP 3	$380,000

Work Plan Year: **2025**
Municipalities(s): **Blue Hill**

Asset(s): **Route 15**

Description: Beginning at the Sedgwick town line and extending north 2.09 miles.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
018777.00	Highway Construction/Rehabilitation Rural Highways Highway Rehabilitation	HCP 3	$8,810,000

Work Plan Year: **2024**
Municipalities(s): **Blue Hill**

Asset(s): **Route 15**

Description: Beginning at the Sedgwick town line and extending north 2.09 miles.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
018777.10	Highway Construction/Rehabilitation Rural Highways Highway Rehabilitation	HCP 3	$400,000

Work Plan Year: **2025**
Municipalities(s): **Blue Hill**

Asset(s): **Route 15**

Description: Beginning 0.37 of a mile north of Route 172 and extending north 0.15 of a mile.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
021845.01	Highway Safety and Spot Improvements Rural Highways Drainage Improvements	HCP 3	$125,000

Work Plan Year: **2024**
Municipalities(s): **Blue Hill**

Asset(s): **Route 175**

Description: Beginning 0.22 of a mile southeast of Parker Point Road and extending southeast 0.08 of a mile.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
025655.00	Highway Safety and Spot Improvements Rural Highways Highway Improvement - PE Only	HCP 4	$105,000

Work Plan Year: **2024**
Municipalities(s): **Blue Hill**

Asset(s): **Route 172**

Description: Beginning 0.07 of a mile south of Turkey Farm Road and extending north 11.31 miles to Route 3.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
027322.00	Highway Paving Rural Highways Light Capital Paving Preservation	HCP 3	

Work Plan Year: **2025**
Municipalities(s): **Blue Hill**

Asset(s): **Route 176**

Description: Beginning at Route 3 and extending southeast 19.47 miles to Route 172.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
027816.00	Highway Paving Light Capital Paving	HCP 3, 4	

Work Plan Year: **2024**
Municipalities(s): **Blue Hill**

Asset(s): **Route 176**

Description: East Blue Hill Bridge (#3668) over McHeard Cove. Located 0.05 of a mile east of Jay Carter Road.

ID	Scope of Work	Highway Corridor Priority	Estimated Funding
028326.00	Highway-Bridges Bridge Replacement - PE Only	HCP 4	$665,000

Local Road Assistance – Fiscal Year – 2024

$56,584

Maintenance Accomplishments – 2023

Activities managed on a larger scale, such as snow & ice control, and work done by contract are not listed. *The maintenance accomplishments may extend into neighboring towns but are listed in the first town where the work was reported*.

10.00	Trees Removed
4.00	Bridge(s) Washed
14.30	Ton(s) of Patch Applied
49.50	Shoulder Miles of Mowing
44.40	Emergency Event Responses
83.10	Miles of Striping Applied
51.60	Shoulder Miles of Sweeping
1,686.00	Linear Feet of Brush Removed
9,715.00	Linear Feet of Grader Ditching
8,065.40	Linear Feet of Backhoe Ditching
6,787.40	Linear Feet of Shoulder Rebuilt
472.00	Sq Feet of Pavement Legend Applied
48.00	Minor Sign(s) Installed or Maintained
8.00	Drainage Structures Installed or Replaced
25.00	Linear Feet of Guardrail or Fence Maintained

Completed Capital Projects – 2023

024315.00	BLUE HILL, SOUTH ST. SIDEWALK Beginning 0.04 of a mile south of Bay School Drive and extending north 0.36 of a mile.