CITY COUNCIL AGENDA

AGENDA
CITY COUNCIL OF THE CITY OF BATH, MAINE
Special Meeting
Wednesday, November 20, 2024, 6:00pm

In-Person: Council Chambers, Bath City Hall, 55 Front Street
Television: BCTV Channel 14
Live Stream: BCTV 14 (castus.tv)
ZOOM: https://us02web.zoom.us/j/87604874516

Call to Order

Pledge of Allegiance

Roll Call

Manager's Report

New Business

2024-118) Order: Approving Climate Action Plan

2024-119) Order: Approving City Manager Contract

2024-120) Order: Extending term of contract with Ubicquia

2024-121) Ordinance: Approving pole attachment agreement with Ubicquia

2024-122) Ordinance: 150 Congress Avenue Contract Zoning

Executive Session

Personnel per 1 MRS §405(6)(A)

Adjournment

NEW BUSINESS

For Clerks Use Only

11/20/2024 | 2024-118

Meeting Date | Item No.

CITY COUNCIL ACTION

Requested Council Meeting Date: November 20 , 2024

Responsible Dept: Sustainability and Enviroment

Requested Action: Resolution

Title

Approval and adoption of the Resilient Bath Climate Action and Resiliency Plan

Summary

The Climate Action Commission is following up on the 2022 City Council's Climate Resolution and a major goal expressed in the 2023 Comprehensive Plan, to conduct a climate action plan process that will provide guidance for the community in navigating a changing climate.

The overall intent of this effort is to serve as the communities first comprehensive climate plan that draws upon past City planning efforts, includes the 2022 adopted climate resolution and the State's 'Maine Won't Wait' Climate Action Plan, affirms community goals through targeted community engagement, provides a detailed list of community actions, and develops a framework for monitoring the implementation of recommended actions.

The plan reflects the community process that heavily relied upon the broader community to identify high priority implementation actions. We have already begun to see how this plan may serve the community, in partner organization support, policy decision making, and enhancing our position for future funding opportunities. It strives to be more than a plan that 'sits on a shelf' by incorporating a recognizable brand, that we believe enables prolonged community engagement during plan implementation.

Key milestones are identified, and an update to the GHG inventory should be conducted at the 5 year mark. With continued oversight, the Resilient Bath Plan will guide our city in reducing greenhouse gas emissions, transitioning to renewable energy, enhancing energy efficiency, and implementing sustainable practices across all sectors.

Staff Comments

Per the 2022 Climate Resolution and 2023 Comprehensive Plan, the Climate Action Commission met on November 7th, 2024 and unanimously voted to recommend the adoption of the Resilient Bath Climate Action and Resiliency Plan.

Action: Recommend for passage

City Manager

Introduced for: New Business

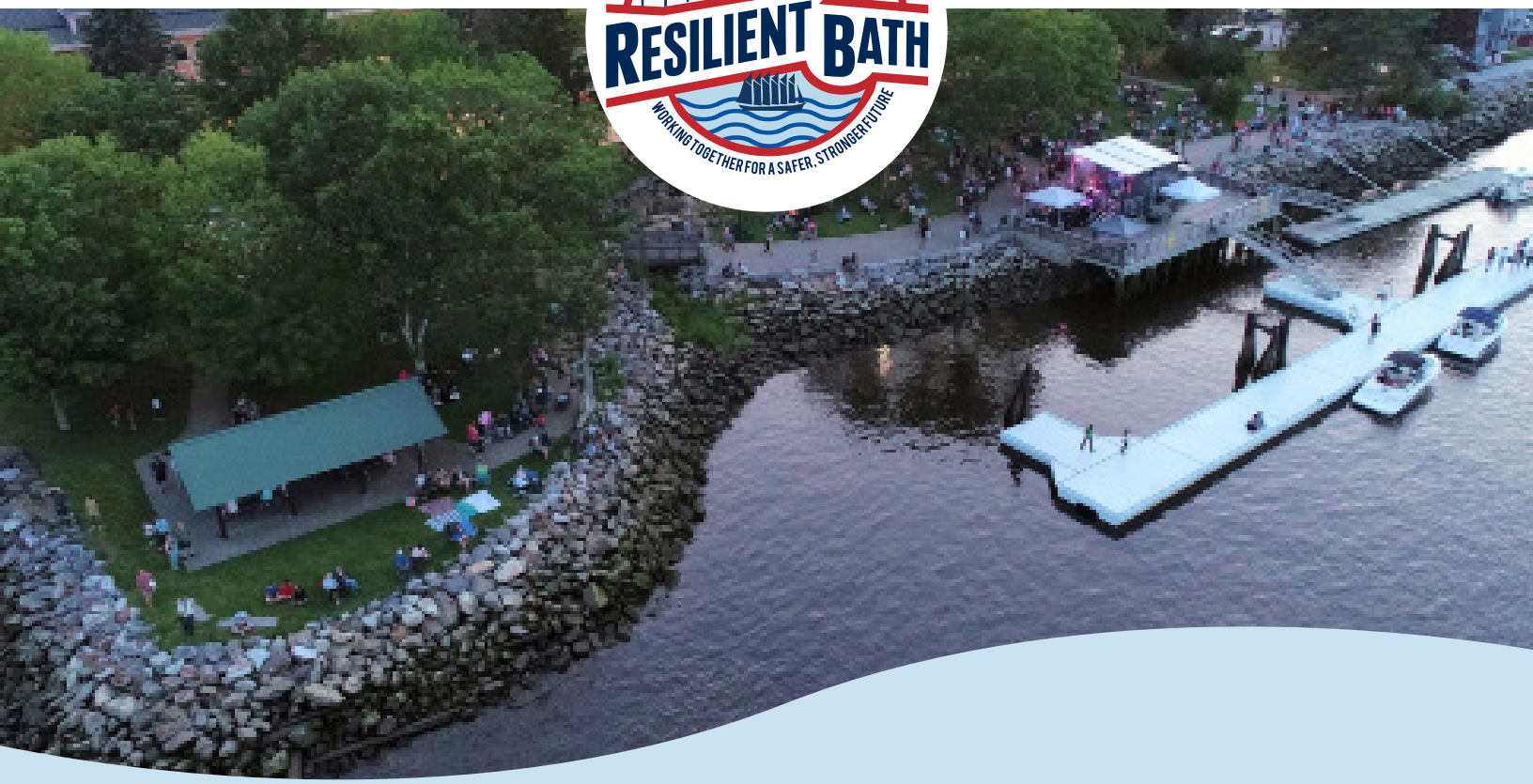
For Clerks Use Only

CITY OF BATH

Date:

Approval and adoption of the Resilient Bath Climate Action and Resiliency Plan

BE IT RESOLVED by the City Council of the City of Bath that the Resilient Bath Climate Action and Resiliency Plan be and is hereby approved and adopted to take effect as of this date, November 20, 2024.



OCTOBER 2024

Resilient Bath

Climate Action & Resiliency Plan


HUFFY

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Letter from the City Manager

As the City Manager of Bath, I am pleased to present *Resilient Bath*, the City's Climate Action & Resiliency Plan, a vital step toward ensuring a sustainable future for our community. It is imperative that we take proactive measures to safeguard our environment and enhance the quality of life for all Bath residents.

Our community has become remarkably familiar with the consequences of an intensifying climate. The recent consecutive flooding events in 2023 and 2024 serve a reminder that climate impacts come at significant cost and with opportunities to learn, adapt and improve. *Resilient Bath* brings focus to these changing realities. This plan also builds upon our community's strengths.

Resilient Bath outlines specific strategies to reduce greenhouse gas emissions, improve energy efficiency, and promote sustainable practices throughout our city. Extensive efforts were made to ensure voices from all our community members are heard in this plan. You will find these voices reflected in each of the plan's objectives.

Key initiatives include:

- **Renewable Energy Transition:** Advancing the use of renewable energy sources, such as solar and wind, for municipal facilities and our community.
- **Energy Efficiency Programs:** Aiming to implement energy-saving measures in municipal buildings and provide resources to help residents and businesses improve the performance of their buildings.
- **Transportation Initiatives:** Enhancing public transit options, promoting electric vehicles, and developing safe pedestrian and cycling infrastructure.
- **Community Engagement:** Encouraging the involvement of all residents by hosting workshops, provide resources, and calling for participation in sustainability initiatives.
- **Resilience Planning:** Assessing and enhancing our infrastructure to withstand the effects of rising sea levels and increasing storm intensity.

Resilient Bath charts a future rich in community, passion and dedication to the greater good. We are proud of this plan and look forward to working alongside everyone willing to help our community achieve the important goals set out in the plan. This city's strengths and momentum, evidenced throughout the development of the plan, give us confidence we can and will move the plan forward.

Marc Meyers
City Manager

Letter from the Climate Action Commission

Climate change threatens our way of life. If humanity does not act to counter this threat over the coming decades, sea level rise could turn Bath's downtown into an island by the end of this century, make low lying roads impassable, and put coastal properties at risk. Summer heat and storm events may become more frequent and intense, mosquito- and tick-borne diseases more prevalent, and our fishing, agricultural, and tourism industries greatly stressed. It is not a future any of us want. To prepare to meet these challenges, and thanks to expert support from team members at Kim Lundgren Associates and Siler Climate Consulting, we are proud to present an updated climate action plan: *Resilient Bath*.

Resilient Bath charts a course to a safe and sustainable future for Bath. The result of extensive research, community engagement, and collaboration with stakeholders throughout our City, it specifies actions to make our community more resilient to climate impacts, to lower the collective carbon emissions which are the root cause of climate change, to enhance the overall quality of life in Bath, and to preserve a robust and thriving economy. *Resilient Bath* emphasizes the role that each of us has to play by offering productive actions for every segment of our community, including residential, commercial, industrial, government, and non-profit sectors.

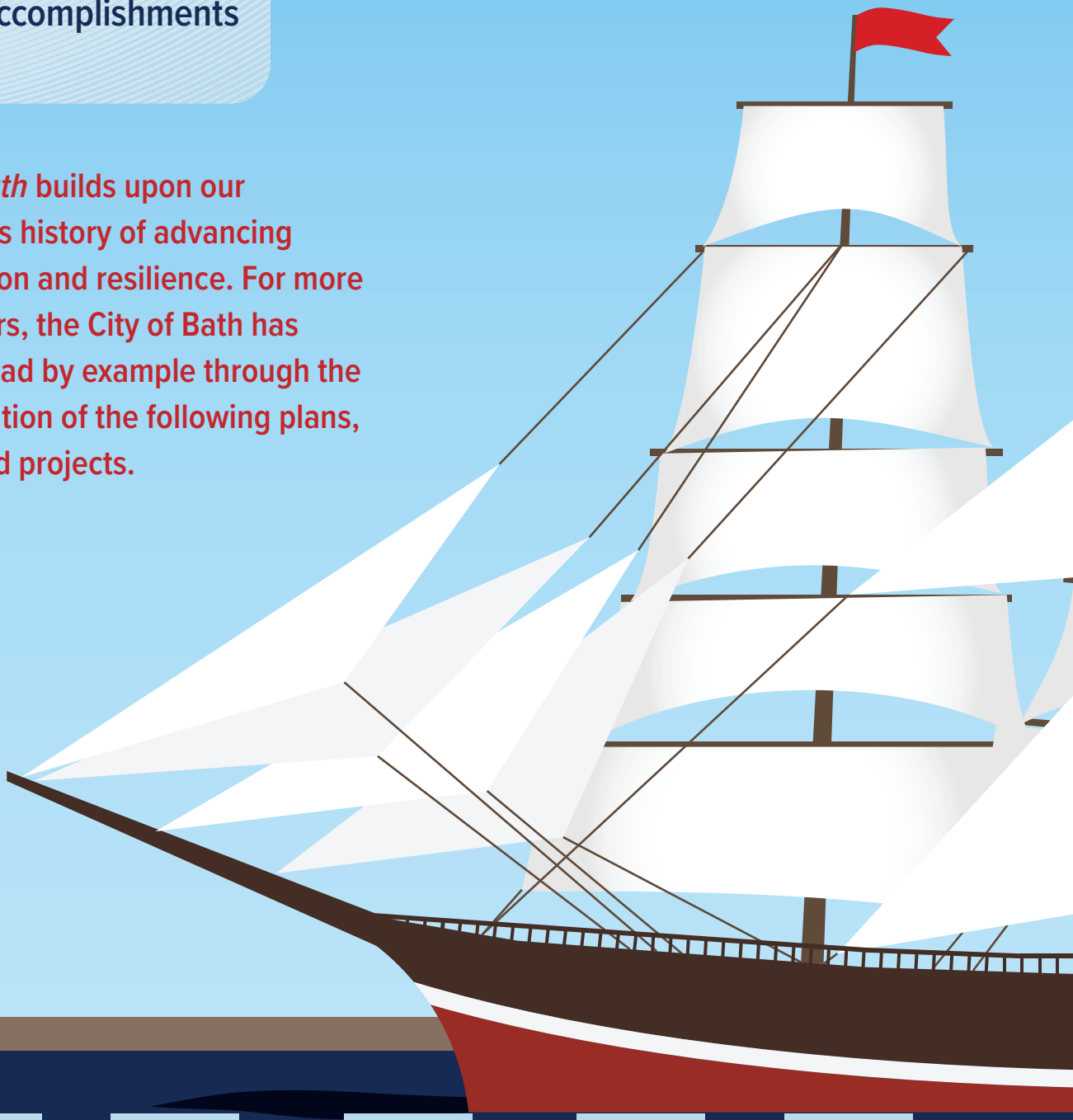
We extend our thanks to the many contributors to *Resilient Bath*. Your dedication to the well-being of our City has culminated in a plan based in science and guided by a wish to leave a lasting legacy for future generations.

No plan is successful until it is actually implemented. We invite you to review *Resilient Bath* for detailed strategies and implementation steps. Our task now is to work together to act on these strategies, drawing on our collective ingenuity, vision, strength, and determination to ensure a resilient and bright future for our community.

Paul Perkins and John Zittel
Bath Climate Action Commission, Co-Chairs

Action & Accomplishments to Date

Resilient Bath **builds upon our community's history of advancing climate action and resilience. For more than 15 years, the City of Bath has sought to lead by example through the implementation of the following plans, policies, and projects.**



2008

Bath completes its first greenhouse gas (GHG) inventory and action plan.

2011

Bath conducts energy audits at municipal facilities to identify opportunities to improve building efficiency.

2013

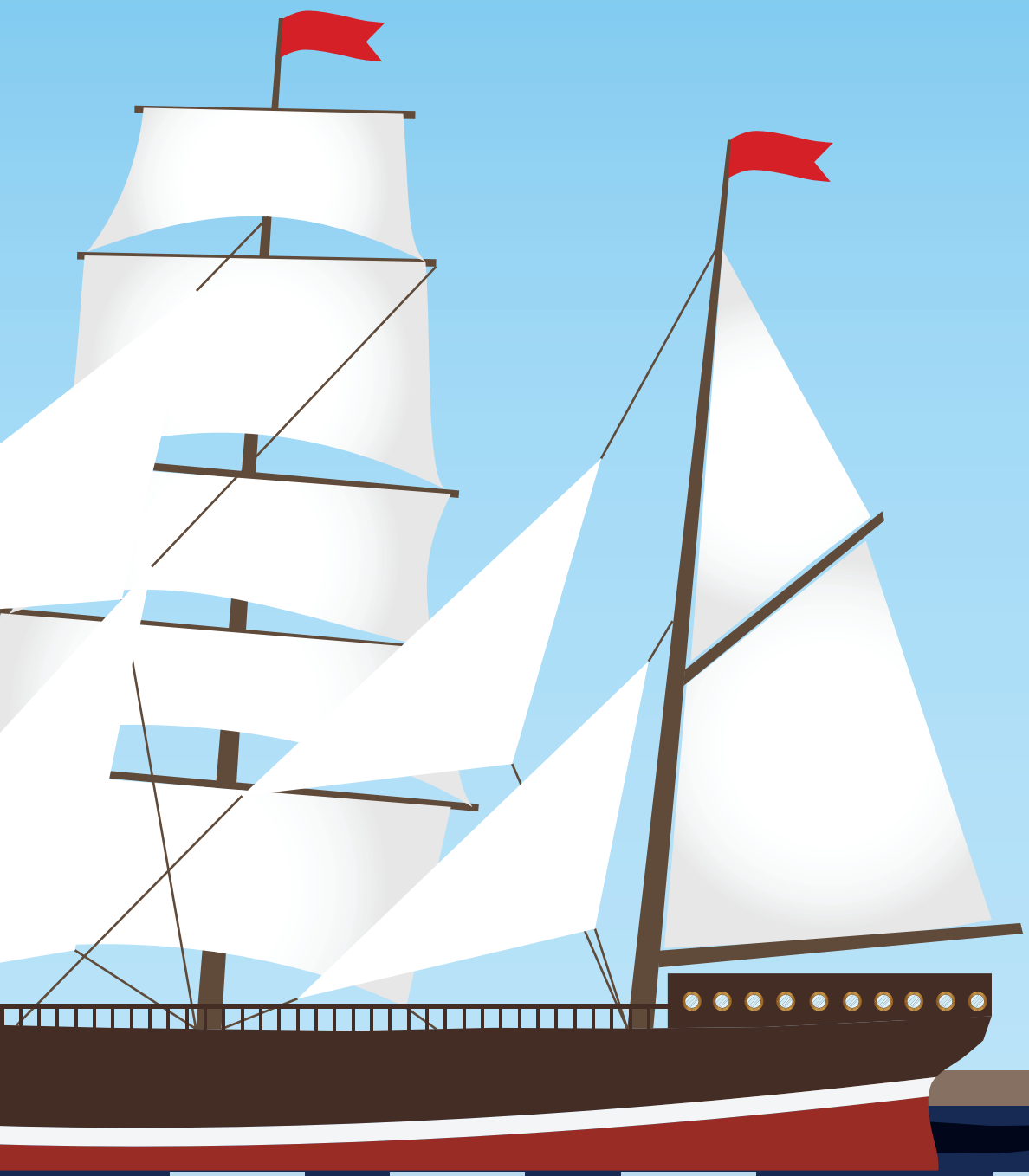
Bath engages in a regional sea level rise study and delivers a report to the State showing potential impacts to the community.

2014

Design and Resiliency Team (DART) strategy is created for the downtown and waterfront to address sea level rise and inform future development projects.

2019

City Adopts its first climate resolution and establishes the Climate Action Commission



2021

First public electric vehicle (EV) charging station is installed in Bath.

2022

Bath update Climat Resolution to align with the State's *Maine Wont Wait* Plan

2022

Bath's Office of Sustainability & Environment is created. Bath City Council updates Bath's Climate Resolution. Climate Action Commission initiates the Window Dresser Community Build Program to provide a low-cost home insulation method to reduce energy use and heating costs.

2023

City initiates projects to: convert streetlights to LEDs; install four EV charging stations at the Patten Free Library; report on Bath's vulnerability to flooding and sea level rise; conduct facilities planning to ultimately remove fossil fuel HVAC systems in City facilities; permit the capped landfill solar project.

2024

RESILIENT BATH

Bath launches *Resilient Bath*, its first comprehensive Climate Action & Resiliency Plan.

Creating a Resilient Bath

When faced with challenges, our community remains strong: this is Bath. As a city that still builds ships on the same river as we did 200 years ago, resilience has always been a part of our community. With the *Resilient Bath Climate Action & Resiliency Plan*, we chart our course towards a safer, stronger future for everyone.

The impacts of climate change are nothing new to Bath residents; we have all experienced more intense storms, increased flooding, and unprecedented seasonal temperature changes in our community. By implementing the *Resilient Bath Plan*, we have a collective opportunity to build resilience to these impacts while continuing to reduce our climate pollution and invest in clean energy.

Our city never backs down from a challenge—let's move forward, together.

Working Together for a Safer, Stronger Future

Bath has already set a high bar for climate action in Maine, and now is our opportunity to strengthen our community and build on our legacy of climate leadership. The *Resilient Bath Plan* includes smart, practical strategies and actions to continue our path towards a more sustainable and resilient future. Our approach and methods of implementing those strategies and actions will be guided by the core values of our community.

Five Guiding Principles were selected to shape the planning process and establish priorities for implementing the *Resilient Bath Plan*:

1 GREENHOUSE GAS EMISSIONS REDUCTION

Minimizing Bath's contribution to climate change by reducing GHG emissions, the primary type of pollution causing climate change.

2 EQUITY AND INCLUSION

Addressing challenges that disproportionately affect underrepresented communities and prioritizing opportunities that benefit them.

3 ECONOMIC VITALITY

Proactively reducing current and future economic impacts due to climate shocks and stressors.

4 GOOD GOVERNANCE

Ensuring honesty and transparency around the allocation of the City's resources and promoting ongoing communication and collaboration between City departments.

5 SOCIAL, ECONOMIC, & ENVIRONMENTAL RESILIENCE

Increasing the capacity of social, economic, and natural systems to thrive in the face of climate impacts.

Climate Impacts in Bath

Climate change is real and we are already seeing the impacts. The good news, however, is that there is so much our community can do to collectively take action and prepare for both extreme weather events and long-term climate impacts, such as sea level rise.

In the State of Maine, we know that:

Our climate is getting warmer.

As global temperatures rise, summers are getting longer and winters are getting shorter. In Maine, the last four years were among the ten warmest years on record.[3]

Our climate is getting wetter.

When compared to historic averages, Maine now receives 1–2 additional days per year with 2+ inches of precipitation, and 2–3 more days per year with 1 inch of precipitation.[5]

Sea levels are rising and flooding is occurring more frequently.

For present-day sea levels, approximately 1.1 miles of roadways, 44 residential buildings, 4 pump stations, and 146.2 acres of wetland will likely be inundated during combined 1% annual chance ("100-year") coastal storms and riverine events.[4]

We will experience more intense and extreme weather on both ends of the spectrum.

Precipitation variability is increasing and has recently produced impactful seasonal extremes; for example, the 2020 growing season was the driest on record while the summer of 2023 was the wettest.[6]

Responding to the Challenge

These climate impacts will affect all areas of our lives, from our health and the stability of our coastline to the cost of energy and home insurance and our tourism industry. In *Maine Won't Wait*, the State's four-year climate action plan, the State outlines numerous recommendations for how communities can mitigate and manage these impacts. In alignment with that plan, the City of Bath affirmed and committed to the following goals through its 2022 Climate Action Resolution.

1. **ACHIEVE CARBON NEUTRALITY BY 2045,** which means that the City will make no net contribution to GHG emissions by reducing emissions and enhancing tree coverage within Bath and beyond.
2. Reduce GHG emissions **80%** by 2050.
3. Commit to manage sea level rise of **1.5 FEET BY 2050 AND 3.9 FEET BY 2100,** as aligned with the "Intermediate-Low Scenario" projected for sea level rise along Maine's coastline.[1]
4. Prepare to manage sea level rise of **3.0 FEET BY 2050 AND 8.8 FEET BY 2100,** as aligned with the "High Scenario" projected for sea level rise along Maine's coastline.[2]

Our Pathway to Achieve Carbon Neutrality

Climate change is happening due to increases in greenhouse gas (GHG) emissions, such as carbon dioxide and methane, which trap heat in our atmosphere. These emissions are created through everyday activities such as burning fossil fuels, like gasoline and natural gas, to power our cars and homes and sending waste to decompose in landfills. Reducing Bath's contribution to climate change means reducing our GHG emissions. As a first step, Bath conducted an updated community-wide GHG inventory to identify the sources of these emissions and our greatest opportunities to reduce them. This inventory provided the foundation for many of the high-impact strategies and actions in the *Resilient Bath Plan*.

In 2022, Bath generated 87,658 metric tons of GHG emissions, measured as metric tons of carbon dioxide equivalent ($MTCO_2e$), across both public and private sectors (11% below 2018 emissions levels, mostly as a result of cleaner electricity).[7] The largest single source of GHGs is attributable to energy used in Bath Iron Works industrial facilities in the city limits (40%). Energy used in residential and commercial buildings for lighting, heating, cooling, and powering appliances and devices accounts for the next largest share (39%). Transportation, primarily from private gasoline-powered vehicle trips, accounts for the third largest source of emissions (19%). Solid waste sent to the landfill accounts for most of the remaining emissions (2%), with small contributions from composted organic waste, water and wastewater treatment processes, and upstream losses from grid electricity.

Bath's 2022 Community GHG Emissions by Sector[8]

27% / 23,416 $MTCO_2e$
RESIDENTIAL BUILDINGS

12% / 10,201 $MTCO_2e$
COMMERCIAL BUILDINGS

40% / 34,990 $MTCO_2e$
INDUSTRIAL ENERGY

19% / 16,775 $MTCO_2e$
TRANSPORTATION

2% / 1,727 $MTCO_2e$
SOLID WASTE

1% / 584 $MTCO_2e$
WATER AND WASTEWATER

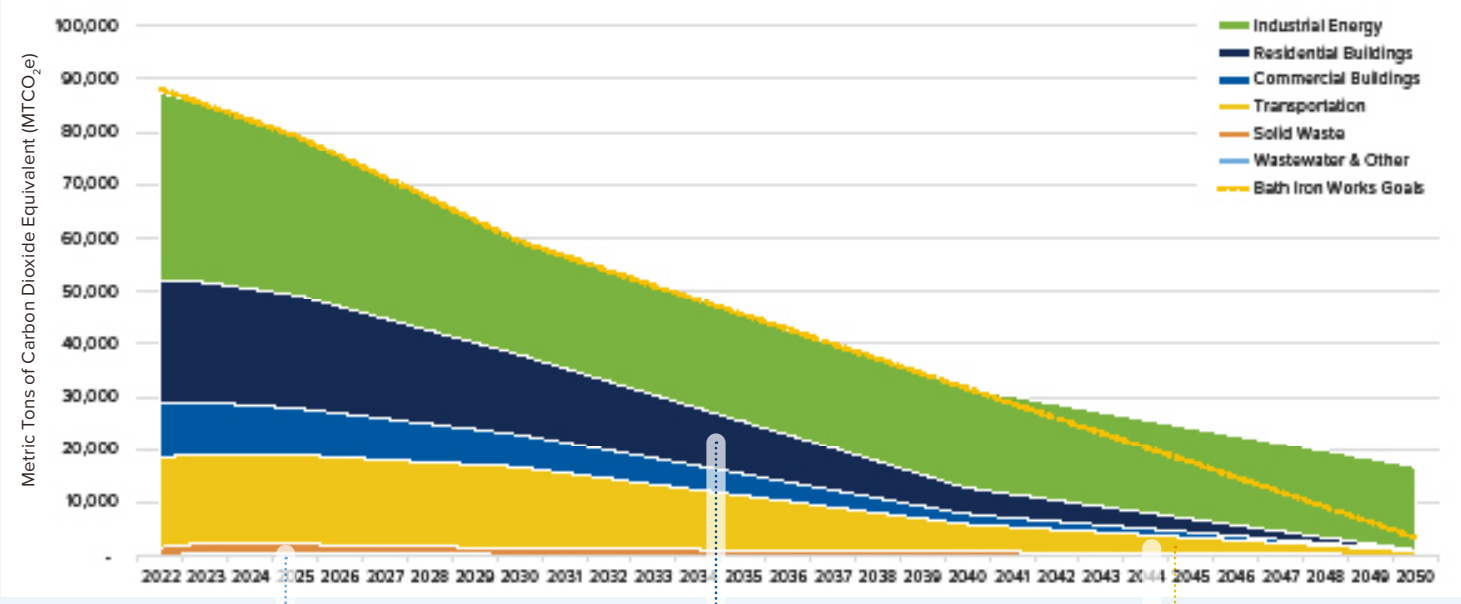
TOTAL
87,658 $MTCO_2e$

Note: Percentages do not add up to 100% due to rounding.

We can rapidly and aggressively reduce GHG emissions in Bath by transforming our buildings, transportation, and industrial systems to be as clean and efficient as possible. The strategies outlined in the *Resilient Bath Plan* are designed to put Bath on a path to achieving an 80% reduction by 2050 and carbon neutrality by 2045, as aligned with the State's reduction goals.

Bath's Pathways Analysis[9] models these opportunities; the wedges in the graph below illustrate the reductions in GHG emissions that can be realized over time as high-impact strategies and actions are implemented. Industrial energy is a major contributor and General Dynamics, the parent company of Bath Iron Works, has corporate targets to reduce GHG emissions 40% by 2034 from a 2019 baseline.[10] It is expected that the transition to cleaner renewable electricity will help meet those targets in the short term. The yellow dashed line illustrates the trajectory that Bath Iron Works could take to reduce emissions, though new technologies and other mechanisms may be needed to realize it.

Pathways to Zero[11]



REDUCE & DIVERT SOLID WASTE

Between now and 2050, we need to steadily increase diversion rates to ultimately reach 90%, the threshold for "zero waste." This means composting organic waste (e.g., food waste), reducing our use of plastics and other non-recyclables, and preventing as much waste as possible from being landfilled by reducing our overall consumption.

ELECTRIFY BUILDINGS & PURSUE EFFICIENCY

To rapidly reduce emissions, we must eliminate the direct use of fossil fuels for heating, cooking, and other uses in both residential and commercial buildings. All electrification efforts should be accompanied by high efficiency retrofits to minimize the demand for new renewable energy.

ELECTRIFY TRANSPORTATION & SHIFT TO ALTERNATIVE MODES

To tackle emissions from the transportation sector, we will need to shift to alternative modes of transportation including biking, walking, public transit, and EVs. Vehicle electrification must be accompanied by the shift from private vehicle trips to increased transit use and alternative mobility options to minimize future electricity demands.

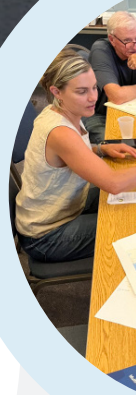
Eliminating the emissions that are currently projected to remain in 2050 will need to come from innovative technologies, improvements, and efficiencies in heavy-duty vehicles and large industry and equipment—primarily within the operations of Bath Iron Works.

Community Priorities & Perspectives

In Bath and around the world, the impacts of climate change are not evenly distributed. Climate hazards disproportionately affect marginalized and vulnerable people—including low-income communities, communities of color, older adults, children, and persons with disabilities—who often lack resources to prepare for and recover from climate-related disasters. The City of Bath is committed to conducting inclusive engagement across planning initiatives. *Resilient Bath* was no exception. Participation and input from community members, residents, and City staff were critical to shaping this plan.

The approach to engagement was unique and had three core goals.

1. Engage a wide and diverse audience across the community and City staff. The team identified and intentionally engaged populations in Bath who will likely be disproportionally impacted by climate change, including youth, low-income residents, renters, and residents living along the coast.
2. Build capacity for community members and staff to act on climate change in their own lives and support *Resilient Bath* implementation efforts.
3. Grow literacy about climate change.



Resilient Bath Advisory Group

25 Members

Understanding the needs of the people most impacted by climate change is vital to ensure the health and safety of everyone in our community. Equity considerations were identified by the *Resilient Bath* Advisory Group as they developed the plan's goals, strategies, and actions, and Implementation Blueprints.

Climate Action Commission/ Communications Training

5 Participants

The *Resilient Bath* team hosted a training with the Climate Action Commission to build skills and capacity to translate complex climate materials into accessible terms for their colleagues, friends, family, and neighbors.

Upper Washington Coastal Resilience Workshop

35 Participants

The City hosted a neighborhood-scale coastal resilience meeting in the Upper Washington neighborhood.

Climate Action Plan Tabling

The City tabled about the climate action plan at several events including Winterfest 2024, July 4th Heritage Days, and Saturday Farmers Markets.

Downtown Coastal Resilience Workshop

40 Participants

The City hosted a coastal resilience workshop focused on downtown geographies to discuss the results of the City's vulnerability assessment and discuss strategies and opportunities for adapting to these future scenarios.

Resilient Bath Workshop

40 Participants

In collaboration with Bath Public Schools, the Climate Action commission hosted a community-wide workshop to share the goals, strategies, and actions with residents and gather feedback.

Climate Action Survey

150 Responses

The City conducted a community-wide survey to identify barriers to climate action and opportunities for impact that helped shape the final plan. For example, residents cited "receiving emergency information and alerts" and "safely evacuating" as top concerns during extreme weather events, which informed several emergency preparedness actions under Goal 2 of the Resilient & Healthy Community section of the plan.

Renter and Landlord Targeted Surveys

5 responses from renters
5 responses from landlords

In partnership with Midcoast Maine Community Action and Bath Housing, the City engaged in targeted outreach to both renters and landlords to understand the unique opportunities and challenges that both of these groups will face in taking climate action.

Our Action Plan

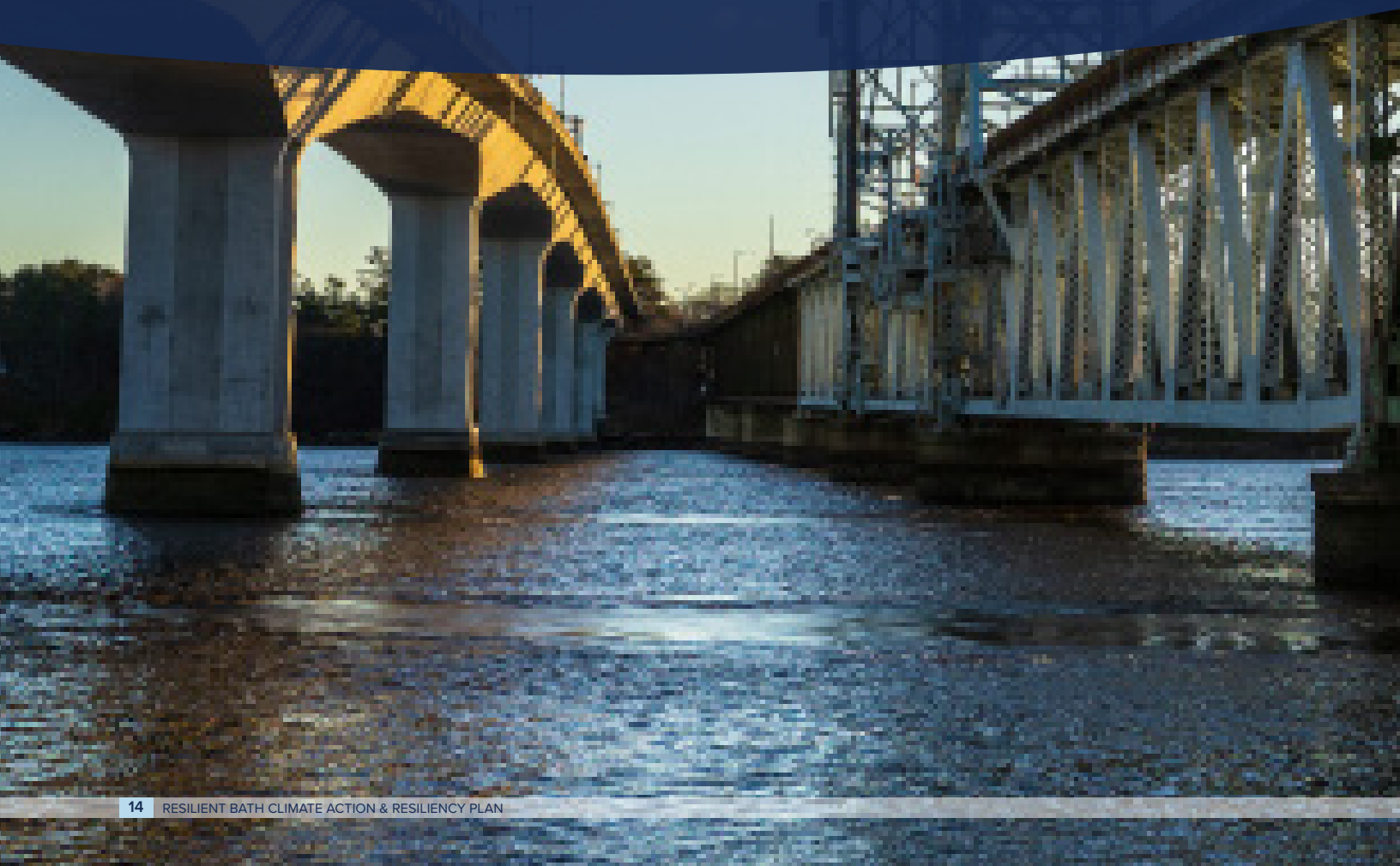
Achieving our climate action goals will ultimately require active engagement from all levels of City government and our community. There are two main ways we can address climate change in Bath:

1

REDUCE OUR GREENHOUSE GAS (GHG) EMISSIONS, the primary pollutants disrupting our climate.

2

ADAPT TO THE IMPACTS OF CLIMATE CHANGE, that we are already seeing and feeling and will continue to experience in the future.



Focus Areas

The goals, strategies, and actions in the *Resilient Bath Plan* are organized into five key focus areas that represent the greatest areas of opportunity for addressing climate change:

CLEAN ENERGY AND EFFICIENT BUILDINGS

RESILIENT AND HEALTHY COMMUNITY

CONNECTED TRANSPORTATION AND MOBILITY

VIBRANT NATURAL RESOURCES

SMART WASTE AND WATER MANAGEMENT

Implementation Approach & Timeline

The actions identified for each focus area are intended to be implemented within the next five to 10 years and will put Bath on the path to achieving its 2045, 2050, and 2100 climate actions goals.

To streamline and facilitate the execution of the plan, implementation blueprints were developed for 10 priority actions. These blueprints were developed with the identified champions during the advisory group process, and are intended to serve as a template for action, and their ability to be easily duplicated for other action items within the plan.

Considering how quickly technology and our climate are changing, action items within this plan should be reviewed and prioritized based upon the availability of resources to conduct thorough implementation. This includes staff and community capacity, availability of funding opportunities, and complexity of the action item.Since the community-wide GHG inventory will not be updated more than every five years (and does not indicate progress on resilience-related goals), tracking the performance metrics identified for each focus area can help the City to measure progress on its goals more frequently. The City will report progress to the community on an annual basis.

RESILIENT BATH

WHAT'S INCLUDED

- ☑ Electrification
- ☑ Energy efficiency
- ☑ Renewable energy
- ☑ Energy resilience

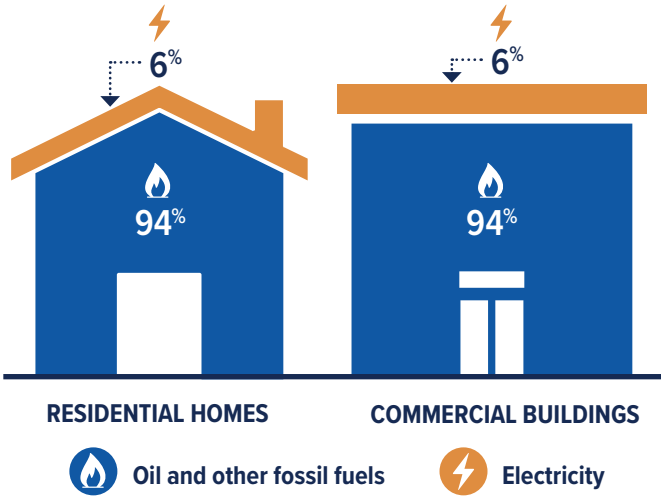
Clean Energy & Efficient Buildings

Vision: Bath minimizes greenhouse gas emissions through improved building energy performance and expanding renewable energy capacity.

BY THE NUMBERS

Energy use in residential and commercial buildings is a substantial share of our emissions at 39%. Scaling up local renewable energy production, pursuing high-efficiency retrofits, and electrifying our homes, businesses, and municipal buildings are Bath's greatest opportunities to reduce GHG emissions. Bath Iron Works accounts for an additional 40% of community GHG emissions through industrial energy use; its parent company, General Dynamics, has plans to reduce emissions through high-efficiency energy retrofits and investments in renewable energy.

Heating Fuels Used in Bath's Buildings[14]



TRACKING PROGRESS

The following metrics will help Bath to track and measure progress toward its goals for Clean Energy & Efficient Buildings. Additional metrics should be identified and reported to provide a more complete picture of progress.

PERFORMANCE METRIC	BASELINE YEAR	2030 TARGET	2040 TARGET	2050 TARGET
Share of Electrified and Energy Efficient Residential Buildings	6% (2023)[12]	60%	80%	100%
Share of Electrified and Energy Efficient Commercial Buildings	6% (2023)[13]	60%	80%	100%
Installed Solar Capacity (MW)	New Metric	15	16	20
Share of Electrified and Energy Efficient Industrial Buildings	New Metric	60%	80%	100%

TAKE ACTION

Enroll in the Maine Green Power electricity program or join a community solar farm to reduce your carbon footprint and support clean energy projects.

ENROLL TODAY

Action Table

The *Resilient Bath* planning process identified the following goals, strategies, and actions for Clean Energy & Efficient Buildings.

GOAL 1	**Buildings in Bath are energy efficient and minimize greenhouse gas emissions.**
STRATEGY 1.1	**Electrify and retrofit existing residential and commercial buildings.**
EB 1.1.A	Continue outreach and education campaigns to support residents and businesses with navigating electrification and efficiency resources and incentives.
EB 1.1.B	Create additional incentive bonus for residents who pursue electrification and weatherization projects.
EB 1.1.C	Create a voluntary rental energy labeling program to spur efficiency investments by landlords, integrating with State Renter Disclosure Request Process.
EB 1.1.D	Establish dedicated resources for low-cost/low-barrier programs like window inserts for homes and rental properties that are difficult to electrify.
EB 1.1.E	Update permitting processes to record comprehensive energy system information (e.g., battery capacity, heating system) with property records.
STRATEGY 1.2	**Create efficiency and electrification standards for new buildings and major renovations.**
EB 1.2.A	Establish expedited zoning and permitting processes for new construction and major renovations incorporating on-site renewable energy and storage.
EB 1.2.B	Adopt the MUBEC Stretch Code aligning with 2021 IECC design standards.

GOAL 2	**Bath achieves enhanced renewable energy capacity and energy resilience.**
STRATEGY 2.1	**Increase energy productivity and integrate innovative renewable energy solutions.**
EB 2.1.A	Determine feasibility of transitioning downtown district heating to networked geothermal.
EB 2.1.B	Pursue backup batteries at critical facilities and large solar projects and leverage peak demand cost savings.
EB 2.1.C	Collaborate with Bath Iron Works to identify opportunities for clean energy use.
STRATEGY 2.2	**Expand renewable energy capacity across the community.**
EB 2.2.A	Develop zoning allowances for large solar and storage developments, prioritizing underutilized sites such as large surface parking areas and brownfields.
EB 2.2.B	Develop model projects for shared ownership of renewable energy systems across property lines.

WHAT'S INCLUDED

- ☑ Electric vehicles (EVs) and charging infrastructure
- ☑ Public transportation
- ☑ Active mobility (e.g., walking, biking)
- ☑ Alternative low-carbon fuels

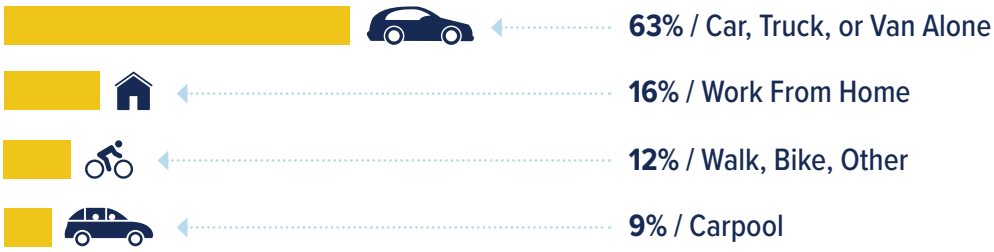
Connected Transportation & Mobility

Vision: Bath accelerates the transition to electric vehicles and connected, sustainable mobility options.

BY THE NUMBERS

Transportation accounts for close to 20% of Bath's GHG emissions, most of which (92%) are generated from personal gas-powered vehicles. Reducing our vehicle miles traveled (VMT) and transforming how we get around are crucial steps to protecting our climate. By electrifying our vehicles and expanding access to walking, biking, and public transit, Bath can reduce emissions, improve local air quality, and create a well-connected, sustainable community.

How the Bath Community Commutes[19]



Almost 20%
of Bath's GHG emissions comes from transportation.

TRACKING PROGRESS

The following metrics will help Bath to track and measure progress toward its goals for Connected Transportation & Mobility. Additional metrics should be identified and reported to provide a more complete picture of progress.

PERFORMANCE METRIC	BASELINE YEAR	2030 TARGET	2040 TARGET	2050 TARGET
Share of Light-Duty Vehicles Electrified	New Metric	20%	80%	100%
Share of Heavy-Duty Vehicles Electrified	New Metric	10%	45%	80%
Public EV Charging Ports	10 (2024)[15]	87	229	290
Average Daily Vehicle Miles Traveled per Household	33 (2017)[16]	26	20	20[17]
Annual Bath CityBus Ridership	17,153 (2024)[18]	Monitor and set targets to increase		

TAKE ACTION

Efficiency Maine offers rebates to residents who purchase electric vehicles. See if you qualify and learn how to stack these rebates with federal tax credits.

MAKE YOUR NEXT VEHICLE AN EV

Action Table

The *Resilient Bath* planning process identified the following goals, strategies, and actions for Connected Transportation & Mobility.

GOAL 1	**Bath is a model for clean transportation options.**
STRATEGY 1.1	**Accelerate the transition to alternative fuel vehicles.**
TM 1.1.A	Develop an electric vehicle transition plan for the City's fleet that considers operational requirements of vehicles and availability of suitable models.
TM 1.1.B	Partner with Bath CityBus to identify and apply for state and federal grant programs to transition the Bath CityBus system to an alternative fuel option, as available and feasible.
TM 1.1.C	Partner with Maine Clean Communities to conduct a public education campaign to encourage community members to purchase an electric or hybrid vehicle as their next vehicle.
STRATEGY 1.2	**Increase charging infrastructure for EVs.**
TM 1.2.A	Identify priority locations and install metered EV charging stations for public lots and street parking.
TM 1.2.B	Work with commercial property owners to educate them about available incentives to install EV charging stations for local and tourism benefits.

GOAL 2	**Bath community members have more options for sustainable and safe travel.**
STRATEGY 2.1	**Increase the use of active mobility options.**
TM 2.1.A	Conduct a robust Complete Streets/Active Transportation planning effort to identify community needs, feasible locations, and funding opportunities to develop corridors that support pedestrians and bicyclists.
TM 2.1.B	Collaborate regionally and with state agencies to connect Bath bicycle and pedestrian trails to other community trails, such as the A2K Trail.
TM 2.1.C	Create an e-bike rebate and/or lending program.
TM 2.1.D	Create an incentive program to encourage City employees to walk, bike, carpool, or use more forms of public transportation for their daily commute.
STRATEGY 2.2	**Enhance and promote transit services.**
TM 2.2.A	Partner with CityBus to expand service to regional destinations, such as the Brunswick Metro BREEZ station.
TM 2.2.B	Promote existing on-demand Bath CityBus service and communicate upcoming service changes and expansions with the public.

WHAT'S INCLUDED

- ☑ Resilient infrastructure
- ☑ Emergency preparedness, management, and communications
- ☑ Access to resources and services
- ☑ Affordable and sustainable housing

Resilient & Healthy Community

Vision: Bath is prepared for climate impacts with resilient neighborhoods, accessible resources, and affordable housing.

BY THE NUMBERS

Climate impacts like severe flooding, intense storms, and extreme heat all present serious threats to the Bath community. The City seeks to build resilience to these impacts through enhancing emergency preparedness, communications and education, and improving the local network of emergency resources and services for community members. Building climate resilience ensures that the Bath community's health and wellbeing are safeguarded for years to come.

15 flood scenarios
were evaluated for the City's Flood Vulnerability Assessment to determine locations and infrastructure most at risk.[24]

2-4˚ F increase
in temperature has been projected for Maine by 2050.[25]

TRACKING PROGRESS

The following metrics will help Bath to track and measure progress toward its goals for Resilient & Health Community. Additional metrics should be identified and reported to provide a more complete picture of progress.

PERFORMANCE METRIC	BASELINE YEAR	2030 TARGET	2040 TARGET	2050 TARGET
Energy Cost Burden of Low-Income Households	10% (2022)[20]	5%[21]	0%	0%
Households with Central AC	9% (2023)[22]	30%	80%	100%
Heat-Related ER Visits in Sagadahoc County	4 (2019)[23]	Monitor and Set Targets to increase		
Miles of Inundated Roads Due to Flooding	2.8 (2022)[4]	Monitor and Set Targets to increase		

TAKE ACTION

The General Assistance Program offers financial assistance for Bath residents unable to access their basic needs (e.g., food, shelter, fuel, electricity).

LEARN MORE

Action Table

The *Resilient Bath* planning process identified the following goals, strategies, and actions for Resilient & Healthy Community.

GOAL 1	**The City leverages climate data and hazard mitigation best practices for infrastructure and neighborhood planning.**
STRATEGY 1.1	**Ensure community infrastructure and households are resilient to climate hazards.**
CO 1.1.A	Develop resilience requirements for new structures within flood zones and/or predicted areas of sea level rise.
CO 1.1.B	Launch a "cool block" pilot program to install features such as white and green roofs, lighter pavement, and/or shade trees in neighborhoods and new developments.
CO 1.1.C	Through additional planning, identify design scenarios for protecting prioritized critical infrastructure identified in the vulnerability assessment.
CO 1.1.D	Conduct an outreach campaign targeting residents and businesses to improve understanding of flood risk and flood prevention measures.

GOAL 2	**The Bath community understands climate change and has tools and resources to stay safe during climate events.**
STRATEGY 2.1	**Ensure community members have resources to prepare for and respond to climate hazards.**
CO 2.1.A	Launch an inclusive climate preparedness campaign that provides information, resources, and sign-ups for emergency alerts for residents, businesses, and visitors.
CO 2.1.B	Establish neighborhood emergency response teams to prioritize preparedness and wellbeing of vulnerable residents.
CO 2.1.C	Support a resilience hub that can serve for tactical response during and after climate events.

GOAL 3	**Housing in Bath is affordable and climate-ready.**
STRATEGY 3.1	**Facilitate the development and maintenance of affordable and climate-ready housing.**
CO 3.1.A	Develop an incentive program for landlords to improve the quality and sustainability of rental units in exchange for deeded income restriction.
CO 3.1.B	Promote affordable housing through zoning changes such as an inclusionary zoning ordinance or density bonus.
CO 3.1.C	Create a local Housing Fund to acquire, rehabilitate, and construct housing, while also providing support services to help residents.

WHAT'S INCLUDED

- ☑ Reducing waste generation
- ☑ Recycling and composting
- ☑ Sustainable municipal operations
- ☑ Stormwater management and green infrastructure

Smart Waste & Water Management

Vision: Bath reduces waste and maintains safe and reliable water infrastructure and services.

BY THE NUMBERS

Landfilled waste not only emits methane, a potent greenhouse gas, but it can also pose a risk to public and environmental health. Reducing our consumption of goods and materials, increasing how much food waste we compost, and keeping recycling free of contamination are a few ways to keep as much waste as possible from the landfill. The City can also lead by example in reducing stormwater runoff and pollution through sustainable, green infrastructure.

52% decrease
in landfilled waste, from 10,073 tons in 2018 to 4,840 tons in 2022.[29]

39 miles
of collection sewers and interceptors owned and operated by the City.[30]

92% decrease
in annual volume of combined sewer overflows (CSOs) from greater than 36 million gallons in 2006 to 2.9 million gallons in 2020.[31]

TRACKING PROGRESS

The following metrics will help Bath to track and measure progress toward its goals for Smart Waste & Water Management. Additional metrics should be identified and reported to provide a more complete picture of progress.

PERFORMANCE METRIC	BASELINE YEAR	2030 TARGET	2040 TARGET	2050 TARGET
Residential Waste Diversion Rate	New Metric	30%	60%	90%
Share of Residential Food Waste Composted	New Metric	50%	75%	100%
Share of Households Enrolled in Garbage to Garden Composting Program	4% (2018)[26]	Monitor and set targets to increase		
Businesses Enrolled in Garbage to Garden Composting Program	13 (2018)[27]	Monitor and set targets to increase		
Combined Sewer Overflows (million gallons)	2.9 (2020)[28]	Monitor and set targets to decrease		

TAKE ACTION

Reduce food waste and emissions by joining the Garbage to Garden curbside composting program.

COMPOST AT HOME

Action Table

The *Resilient Bath* planning process identified the following goals, strategies, and actions for Smart Waste & Water Management.

GOAL 1	**The Bath community reduces its carbon footprint by minimizing waste; reducing the consumption of disposal goods; sharing, fixing, and upcycling materials; and recycling and composting.**
STRATEGY 1.1	**Reduce waste generated from municipal operations.**
WW 1.1.A	Adopt a municipal sustainable purchasing screening process and criteria.
WW 1.1.B	Eliminate single-use items from municipal facilities and replace them with reusable options where feasible.
WW 1.1.C	Pilot a zero-waste program at City Hall with the goal of expanding to all municipal facilities.
WW 1.1.D	Prepare to participate in the State's Extended Producer Responsibility Program for Packaging when launched.
STRATEGY 1.2	**Reduce waste generated by businesses, households, and individuals.**
WW 1.2.A	Create and launch a public education campaign to increase the number of residents who compost and participate in reuse and repair programs.
WW 1.2.B	Pilot the Green Restaurant Association's certification program.
WW 1.2.C	Support the creation of a public "lending library" to encourage community members to share household tools and equipment.
WW 1.2.D	Create a citywide compost program.

GOAL 2	**The City efficiently and sustainably manages wastewater, stormwater, and the combined sewage overflow (CSO) system.**
STRATEGY 2.1	**Reduce pollution and overflow risks of wastewater and CSO systems.**
WW 2.1.A	Incorporate climate data and projections into design of capital wastewater and CSO projects and system upgrades.
WW 2.1.B	Develop a stormwater utility to fund storm drain upgrades and expansions.
WW 2.1.C	Continue implementing the CSO Master Plan to separate sewage from stormwater flow, prioritizing upgrades with the highest impact and those that can be done alongside other roadway and maintenance projects.
WW 2.1.D	Work with code inspection and enforcement to educate local businesses about Bath's CSO system and how to minimize fats, oils, and grease (FOG) in sewer lines.
STRATEGY 2.2	**Utilize green infrastructure to manage stormwater and flood risk.**
WW 2.2.A	Conduct a stormwater study to identify and prioritize locations to implement green infrastructure and other stormwater controls, prioritizing areas without existing stormwater infrastructure.
WW 2.2.B	Align local standards with the State's chapter 500 regulations and set local thresholds for applicability.
WW 2.2.C	Offer reduced permit fees for new development projects that incorporate green infrastructure into their site designs.

WHAT'S INCLUDED

- ☑ Urban tree canopy
- ☑ Forested and open spaces
- ☑ Coastal resources and blue economy
- ☑ Carbon sequestration

Thriving Natural Resources

Vision: Bath protects natural resources and public lands and ensures they are resilient in the face of climate change.

BY THE NUMBERS

Achieving carbon neutrality, in alignment with the State's climate goals, will require proactive stewardship of natural resources to maximize how much carbon dioxide they remove from the atmosphere. Trees are an essential resource in many ways: they reduce heat, absorb and filter stormwater, sequester carbon emissions, and act as vital parts of local ecosystems. Tree preservation, planting, and maintenance are key to reducing our contribution to climate change and minimizing the impacts of climate hazards. As a coastal city, protecting and enhancing our coastal resources is also vital to economic and recreational activity, as well as climate resilience.

89

Bath's Tree Equity Score, indicating a good distribution of trees across the community.[36]

$8 million

worth of ecosystem services and co-benefits provided by the 20,000 City-owned trees.[37]

16,000 gallons

of annual stormwater runoff prevented by Bath's tree canopy.[38]

TRACKING PROGRESS

The following metrics will help Bath to track and measure progress toward its goals for Thriving Natural Resources. Additional metrics should be identified and reported to provide a more complete picture of progress.

PERFORMANCE METRIC	BASELINE YEAR	2030 TARGET	2040 TARGET	2050 TARGET
Tree Canopy Coverage	44% (2024)[32]	50%	55%	59%
Residents Living Within a 10-Minute Walk of a Park	41% (2024)[33]	Monitor and set targets to increase		
City Owned Trees	20,000 (2022)[34]	Monitor and set targets to increase		
Acres of Conservation Land	3,672 (2024)[35]	Monitor and set targets to increase		

TAKE ACTION

Try your hand at sustainable landscaping by replacing grass with native plants and avoiding harmful pesticides. Check out local resources like the Bath Garden Club.

JOIN THE CLUB

Action Table

The *Resilient Bath* planning process identified the following goals, strategies, and actions for Thriving Natural Resources.

GOAL 1	**Bath's existing and future natural resources are healthy and sustainable.**
STRATEGY 1.1	**Protect and enhance trees and open space.**
NR 1.1.A	Increase the urban tree canopy by 15% above current canopy coverage, prioritizing vulnerable areas and maintain the health of the existing canopy.
NR 1.1.B	Incorporate an Open Space/Landscape Surface Ratio requirement into the Land Use Code update, including design standards for street trees.
NR 1.1.C	Collaborate with KELT and Forestry Committee on forestry management plans and identify large tracts of forested landscapes and coastal ecosystems for conservation and restoration.
NR 1.1.D	Prioritize infill development over low-density expansion, particularly in critical rural areas.

GOAL 2	**Bath's coastal resources are resilient to climate change.**
STRATEGY 2.1	**Protect and enhance coastal natural resources.**
NR 2.1.A	Develop a Waterfront Plan that combines climate resilience strategies with connected public access.
NR 2.1.B	Identify near-term nature-based solutions and pilot projects based on 2050 coastal flood pathways identified in the vulnerability assessment.
NR 2.1.C	Identify current blue and green economy assets in Bath.
NR 2.1.D	Promote skills training and workforce development in emerging natural resources and Blue Economy sectors.

GOAL 3	**The City understands and promotes the potential of Bath's natural resources to sequester carbon from the atmosphere.**
STRATEGY 3.1	**Leverage nature to strategically remove carbon from the atmosphere.**
NR 3.1.A	Identify the carbon sequestration potential of City-owned land and ensure no net loss of high potential land.

Implementation Blueprints

Clean Energy & Efficient Buildings

ACTION EB 1.1.B

Create additional incentive bonus for residential building owners to pursue electrification and weatherization projects.

EXPECTED OUTCOME	Bath has a usable and useful program to financially support residents to pursue high-efficiency energy retrofits and electrification projects to reduce household energy use and greenhouse gas emissions while minimizing stress on the electricity grid.
OVERALL TIME FRAME	Medium (1-3 years)
CHAMPION	Office of Sustainability and Environment

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Research and assess the range of similar programs and applicable project types.	1 month	Climate Action Commission
2. Engage Efficiency Maine to align program design, payment mechanisms, and contractor vetting process.	2 months	Climate Action Commission
3. Engage contractors and potential applicants to learn what support would be most effective.	1 month	Economic and Community Development
4. Establish clear definitions of the types of retrofits eligible for incentives applicable buildings.	< 1 month	Climate Action Commission Codes Enforcement Housing Committee
5. Identify grant and other funding opportunities and secure resources to fund the initial program.	6-12 months	Finance Committee Economic Development Committee
6. Establish final program design, incentive levels and mechanisms as appropriate for the funding levels received.	2 months	Finance Committee Climate Action Commission Housing Committee
7. Present final program to relevant committees and City Council for adoption.	2 months	Climate Action Commission

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity
- Additional funding
- Additional training
- Additional buy-in from leadership or community

FINANCIAL TOOLS

- Maine Community Foundation
- Community Resilience Partnership
- Community Development Block Grants
- Maine Economic and Community Development Home Repair Network

TECHNICAL RESOURCES

- ACEEE: Designing Home Energy Programs that Leverage Federal Climate Investments with Other Funding
- C40: Guidelines for creating community-driven building retrofit programs
- Elevate: Guidelines for Maximizing the Benefits of Federal Investments in Buildings

EQUITY CONSIDERATIONS

- Ensure mechanisms allow for improvements to small rental properties and consider ways to limit rent increases that could result from improvements made.
- Create clear and accessible materials for contractors to understand and participate in the process.
- Design rebates to minimize first costs and avoid complex loans and financing arrangements for low-capacity residents.

Clean Energy & Efficient Buildings

ACTION EB 2.2.A

Develop zoning allowances for large solar and storage developments, prioritizing underutilized sites such as large surface parking areas and brownfields.

EXPECTED OUTCOME	The Zoning Code is updated to allow development of large solar and storage projects is permitted where appropriate, driving significant progress towards local renewable energy, reducing greenhouse gas emissions related to energy use while reducing stress on the electricity grid, and enhancing energy resilience.
OVERALL TIME FRAME	Short (<1 year)
CHAMPION	Office of Sustainability and Environment

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Convene a working group to 1) assess known gaps in the City's energy resilience that could be enhanced with large solar and storage projects and 2) develop criteria for identifying potential project locations.	1 month	Planning Department Climate Action Commission Public Works
2. Create an inventory of underutilized sites, documenting known limitations.	2 months	Economic and Community Development Planning Department Code Enforcement
3. Review current and near-term technology options and cross reference for compatibility with documented site conditions.	1 month	Climate Action Commission External Contractor/ Technical Support
4. Convene property owners of identified sites and potential project developers to determine additional clarifications that might be needed in zoning update.	1 month	Economic and Community Development Planning Department
5. Draft updates to zoning code as needed based on findings in prior steps.	1 month	Planning Board Planning Department Codes Enforcement Climate Action Commission
6. Present proposed updates to City Council, Planning Board, and incorporate feedback as needed.	1 month	Planning Department City Council
7. Adopt updates to Land Use Code to explicitly allow development of renewable energy and storage projects. Incorporate provisions to reevaluate code updates at regular intervals.	1 month	Planning Department Planning Board

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity
- Additional funding
- Additional training
- Additional buy-in from leadership

FINANCIAL TOOLS

- Maine Solar for All Program
- Community Resilience Partnership
- Property Assessed Clean Energy Programs, U.S. Department of Energy

TECHNICAL RESOURCES

- US DOE Community Solar Best Practices Guide: Developing Projects with Meaningful Benefits
- Clean Energy States Alliance: Consumer Protection for Community Solar
- SolSmart: Solar + Storage: A Guide for Local Governments
- SolSmart: Solar and Energy Storage System Permitting & Inspection Guidelines
- https://www.mainefarmlandtrust.org/future/policy-and-planning-resources-for-towns
- https://maineaudubon.org/advocacy/solar/

EQUITY CONSIDERATIONS

- Ensure a process for neighboring property owners to weigh in on site configuration.
- Utilize Solar for All to give residents access to project benefits while providing financing for projects in Bath.

Connected Transportation & Mobility

ACTION TM 1.1.A

Develop an electric vehicle transition plan for the City's fleet that considers operational requirements of vehicles and availability of suitable models.

EXPECTED OUTCOME	The City leads by example in reducing emissions from the transportation sector by phasing out fossil fuels vehicles from the municipal fleet in accordance with the electric vehicle transition plan.
OVERALL TIME FRAME	Short (<1 year)
CHAMPION	Office of Sustainability and Environment

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Review sustainable vehicle transition plans and policies from other local government fleets by department (police, fire, public works, and parks and recreation).	2 months	Departments with Fleets Transportation Committee Police Fire & PW Unions Climate Action Commission
2. Identify common goals, progress metrics, allowable costs, enforcement mechanisms, and other plan design elements.		
3. Conduct a fleet baseline by reviewing the existing vehicles, identifying mileage, fuel use, duty cycle and age. Review any past projects in Bath involving vehicle electrification for best practices.	2 months	Department Heads City Manager Fleet Manager Mechanics
4. Identify electric vehicle options for fleet vehicle needs and categorize by: (1) has options, (2) has options, but doesn't meet needs, or (3) no options available.	3 months	Department Heads
5. Based on these categorizations, develop a prioritized list of vehicles for replacement.		
6. Identify opportunities for efficiencies by adjusting routes or operation practices. Identify procurement implications, including vehicle costs, procurement method, and infrastructure requirement. Identify repair, maintenance, and staff training requirements.	1 month	-
7. Conduct an electrical assessment of municipal sites to see if any infrastructure upgrades will be required to meet current and future charging demands, considering the addition of new fleet EVs. Consider adding generators for the departments.	1 month	Facilities Outside Electricians

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
8. Use the best practice research, fleet analysis, and EV charging infrastructure assessment to develop a vehicle transition plan.	2 months	-
9. Conduct yearly evaluations to track progress of the plan and assess any updates that should be made based on market conditions, new technologies, etc.	Ongoing	-

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional funding
- Additional training
- Additional buy-in from leadership or community

FINANCIAL TOOLS

- Community Resilience Partnership
- Inflation Reduction Act Rebates
- Public-Private Partnerships – Oregon Case Study
- Public Access and Workplace Charging Incentives
- Efficiency Maine – EV Tax Credits and Incentives

TECHNICAL RESOURCES

- U.S. Department of Energy Clean Cities Technical Assistance
- U.S. Department of Energy Alternative Fuels Data Center
- Climate Mayors Electric Vehicle Purchasing Collaborative

EQUITY CONSIDERATIONS

- Prioritize the replacement of vehicles that are used most heavily and have the highest potential for reducing local air pollution and emissions.
- For vehicles that are still in working condition when they are retired from the fleet and replaced, identify opportunities to repurpose parts or donate the vehicle.
- Utilize a phased approach and maximize grant funding to make best use of taxpayer funds.

Connected Transportation & Mobility

ACTION TM 1.2.A

Identify priority locations and install metered EV charging stations for public lots and street parking.

EXPECTED OUTCOME	The City of Bath offers additional public charging infrastructure to accommodate more residents and visitors in adopting electric vehicles.
OVERALL TIME FRAME	Medium (1-3 years)
CHAMPION	Office of Sustainability and Environment

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Conduct a baseline assessment of current EV infrastructure (public and private) including existing number and adoption rate of EVs.	Completed	-
2. Research best practices and upcoming developments in the industry.	12 months (currently underway)	Climate Action Commission Public Works Parking Enforcement Fire & Rescue Code Enforcement Electric Utility BPT
3. Define criteria for priority locations and set City targets for infrastructure expansion utilizing best practice research and baseline assessment.		
4. Identify barriers to EV adoption at all scales and engage the community for feedback.		
5. Analyze data and stakeholder feedback to identify priority locations for EV charging infrastructure.	6 months	Climate Action Commission Transportation Commission
6. Launch installations at priority locations with a public outreach campaign.	Ongoing	Climate Action Commission Vendor Utility Public Relations Constituents
7. Conduct yearly evaluations to track progress. Expand pilot activities to additional sites, as appropriate, with a focus on matching the demand from future EV adoption rates.	Ongoing	Climate Action Commission

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity
- Additional funding
- Additional training
- Additional buy-in from community

FINANCIAL TOOLS

- Pay for Use Funding
- US Department of Transportation – Low or No Emission Vehicle Program
- US Department of Energy – Federal Tax Credits
- Efficiency Maine – EV Tax Credits and Incentives
- EMPOWER: New Workplace Charging Assistance Program

TECHNICAL RESOURCES

- Freeport Maine – EV Charging Stations
- Portland, Maine – EV Charging Stations
- USDN - Electric Vehicle Charging Access for Renters: A Guide to Questions, Strategies, and Possible Next Steps
- MJ B&A - Regional EV Charging Infrastructure Location Identification Toolkit (ILIT)
- US Department of Energy – Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite
- Tucson Electric Power - Electric Vehicle 5-Year Strategic Roadmap

EQUITY CONSIDERATIONS

- Ensure EV charging stations are physically, logistically, and financially accessible to all residents.
- Consider provisions to increase access to electric vehicles for low-income community members.

Resilient & Healthy Community

ACTION CO 1.1.A

Develop resilience requirements for new structures within flood zones and/or predicted areas of sea level rise.

EXPECTED OUTCOME	Developers are required to utilize design guidelines to manage 1.5 feet of sea level rise by 2050 and 3.9 by 2100. This may include measures such as elevating critical infrastructure and equipment in current and future flood-prone areas, right-sizing stormwater infrastructure, selecting more durable equipment and materials to withstand extreme storm events. The design guidelines will include measures for preparing to manage sea level rise for 3.0 feet by 2050 and 8.8 feet by 2100.
OVERALL TIME FRAME	Medium (1-3 years)
CHAMPION	Planning Department

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Based on the Bath Flood Vulnerability Assessment from 2023, determine the common key design issues for the identified infrastructure and facilities that frequently need repair or maintenance (i.e., culvert sizing, material selection, location, etc.)	3 months	Office of Sustainability and Environment Department of Public Works Code Enforcement Impacted Private Property Owners
2. Create unique Bath vulnerability typologies based on key design issues that can shape the process.	3 months	Neighboring Communities
3. Research best practices and case studies of resilient design measures being piloted or utilized for similar infrastructure types and based on similar climate change projections and considerations for Bath.	3 months	Office of Sustainability and Environment Climate Action Commission
4. Review ME State standards and any other standards (e.g., MA Resilience Design Standards) to align efforts.	3 months	Office of Sustainability and Environment Climate Action Commission
5. Review Bath's current Design Guidelines and identify specific opportunities for updating and/or making recommendations for new resilient design standards.	6 months	Office of Sustainability and Environment Code Enforcement Department of Public Works
6. Identify municipal project to pilot the newly incorporated resilient design standards.	Project dependent	Fire Department Housing Committee (Housing Trust Fund)
7. Incorporate lessons learned from the pilot project to modify and formalize the resilient design considerations in the City's guidelines.	2 months	Office of Sustainability and Environment City Council Climate Action Commission

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional funding
- Technical capacity

FINANCIAL TOOLS

- Maine Housing Trust Fund
- Hazard Mitigation Assistance Grants, Maine Emergency Management Agency
- Community Resilience Partnership
- The Onion Foundation
- Maine Economic and Community Development Home Repair Network

TECHNICAL RESOURCES

- City of Boston, Coastal Flood Resilience Design Guidelines
- Municipal Guidance for Coastal Resilience, Model Ordinance Language for Maine Municipalities
- NSW Coastal Design Guidelines 2023
- Portland ReCODE Resilience

EQUITY CONSIDERATIONS

- Consider how these guidelines could apply to single family residential and how lower income residents could afford to pay for building level adaptation.
- Assess how these requirements would shift developer proformas and how to ensure there is still substantial affordable housing.

Resilient & Healthy Community

ACTION CO 1.1.D

Conduct an outreach campaign targeting residents and businesses to improve understanding of flood risk and flood prevention measures.

EXPECTED OUTCOME	Private landowners, developers, and contractors understand flood management best practices including design, construction, operations, and long-term maintenance, helping to minimize property damage and pollution of waterways caused by harmful runoff.
OVERALL TIME FRAME	Medium (1-3 years)
CHAMPION	Office of Sustainability and Environment

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Review existing practices for public outreach campaigns. Meet with City staff who have led previous campaigns and determine best practices for the flood prevention campaign.	3 months	Public Works Department Sagadahoc County EMA City of Bath Marketing and Communications Fire Department
2. Review existing public outreach data to understand potential barriers, opportunities, and equity considerations for improving understanding of flood risk in the Bath community.	3 months	Public Works Department Sagadahoc County EMA City of Bath Marketing and Communications Fire Department Midcoast Maine Community Action Bath Housing, Climate Action Commission
3. Assess the community's flood risks and identify the opportunities, best practices, and technologies for prevention.	3 months	Planning Department Code Enforcement
4. Develop a framework to support funding and administration of the campaign. Identify potential nonprofits, businesses, universities, and other community partners that could aid in administering the campaign or have experience organizing similar campaigns.	9 months	City of Bath Marketing and Communications Planning Department
5. Informed by the feedback compiled in Steps 1-3, create an outreach strategy that identifies target audiences, key messages, channels, tactics, and a timeline for implementation.	1 month	City of Bath Marketing and Communications Chamber of Commerce Main Street Bath Morse High School Green Club

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
6. Develop and design coordinated outreach materials that can be deployed in different contexts, using in-house resources or outsourced consultants.	3 months	City of Bath Marketing and Communications Bath Housing Midcoast Maine Community Action
7. Identify metrics of success and mechanisms to track progress of the campaign throughout implementation.	1 month	City of Bath Marketing and Communications

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity
- Additional funding
- Additional training
- Additional buy-in from community

FINANCIAL TOOLS

- Community Resilience Partnerships
- Maine Community Foundation
- The Onion Foundation
- Hazard Mitigation Assistance Grants, Maine Emergency Management Agency

TECHNICAL RESOURCES

- Frameworks Institute
- Maine Municipal Association Workshops and Training
- Yale Program on Climate Change Communications

EQUITY CONSIDERATIONS

- Translate outreach materials and communications into multiple languages.
- Partner with organizations like Midcoast Maine Community Action, Morse High School, Bath Housing, and more.
- Tailor messaging to different socially vulnerable populations and audiences.

Smart Waste & Water Management

ACTION WW 1.1.C

Pilot a zero-waste program at City Hall with the goal of expanding to all municipal facilities.

EXPECTED OUTCOME	A successful pilot will achieve a 90% diversion rate in City Hall and provide a blueprint for expanding the program to additional City facilities.
OVERALL TIME FRAME	Medium (1-3 years)
CHAMPION	Public Works

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Research appropriate waste reduction strategies and technologies and establish a definition of zero-waste (e.g., a diversion rate of 90% or higher).	6 months	Office of Sustainability and Environment City Manager Vendors Facilities Department Solid Waste Advisory Committee Casella Interns
2. Perform an audit of City Hall waste streams and sources.		
3. Based on waste audit, prioritize key opportunities for reduction of landfilled material and improved diversion for recycling, reuse, and composting. For example: • Identify changes to procurement policies to require minimal waste or non-landfill stream product purchasing. • Identify opportunities to avoid printing and reduce the use of paper. • Identify opportunities to eliminate single-use plastics.	6 months	Office of Sustainability and Environment City Manager Vendors Facilities Department Solid Waste Advisory Committee Casella Interns
4. Conduct a pilot for waste reduction practices, alongside an education campaign to ensure City Hall staff participation. This will include identifying incentives to support change (e.g., competitions or games) and providing reusable resources to encourage compliance.	6 months	Office of Sustainability and Environment City Manager Vendors Facilities Department Solid Waste Advisory Committee Casella Interns
5. Display waste status and goals publicly to track progress (e.g., backwards thermometer).		

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
6. Expand pilot activities to additional City facilities, as possible and appropriate, with a focus on creating permanent, ongoing systems.	6 months	Office of Sustainability and Environment City Manager Vendors Facilities Department Solid Waste Advisory Committee Casella Interns
7. Complete an evaluation to confirm success and workability and include documentation of processes and procedures.		

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity or interns
- Additional funding for signage, bins, and incentives
- Additional training for City and custodial staff
- Continued buy-in from leadership

FINANCIAL TOOLS

- Corporate Sponsors
- Solid Waste Diversion Grant Program, Maine Department of Environmental Protection
- Consumer Recycling Education and Outreach Grant Program, U.S. EPA
- Solid Waste Infrastructure for Recycling Grants for Communities, U.S. EPA

TECHNICAL RESOURCES

- Recycle, Compost, Landfill Sign Maker, San Francisco Environment Department
- Reducing Waste: What You Can Do, U.S. EPA
- Paving the Way Toward a Zero Waste Philadelphia, City of Philadelphia
- Guide to Conducting Student Food Waste Audits, USDA, U.S. EPA, & University of Arkansas

EQUITY CONSIDERATIONS

- Ensure that educational materials are accessible to all (i.e., multilingual, multimedia, accommodates individuals with disabilities).

Smart Waste & Water Management

ACTION WW 2.1.B

Develop a stormwater utility to fund storm drain upgrades and expansions.

EXPECTED OUTCOME	City staff utilize funds from the stormwater utility to repair and replace stormwater infrastructure, ensure separation of storm and sewer systems, and establish water quality testing, and anticipate a future MS4 community designation and begin to develop standards/practices to align with designation.
OVERALL TIME FRAME	Long (3+ Years)
CHAMPION	Department of Public Works

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Conduct an inventory and assessment of current stormwater infrastructure, regulations, additional financial needs, cost estimates, and future needs.	2.5 years	Planning Department City Council Maine Department of Environmental Protection
2. Research stormwater regulation and best practices from progressive towns and cities and evaluate state recommendations.		
3. Update stormwater regulations based on assessment.	12 months	Planning Department Assessor's Office Finance Council Climate Action Commission City Solicitor
4. Conduct analysis of appropriate stormwater utility fee.		
5. Develop and distribute educational material created throughout the process to residents regarding residential stormwater runoff and solutions.	2 months	Communications City Council CMO MRWA MWEA Climate Action Commission Community Members
6. Hold public meetings regarding creation of stormwater enterprise to provide an opportunity for resident feedback.		
7. Rollout updated stormwater regulations and hold a hearing on stormwater utility fee.	1 month	Communications
8. Create and facilitate a City Stormwater Utility Committee.	Ongoing	City Staff City Council Community Members

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity
- Additional funding
- Additional buy-in from the community

FINANCIAL TOOLS

- Clean Water State Revolving Fund (CWSRF), Maine Department of Environmental Protection
- Navigating the Federal Funding Landscape, New England Environmental Finance Center
- Nonpoint Source Water Pollution Control Grants, Maine Department of Environmental Protection
- EPA Urban Small Waters Grants Program

TECHNICAL RESOURCES

- Stormwater Utility Case Study, Lancaster, Pennsylvania
- Bangor Stormwater Utility Feasibility Study

EQUITY CONSIDERATIONS

- Provide education and resources to residents (e.g., rain barrels, guidance on replacing impervious surfaces, etc.) to help minimize fees for residents.

Thriving Natural Resources

ACTION NR 1.1.A

Increase the urban tree canopy by 15% above current canopy coverage, prioritizing vulnerable areas and maintaining the health of the existing canopy.

EXPECTED OUTCOME	City staff utilize a management plan that considers location, tree type, long-term growth, care and maintenance to ensure Bath's tree canopy is resilient to the projected impacts of climate change – ultimately expanding the urban tree canopy by 15%.
OVERALL TIME FRAME	Long (3+ Years)
CHAMPION	Parks & Recreation Department

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Complete GIS mapping of city trees with information on each tree, benefits of species, etc. Engage stakeholders to understand baseline data. This process can build on existing City data and incorporate a street tree equity survey of Bath neighborhoods to determine what areas lack trees, as suggested by the City's Comprehensive Plan.	6 months	Office of Sustainability and Environment Kennebec Estuary Land Trust Bath Community Forestry Committee Midcoast Council of Governments
2. Develop scope for tree canopy management plan and appropriate board, committee, or city department to charge with implementation. Plan should consider: • Annual public tree removal tracking and private tree census data. • Policies for equal replacement for public tree removals. • Incentives for public tree planting on private land.	12 months	Office of Sustainability and Environment Bath Community Forestry Committee
3. Formalize a tree canopy management plan and embed it within the Parks Department, committee, or board with authority to restore and expand Bath's tree canopy.	6 months	Central Maine Power Office of Sustainability and Environment Bath Community Forestry Committee Department of Public Works
4. Develop community awareness and educational materials on the benefits of urban tree health.	This can be ongoing throughout all steps.	City of Bath Marketing and Communications

TOOLS & RESOURCES

RESOURCES NEEDS

- Additional staff capacity
- Additional funding
- Additional training

FINANCIAL TOOLS

- Maine Project Canopy
- Tree City USA
- Urban & Community Forestry Inflation Reduction Act Grants
- The Onion Foundation

TECHNICAL RESOURCES

- Trust for Public Land
- Center for Regenerative Solutions
- US Forest Service
- C40 Knowledge Hub

EQUITY CONSIDERATIONS

- Consider tree placement and location based on which neighborhoods have less tree coverage and increased urban heat island effect.

Thriving Natural Resources

ACTION NR 2.1.D

Promote skills training and workforce development in emerging natural resources and Blue Economy sectors.

EXPECTED OUTCOME	Workforce development and training programs enhance businesses, industries, and institutions that contribute to environmental management fields – particularly in relation to coastal resources and the Blue Economy sector.
OVERALL TIME FRAME	Medium (1-3 years)
CHAMPION	Department of Community and Economic Development

IMPLEMENTATION STEPS	ESTIMATED TIME TO IMPLEMENT STEP	COLLABORATORS
1. Convene regional working group focused on green workforce development.	4 months	Midcoast Council of Governments (Campaign this step) Island Institute Gulf of Maine research Institute
2. Conduct interviews and focus groups with local and regional business, organizations, and educational institutions to identify workforce development and training opportunities and needs.	6 months	Midcoast Council of Governments (Campaign this step)
3. Identify businesses and industries that contribute to and capitalize on emerging environmental technologies.	3 months	Main Street Bath Chamber of Commerce National League of Cities Department of Labor Maine Municipal Association
4. Assess opportunities for the identified businesses and industries to collaborate, share resources, and use the by-products within and across fields.	2 months	Midcoast Council of Governments (Campaign this step)
5. Identify regional experts and best practice examples for the identified opportunities to guide workforce development and training programs.	3 months	Midcoast Council of Governments Main Street Bath Chamber of Commerce
6. Partner with local and regional organizations and schools to host workforce development and training programs.	Ongoing	Midcoast Maine Community Action Union & Co.
7. Advertise workforce development programs to a diverse group of existing and potential future employees.	Ongoing	Morse High School/Bath Tech

TOOLS & RESOURCES	
RESOURCES NEEDS	
• Additional staff capacity	• Additional funding
FINANCIAL TOOLS	
• Department of Labor Funding • Community Resilience Partnership Action Grants	• The Onion Foundation
TECHNICAL RESOURCES	
• Economic Opportunity & Workforce Development Resources from the National League of Cities	• Gulf of Maine Research Institute • National Oceanic and Atmospheric Administration

EQUITY CONSIDERATIONS	
• Wrap around social infrastructure and services to enable all people to participate. • Consider providing scholarships for low-income participants.	• Examine working culture to ensure that the workforce diversity could change over time.

Endnotes

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3 Scientific Assessment of Climate Change and Its Effects in Maine, Maine Climate Council (2024).

4 Bath Flood Vulnerability Assessment, City of Bath (2023).

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33 ParkScore, Trust for Public Land (2024).

34 Annual Report, City of Bath (2022)

35 Conservation Areas, Bath Preservation Trust (2024).

36 National Explorer Locality Report, Tree Equity Score (2024).

37 Forestry Department, City of Bath (2024).

38 National Explorer Locality Report, Tree Equity Score (2024).

Acknowledgements

Climate Advisory Group

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Climate Action Commission

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Paul Perkins – Co Chair

Mary Ellen Bell- Chair City Council

Julie Ambrosino – Vice Chair City Council

Connor English- Bicycle, Pedestrian, and Transportation Committee

Laura Walters- At Large

Ruth Indrick-Kennebec Estuary Land Truct

Nancy Sferra- Bath Community Forestry Commission

Prepared by Kim Lundgren Associates, Inc. & Siler Climate Consulting

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City of Bath, ME

2022 Community GHG Emissions Inventory and Pathways Reduction Analysis Methodology Report

Prepared by Kim Lundgren Associates, Inc.
October 2024

Contents

Introduction

The City of Bath has updated their community greenhouse gas (GHG) inventory using the ICLEI ClearPath Community Track, designed for GHG accounting on the local level, for the 2022 inventory year to determine where they stand in relation to their climate goals. As part of the planning process, the City has also completed an analysis of the specific pathways and targets necessary to reduce GHG emissions associated with City operations and the broader community.

This report provides an overview of the data sources and methodologies used in the 2022 completed prior to the Resilient Bath Climate Action Plan, including updates and corrections to provide the basis for a forecast and reduction analysis develop the high-impact strategies and actions detailed in the *Resilient Bath Climate Action Plan*.

Methodologies reported here for the 2022 inventory reflect those with the "Bath 2022 Inventory – Updated" inventory records in the ICLEI ClearPath tool.

- An export of the ClearPath "Updated_2022_ClearPath_detailedRpt.xlsx" contains all input and output values for each calculation performed in the inventory, as well as notes describing updates made to records.

GHG Inventory Methodology & Data Sources

The community GHG inventory follows the methods and emissions factors provided in the ICLEI ClearPath Community Track, in alignment with the reporting conventions defined by the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions. The ClearPath inventory uses 100-year horizon Global Warming Potential values from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report.

Residential Energy

Electricity

Data Sources: Central Maine Power

Activity Data: Measured annual electricity use aggregated at the residential sector was sourced from Central Maine Power.

Emissions Factors: Emissions factors for purchased electricity follow best practice guidance to utilize a 'location-based' assessment of GHG emissions to establish the physical reality of the impact of grid energy consumption. A complete accounting of GHGs from combustion generation resources needs to include factors for CO_2, CH_4, and N_2O. These were sourced from U.S. EPA eGRID and were entered into the ClearPath tool factor sets.

Metric	Value	Unit	Source
Residential Electricity Use	31,327	MWh	Central Maine Power

CO_2 Emissions Factor	536.4	lbs / MWh	EPA eGRID 2022, NEWE Subregion
CH_4 Emissions Factor	63	lbs / GWh	
N_2O Emissions Factor	8	lbs / GWh	

Methodology:

- Add EPA eGRID emissions factors to the Factor Sets in ClearPath.
- Obtain residential electricity consumption from Central Maine Power.
- Input electricity use into ClearPath using the "Emissions from Grid Electricity" calculator.
- Select the EPA eGRID 2022 NEWE emissions factors in the ClearPath calculator.
- The ClearPath tool will multiply electricity consumption by eGRID emissions factors to output emissions.

Note: Data input into the ClearPath software was checked against notes and raw data that was attached to records in the original 2022 inventory. Initial review found that data inputs matched the values provided by Central Maine Power. Further review of results led to a determination that the quantity of energy represented by the records was unrealistically small and 2018 data was checked for reference. This review led to the realization that data reported by Central Maine Power was low by an order of magnitude, or a single decimal point. To correct for this, records for electricity use in the Residential, Commercial, and Industrial sectors were increased by 10x.

Future engagement with Central Maine Power should include checks to ensure correct units. Where possible, it may be advantageous to also seek electricity use data at monthly intervals instead of annual totals.

Natural Gas

Data Sources: Maine Natural Gas

Activity Data: Measured annual natural gas use aggregated at the residential sector was sourced from Maine Natural Gas.

Emissions Factors: Emissions factors for natural gas follow ClearPath defaults.

Metric	Value	Unit	Source
Residential Natural Gas Use	244,013	Therms	Maine Natural Gas
CO_2 Emissions Factor	53.02	Kg / MMBtu	ICLEI ClearPath Defaults
CH_4 Emissions Factor	0.005	Kg / MMBtu	
N_2O Emissions Factor	1×10^{-4}	Kg / MMBtu	

Methodology:

- Obtain residential natural gas consumption from Maine Natural Gas.
- Input natural gas use into ClearPath using the "Emissions from Stationary Fuel Combustion" calculator and select Natural Gas as the fuel type.
- The ClearPath tool will multiply natural gas consumption by national default emissions factors to output emissions.

Fuel Oil

Data Sources: City of Bath Assessor's Database; U.S. Census Bureau American Community Survey; U.S. Energy Information Administration

Activity Data: Residential fuel oil consumption in Bath was estimated from the average statewide rate of oil use per household applied to the number of oil-heated homes in Bath, sourced from the city's Assessor's Database. The statewide rate of household fuel use was estimated from the number of oil-heated homes in Maine, sourced from the U.S. Census ACS, and statewide residential fuel oil consumption, sourced from the U.S. EIA.

Emissions Factors: Emissions factors for fuel oil follow ClearPath defaults.

Metric	Value	Unit	Source
Homes in Maine with Oil Heating (2021)	345,180	#	U.S. Census ACS 5-Year Estimates Table B25040
Maine Residential Oil Consumption (2021)	28.1	trillion Btu	U.S. EIA Maine State Profile and Energy Estimates Table CT4
Statewide Oil Use per Household	81.4068	MMBtu / Household	Calculated from Above
Homes in Bath with Oil Heating	2,348	#	City of Bath Assessor's Database
Bath Residential Oil Use	191,143	MMBtu	Calculated from Above
CO_2 Emissions Factor	73.96	kg / MMBtu	ICLEI ClearPath Defaults
CH_4 Emissions Factor	0.01087	kg / MMBtu	
N_2O Emissions Factor	7.2464×10^{-4}	kg / MMBtu	

Methodology:

- Obtain the total number of homes heated with oil in Maine from the U.S. Census ACS 5-Year Estimates Table B25040.
- Obtain statewide residential fuel oil energy consumption from the EIA State Profile and Energy Estimates Table CT4.
- Divide statewide residential fuel oil consumption by the number of oil-heated homes to calculate fuel oil use per household.
- Obtain the number of homes heated with oil in Bath from the city's Assessor's Database.
- Apply the statewide rate of oil use per household to the number of oil-heated homes in Bath to estimate residential fuel oil consumption in Bath.
- Input fuel oil use into ClearPath using the "Emissions from Stationary Fuel Combustion" calculator and select Distillate Fuel Oil No. 2 as the fuel type.
- The ClearPath tool will multiply fuel oil consumption by national default emissions factors to output emissions.

Note: While utilities supply buildings with electricity and natural gas, other fuels – such as fuel oil and propane – are supplied by a myriad of companies, limiting access to usage data. Non-utility fuel use may be estimated based on the square footage of households (for residential usage) or non-residential building area (for non-residential usage) and energy consumption intensities provided by EIA intensities. This estimation methodology provides a general picture of the scale of transition needed; however, it does not provide a measured value of actual fuel usage. Any detection of changes from this source will be a function of how many properties are using the fuel, not actual measures of consumption. Any efficiency measures such as weatherization to oil heated structures will not be detectable in future inventories unless paired with fuel switching that reduces the count of properties using the fuel. Bath Assessors' processes should be updated to comprehensively capture and continuously update fuels used across properties within the City capture any fuel switching.

Propane

Data Sources: City of Bath Assessor's Database; U.S. Census Bureau American Community Survey; U.S. Energy Information Administration

Activity Data: Residential propane consumption in Bath was estimated from the average statewide rate of propane use per household applied to the number of propane-heated homes in Bath, sourced from the city's Assessor's Database. The statewide rate of household fuel use was estimated from the number of propane-heated homes in Maine, sourced from the U.S. Census ACS, and statewide residential propane consumption, sourced from the U.S. EIA.

Emissions Factors: Emissions factors for propane follow ClearPath defaults.

Metric	Value	Unit	Source
Homes in Maine with Propane Heating (2021)	68,174	#	U.S. Census ACS 5-Year Estimates Table B25040
Maine Residential Propane Consumption (2021)	6.7	trillion Btu	U.S. EIA Maine State Profile and Energy Estimates Table CT4
Statewide Propane Use per Household	98.2779	MMBtu / Household	Calculated from Above
Homes in Bath with Propane Heating	32	#	City of Bath Assessor's Database
Bath Residential Propane Use	3,144	MMBtu	Calculated from Above
CO_2 Emissions Factor	62.98	Kg / MMBtu	ICLEI ClearPath Defaults
CH_4 Emissions Factor	0.01087	Kg / MMBtu	
N_2O Emissions Factor	0.001087	Kg / MMBtu	

Methodology:

- Obtain the total number of homes heated with propane in Maine from the U.S. Census ACS 5-Year Estimates Table B25040.

- Obtain statewide residential propane consumption from the EIA State Profile and Energy Estimates Table CT4.
- Divide statewide residential propane consumption by the number of propane-heated homes to calculate propane use per household.
- Obtain the number of homes heated with propane in Bath from the city's Assessor's Database.
- Apply the statewide rate of propane use per household to the number of propane-heated homes in Bath to estimate residential propane consumption in Bath.
- Input propane use into ClearPath using the "Emissions from Stationary Fuel Combustion" calculator and select LPG as the fuel type.
- The ClearPath tool will multiply propane consumption by national default emissions factors to output emissions.

Note: All notes included above for Residential Fuel Oil use as it relates to the estimation method used for this inventory are applicable to this section.

Wood

Data Sources: City of Bath Assessor's Database; U.S. Census Bureau American Community Survey; U.S. Energy Information Administration

Activity Data: Residential wood consumption in Bath was estimated from the average statewide rate of wood use per household applied to the number of wood-heated homes in Bath, sourced from the city's Assessor's Database. The statewide rate of household wood use was estimated from the number of wood-heated homes in Maine, sourced from the U.S. Census ACS, and statewide residential wood consumption, sourced from the U.S. EIA.

Emissions Factors: Emissions factors for propane follow ClearPath defaults.

Metric	Value	Unit	Source
Homes in Maine with Wood Heating (2021)	51,807	#	U.S. Census ACS 5-Year Estimates Table B25040
Maine Residential Wood Consumption (2021)	16.1	trillion Btu	U.S. EIA Maine State Profile and Energy Estimates Table CT4
Statewide Wood Use per Household	310.7688	MMBtu / Household	Calculated from Above
Homes in Bath with Wood Heating	3	#	City of Bath Assessor's Database
Bath Residential Wood Use	932	MMBtu	Calculated from Above
CO_2 Emissions Factor	0	Kg / MMBtu	ICLEI ClearPath Defaults
CH_4 Emissions Factor	0.316	Kg / MMBtu	
N_2O Emissions Factor	0.0042	Kg / MMBtu	

Methodology:

- Obtain the total number of homes heated with wood in Maine from the U.S. Census ACS 5-Year Estimates Table B25040.
- Obtain statewide residential wood consumption from the EIA State Profile and Energy Estimates Table CT4.
- Divide statewide residential wood consumption by the number of wood-heated homes to calculate wood use per household.
- Obtain the number of homes heated with wood in Bath from the city's Assessor's Database.
- Apply the statewide rate of wood use per household to the number of wood-heated homes in Bath to estimate residential wood consumption in Bath.
- Input wood use into ClearPath using the "Emissions from Stationary Fuel Combustion" calculator and select Wood as the fuel type.
- The ClearPath tool will multiply wood consumption by national default emissions factors to output emissions.

Note: All notes included above for Residential Fuel Oil use as it relates to the estimation method used for this inventory are applicable to this section.

Carbon dioxide emissions from wood burning are set to 0 in ClearPath as they are biogenic and not counted towards the inventory total.

Commercial Energy

Electricity

Data Sources: Central Maine Power

Activity Data: Measured annual electricity use aggregated at the commercial sector was sourced from Central Maine Power.

Emissions Factors: Emissions factors for purchased electricity follow best practice guidance to utilize a 'location-based' assessment of GHG emissions to establish the physical reality of the impact of grid energy consumption. A complete accounting of GHGs from combustion generation resources needs to include factors for CO_2, CH_4, and N_2O. These were sourced from U.S. EPA eGRID and were entered into the ClearPath tool factor sets.

Metric	Value	Unit	Source
Commercial Electricity Use	20,788	MWh	Central Maine Power
CO_2 Emissions Factor	536.4	lbs / MWh	EPA eGRID 2022, NEWE Subregion
CH_4 Emissions Factor	63	lbs / GWh	
N_2O Emissions Factor	8	lbs / GWh	

Methodology:

- Add EPA eGRID emissions factors to the Factor Sets in ClearPath.
- Obtain commercial electricity consumption from Central Maine Power.

- Input electricity use into ClearPath using the "Emissions from Grid Electricity" calculator.
- Select the EPA eGRID 2022 NEWE emissions factors in the ClearPath calculator.
- The ClearPath tool will multiply electricity consumption by eGRID emissions factors to output emissions.

Note: All notes included above for Residential Electricity use as it relates to the correction of input data for this inventory are applicable to this section.

Natural Gas

Tracking natural gas use in commercial buildings within Bath faces some challenges with the presence of large industrial users which are aggregated along with all other commercial accounts when reported from Maine Natural Gas. Unfortunately, this makes it difficult to differentiate between gas used for space heating, water heating, and cooking within non-industrial uses from what is utilized at Bath Iron Works and other firms supporting the shipyard.

Bath Iron Works total GHG footprint is available via Maine Department of Environmental Protection[1], however it is undifferentiated by source energy. In this situation, utility data sharing aggregation rules prevent clear tracking of domestic end uses within non-industrial commercial facilities. To correct for this, natural gas energy use was estimated using consistent methods as is applied to estimating residential fuel-oil and propane use. One important distinction in the method provided here is the use of energy intensity values that are matched to the building types in the Bath Assessors database using NREL Comstock as opposed to coarse energy intensities published in the EIA Commercial Building Energy Consumption Survey. This provides a more refined estimate for Bath in terms of understanding what share of emissions need to be addressed through commercial building focused strategies. Unfortunately, it will be difficult to detect a measured impact of strategies focused on commercial buildings, which may need to be estimated from individual projects in the short term.

Data Sources: City of Bath Assessor's Database; NREL ComStock End Use Savings Shapes

Activity Data: Natural gas used for heating in commercial buildings was estimated using the Bath's Assessor's Database and the NREL ComStock public datasets, highly granular models of the U.S. building stock categorized by building type.

Emissions Factors: Emissions factors for natural gas follow ClearPath defaults.

Metric	Value	Unit	Source
Medium Offices with Natural Gas Heating	205,955	Square Feet	City of Bath Assessor's Database
Primary Schools with Natural Gas Heating	168,714	Square Feet	
Retail Standalone with Natural Gas Heating	220,970	Square Feet	

[1] https://www.maine.gov/dep/ftp/AIR/DATA/GHG_SUMMARIES/

Small Hotels with Natural Gas Heating	118,301	Square Feet	
Warehouses with Natural Gas Heating	16,155	Square Feet	
Multifamily with Natural Gas Heating	356,396	Square Feet	
Natural Gas Use Intensity for Medium Offices	7.4	kWh / Square Feet	End Use Load Profiles TMY3 2021.1 Release, NREL ComStock
Natural Gas Use Intensity for Primary Schools	15.4	kWh / Square Feet	
Natural Gas Use Intensity for Retail Standalone	13.8	kWh / Square Feet	
Natural Gas Use Intensity for Small Hotels	35.8	kWh / Square Feet	
Natural Gas Use Intensity for Warehouses	1.5	kWh / Square Feet	
Natural Gas Use Intensity for Multifamily	14.0	kWh / Square Feet	
Commercial Natural Gas Use	390,552	Therms	Calculated from Above
CO_2 Emissions Factor	53.02	Kg / MMBtu	ICLEI ClearPath Defaults
CH_4 Emissions Factor	0.005	Kg / MMBtu	
N_2O Emissions Factor	1×10^{-4}	Kg / MMBtu	

Methodology:

- Obtain the total area of commercial buildings heated with natural gas in Bath by building type from the City's Assessor's Database.
- Determine the energy consumption intensity of commercial buildings heated with natural gas by building type using the NREL ComStock End Use Savings Shapes dataset filtered to Maine and the respective building types.
- Multiply the total heating energy per square foot by commercial building area per respective building type to calculate fuel usage.
- Input natural gas use into ClearPath using the "Emissions from Stationary Fuel Combustion" calculator, selecting Natural Gas as the fuel type.
- The ClearPath tool will multiply natural gas consumption by national default emissions factors to output emissions.

Note: An unfortunate complication for tracking natural gas usage in Bath is the presence of a single large customer using fuels in a productive capacity at Bath Iron Works with the inability to distinguish that usage from consumptive usage for the heating of buildings, domestic hot water, and cooking; all of which have viable options for decarbonization with today's technology. Thankfully this situation does not impact residential usage, but it does complicate getting a clear understanding of utility gas within non-residential structures in Bath. It is recommended that the city continue to engage with Maine Natural Gas to exclude Bath Iron Works from future reports on aggregate gas consumption in order to better track progress in this area.

Alternatively, some directed survey efforts focused on downtown businesses or other voluntary disclosure could fill gaps in knowledge. While improved information would be useful to know, the current situation should not be an impediment to action as individual building owners can still make proactive decisions to decarbonize their properties. It is worth noting that the situation in Bath is not unique and the need for modernizing utility privacy rules to advance climate action are recognized in other places, particularly within the State of California.[2]

Fuel Oil

Data Sources: City of Bath Assessor's Database; NREL ComStock End Use Savings Shapes

Activity Data: Fuel oil used for heating in commercial buildings was estimated using the Bath's Assessor's Database and the NREL ComStock public datasets, highly granular models of the U.S. building stock categorized by building type

Emissions Factors: Emissions factors for fuel oil follow ClearPath defaults.

Metric	Value	Unit	Source
Medium Offices with Oil Heating	732,695	Square Feet	City of Bath Assessor's Database
Primary Schools with Oil Heating	339,919	Square Feet	
Retail Standalone with Oil Heating	265,578	Square Feet	
Secondary Schools with Oil Heating	6,876	Square Feet	
Small Hotels with Oil Heating	6,248	Square Feet	
Warehouses with Oil Heating	27,887	Square Feet	
Multifamily with Oil Heating	356,111	Square Feet	
Oil Use Intensity for Medium Offices	6.6	kWh / Square Feet	End Use Load Profiles TMY3 2021.1 Release, NREL ComStock
Oil Use Intensity for Primary Schools	11.3	kWh / Square Feet	
Oil Use Intensity for Retail Standalone	10.7	kWh / Square Feet	
Oil Use Intensity for Secondary Schools	19.2	kWh / Square Feet	
Oil Use Intensity for Small Hotels	17.0	kWh / Square Feet	
Oil Use Intensity for Warehouses	1.8	kWh / Square Feet	

[2] Data Access for a Decarbonized Grid: Policy Solutions to Improve Energy Data Access and Drive the Clean and Resilient Grid of the Future, Berkeley Law (2021).

Oil Use Intensity for Multifamily	12.9	kWh / Square Feet	
Commercial Fuel Oil Use	40,212	MMBtu	Calculated from Above
CO_2 Emissions Factor	73.96	Kg / MMBtu	ICLEI ClearPath Defaults
CH_4 Emissions Factor	0.01087	Kg / MMBtu	
N_2O Emissions Factor	7.2464×10^{-4}	Kg / MMBtu	

Methodology:

- Obtain the total area of commercial buildings heated with fuel oil in Bath by building type from the City's Assessor's Database.
- Determine the energy consumption intensity of commercial buildings heated with fuel oil by building type using the NREL ComStock End Use Savings Shapes dataset filtered to Maine and the respective building types.
- Multiply the total heating energy per square foot by commercial building area per respective building type to calculate fuel usage.
- Input fuel oil use into ClearPath using the "Emissions from Stationary Fuel Combustion" calculator, selecting Distillate Fuel Oil No. 2 as the fuel type.
- The ClearPath tool will multiply fuel oil consumption by national default emissions factors to output emissions.

Note: For consistency with the treatment of natural gas energy intensity, fuel oil intensity for commercial facilities were updated to use the ComStock model as well. This change created a significant reduction in estimated fuel oil consumption in commercial facilities than was previously estimated using reference values from the EIA Commercial Building Energy Consumption Survey.

Industrial Energy

Electricity

Data Sources: Central Maine Power

Activity Data: Measured annual electricity use aggregated at the industrial sector was sourced from Central Maine Power.

Emissions Factors: Emissions factors for purchased electricity follow best practice guidance to utilize a 'location-based' assessment of GHG emissions to establish the physical reality of the impact of grid energy consumption. A complete accounting of GHGs from combustion generation resources needs to include factors for CO_2, CH_4, and N_2O. These were sourced from U.S. EPA eGRID and were entered into the ClearPath tool factor sets.

Metric	Value	Unit	Source
Industrial Electricity Use	80,221	MWh	Central Maine Power
CO_2 Emissions Factor	536.4	lbs / MWh	EPA eGRID 2022, NEWE Subregion
CH_4 Emissions Factor	63	lbs / GWh	

N_2O Emissions Factor	8	lbs / GWh	

Methodology:

- Add EPA eGRID emissions factors to the Factor Sets in ClearPath.
- Obtain industrial electricity consumption from Central Maine Power.
- Input electricity use into ClearPath using the "Emissions from Grid Electricity" calculator.
- Select the EPA eGRID 2022 NEWE emissions factors in the ClearPath calculator.
- The ClearPath tool will multiply electricity consumption by eGRID emissions factors to output emissions.

Note: All notes included above for Residential Electricity use as it relates to the correction of input data for this inventory are applicable to this section.

Bath Iron Works – Bath Facility

Data Sources: Maine Department of Environmental Protection (DEP)

Emissions Data: Every facility that is licensed by Maine DEP to emit criteria air pollutants at or above the limits established in DEP Rules, Chapter 137, "Emission Statements" is required to submit an annual air emissions inventory. Maine DEP provides annual summaries of these criteria air pollutant and greenhouse gas emissions inventories for each facility. These reports include facility-level emissions by criteria air pollutant and GHG; activity data and fuel source information are not included.

CO_2 emitted from the Bath Iron Works (Bath Facility) in 2021 were obtained from the Maine DEP emissions inventory database, and were entered directly into ClearPath

The Bath Iron Works Harding Facility was also listed in the database, but is excluded from the City of Bath's GHG inventory as this facility is located in Brunswick, ME.

Metric	Value	Unit	Source
CO_2 Emissions	15,330	Metric tons	Maine DEP Air Emissions Inventory Data: GHG Summaries

Methodology:

- Obtain annual CO_2 emissions for the Bath Iron Works – Bath Facility from the Maine DEP Air Emissions Inventory Database.
- Select the "Emissions from Stationary Fuel Combustion" calculator in ClearPath.
- Select "Yes" under the "Were emissions calculated externally from ClearPath" question and input CO_2 emissions.

Transportation & Mobile Sources

Resident Vehicles – Gasoline & Diesel

Data Sources: Maine Department of Transportation;

Activity Data: Annual VMT per vehicle type in Bath was sourced from Maine Department of Transportation. Vehicle counts distributed by vehicle class, fuel type, and age for Bath was obtained from the Maine DEP Vehicle Emissions and Greenhouse Gas Data. The allocation between gasoline and diesel vehicles per vehicle type, sourced from MDEP, was applied to the VMT per vehicle type, sourced from MDOT, to determine VMT by vehicle and fuel type.

Emissions Factors: National fuel efficiencies and emissions factors for gasoline and diesel use per vehicle type follow ClearPath defaults.

Metric	Value	Unit	Source
Gasoline Passenger Vehicles	26,002,291	VMT	Estimated from Maine Department of Transportation and Maine Department of Environmental Protection data.
Gasoline Light Trucks	7,291,334	VMT	
Gasoline Heavy Trucks	1,738,404	VMT	
Gasoline Motorcycles	923,566	VMT	
Diesel Passenger Vehicles	248,375	VMT	
Diesel Light Trucks	91,990	VMT	
Diesel Heavy Trucks	578,537	VMT	

Methodology:

- Obtain VMT by vehicle type in Bath from Maine Department of Transportation.
- Obtain vehicle counts in Bath by vehicle class and fuel type from the Maine DEP Vehicle Emissions and Greenhouse Gas Data.
- Divide the number of diesel passenger vehicles by the total number of passenger vehicles to determine the share of diesel passenger vehicles in Bath.
- Apply the share of diesel passenger vehicles to the total VMT for passenger vehicles to estimate diesel passenger vehicle VMT.
- Subtract diesel passenger vehicle VMT from total passenger vehicle VMT to determine gasoline passenger vehicle VMT.
- Repeat this process for motorcycles, light trucks, and heavy trucks.
- For each vehicle class and fuel type combination, create a record in ClearPath using the “On-Road Transportation” calculator.
- Select “VMT & MPG” as the Calculation Method, “In-Boundary” as the VMT Location, and “Passenger” as the Travel Type.
- Input VMT for each vehicle type and fuel type combination record, and enter “100%” under the respective Percent Vehicle Type field.
- The ClearPath tool will multiply fuel consumption and VMT by national default emissions factors per vehicle type to output emissions.

Notes: Emissions from on-road transportation in Bath's GHG inventories to date have been based on measures of total VMT occurring within the city limits derived from simple traffic counts on major roads. While this is an overall good and repeatable measure of traffic activity, it does not indicate much about the transportation demands of Bath residents and workforce. Alternative data sources such as those derived from cell phone and vehicle location data can provide a clearer picture of what Bath resident's individual contributions are; however, those alternatives are currently expensive. Over time options may continue to improve and possibly studies from the State of Maine or Mid-Coast Council of Governments could refine inventory estimates in this sector.

Evolving data availability is a factor that all communities working on climate action must work with. The City of Bath should not shy away from continued improvements in data collection and shifting to improved methodologies even if they lead to inconsistencies with the baselines from which targets were set. As field of local government climate action continues to evolve, it is likely that messaging and updating targets in the future may re-orient in terms of our distance from zero emissions rather than how far we've come from an uncertain starting point.

Solid Waste

Landfilled Waste

Data Sources: Bath Public Works

Activity Data: Tons of municipal solid waste collection sent to landfill from Bath was sourced from the City's Public Works department. The 2011 Maine Residential Waste Characterization Study was used to allocate total tons of landfilled waste by material type.

Emissions Factors: Emissions factors for landfilled waste per material type follow ClearPath defaults.

Metric	Value	Unit	Source
Waste Collected in Bath Sent to the Landfill	4,840	Tons	City of Bath Department of Public Works
Mixed MSW Emissions Factor	0.0648	MT CH_4 / Wet Short Ton	ICLEI ClearPath Defaults
Newspaper Emissions Factors	0.042	MT CH_4 / Wet Short Ton	
Office Paper Emissions Factor	0.1556	MT CH_4 / Wet Short Ton	
Corrugated Cardboard Emissions Factor	0.1048	MT CH_4 / Wet Short Ton	
Food Scraps Emissions Factors	0.0648	MT CH_4 / Wet Short Ton	
Leaves Emissions Factor	0.026	MT CH_4 / Wet Short Ton	

Branches Emissions Factor	0.058	MT CH_4 / Wet Short Ton	
Dimensional Lumber Emissions Factor	0.0068	MT CH_4 / Wet Short Ton	

Methodology:

- Obtain total landfilled waste from the City's Department of Public Works.
- Add the 2011 Maine Residential Waste Characterization to the Factor Sets in ClearPath.
- Input tons of landfilled waste into ClearPath using the "Landfilled Waste" calculator.
- Select the ME Solid Waste Characterization factor set in the ClearPath calculator.
- Select the "Worst-Case Collection" as the Landfill Methane Collection Scenario, "Moderate" as the Landfill Moisture Content, and "Inside the Jurisdiction" as the Disposal Location.
- The ClearPath tool will multiply tons of landfilled waste by default emissions factors per material type to output emissions.

Composted Waste

Data Sources: Bath Public Works

Activity Data: Tons of municipal solid waste collection sent to compost was sourced from the City's Public Works department.

Emissions Factors: Emissions factors for composted waste per material type follow ClearPath defaults.

Metric	Value	Unit	Source
Green Waste Collected in Bath Sent to Compost	95	Tons	City of Bath Public Works Department
CH_4 Emissions Factor	0.0044	MT CH_4 / Ton	ICLEI ClearPath Defaults
N_2O Emissions Factor	6.7×10^{-5}	MT N_2O / Ton	

Methodology:

- Input tons of composted green waste into ClearPath using the "Biologic Treatment of Solid Waste (Composting)" calculator – selecting "Green Waste" as the waste type and "Generated and Disposed In-Boundary" as the disposal location.
- The ClearPath tool will multiply tons of composted green waste by default emissions factors to output emissions.

Landfill Gas Flared

Data Sources: Bath Public Works

Activity Data: Volume of landfill gas flared was sourced from the City's Public Works department.

Emissions Factors: Emissions factors for flaring of landfill gas follow ClearPath defaults.

Metric	Value	Unit	Source
Landfilled Gas Flared	8,030,000	Cubic Feet / Year	City of Bath Public Works Department
Fraction of CH_4 in Landfill Gas	0.50	Decimal	ICLEI ClearPath Defaults
Destruction Efficiency	0.99	Decimal	
CH_4 Emissions Factor	9.3673×10^{-8}	MT CH_4 / Scf	

Methodology:

- Input the volume of flared landfill gas into ClearPath using the "Emissions from Flaring of Landfill Gas" calculator.
- Keep the ClearPath defaults of the fraction of CH4 in Landfill Gas and the Destruction Efficiency as is.
- The ClearPath tool will multiply the volume of flared gas by default emissions factors to output emissions.

Water & Wastewater

Water Treatment – Electricity Use

Data Sources: Bath Water District

Activity Data: Electricity used for the extraction, treatment, and distribution of potable water for residents and businesses of Bath was sourced from the Bath Water District.

Emissions Factors: Emissions factors for purchased electricity follow best practice guidance to utilize a 'location-based' assessment of GHG emissions to establish the physical reality of the impact of grid energy consumption. A complete accounting of GHGs from combustion generation resources needs to include factors for CO_2, CH_4, and N_2O. These were sourced from U.S. EPA eGRID and were entered into the ClearPath tool factor sets.

Metric	Value	Unit	Source
Electricity Use for Potable Water	900	MWh	Bath Water District
CO_2 Emissions Factor	536.4	lbs / MWh	EPA eGRID 2022, NEWE Subregion
CH_4 Emissions Factor	63	lbs / GWh	
N_2O Emissions Factor	8	lbs / GWh	

Methodology:

- Add EPA eGRID emissions factors to the Factor Sets in ClearPath.

- Obtain electricity used for potable water treatment and delivery from the Bath Water District.
- Input electricity use into ClearPath using the "Emissions from the Supply of Potable Water" calculator.
- Select the EPA eGRID 2022 NEWE emissions factors in the ClearPath calculator.
- The ClearPath tool will multiply electricity consumption by eGRID emissions factors to output emissions.

Wastewater Treatment – Electricity & Natural Gas Use

Data Sources: Bath Wastewater Division

Activity Data: Electricity and natural gas used at the wastewater facility was sourced from the Bath Wastewater Division.

Emissions Factors: Emissions factors for purchased electricity follow best practice guidance to utilize a 'location-based' assessment of GHG emissions to establish the physical reality of the impact of grid energy consumption. A complete accounting of GHGs from combustion generation resources needs to include factors for CO_2, CH_4, and N_2O. These were sourced from U.S. EPA eGRID and were entered into the ClearPath tool factor sets.

Emissions factors for natural gas follow ClearPath defaults.

Metric	Value	Unit	Source
Electricity Use at the Wastewater Facility	1,215	MWh	Bath Wastewater Division
Natural Gas Use at the Wastewater Facility	1,064	MMBtu	
Electricity CO_2 Emissions Factor	536.4	lbs / MWh	EPA eGRID 2022, NEWE Subregion
Electricity CH_4 Emissions Factor	63	lbs / GWh	
Electricity N_2O Emissions Factor	8	lbs / GWh	
Natural Gas CO_2 Emissions Factor	0.05302	MT / MMBtu	ICLEI ClearPath Defaults
Natural Gas CH_4 Emissions Factor	5×10^{-6}	MT / MMBtu	
Natural Gas N_2O Emissions Factor	1×10^{-7}	MT / MMBtu	

Methodology:

- Add EPA eGRID emissions factors to the Factor Sets in ClearPath.
- Obtain electricity and natural gas used at the wastewater treatment facility from the Bath Wastewater Division.

- Input electricity and natural gas use into ClearPath using the "Emissions from Wastewater Treatment Energy Use" calculator.
- Select the EPA eGRID 2022 NEWE emissions factors in the ClearPath calculator.
- The ClearPath tool will multiply electricity and natural gas consumption by eGRID and national default emissions factors to output electricity and natural gas-based emissions, respectively.

Wastewater Treatment – Process Emissions

Data Sources: Bath Wastewater Division

Activity Data: The population served by the City's wastewater treatment facility was sourced from the Bath Wastewater Division.

Emissions Factors: The process N_2O emissions factor for the population served by a wastewater treatment facility follow ClearPath defaults.

Metric	Value	Unit	Source
Population Served by the Wastewater Treatment Facility	8,788	People	Bath Wastewater Division
Industrial Commercial Discharge Multiplier	1.26	Unitless	U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions.
N_2O Emissions Factor for Wastewater Treatment	3.2	Grams / Person	ICLEI ClearPath Defaults

Methodology:

- Input the population served by the wastewater treatment facility into ClearPath using the "Process N2O Emissions from Wastewater Treatment" calculator – selecting "No" for the inclusion of nitrification/denitrification as a step in the treatment process.
- Input 1.26 as the Industrial Commercial Discharge Multiplier per the U.S. Community Protocol for GHG Emissions.
- The ClearPath tool will multiply population served by the wastewater treatment facility by default emissions factors to output emissions.

Upstream Impacts of Activities

Grid Loss

Data Sources: Central Maine Power

Activity Data: Measured annual electricity use aggregated at the residential, commercial, and industrial sectors was sourced from Central Maine Power.

Emissions Factors: Emissions factors for purchased electricity follow best practice guidance to utilize a 'location-based' assessment of GHG emissions to establish the physical reality of the impact of grid energy consumption. A complete accounting of GHGs from combustion generation resources needs to include factors for CO_2, CH_4, and N_2O. These were sourced from U.S. EPA eGRID and were entered into the ClearPath tool factor sets.

Metric	Value	Unit	Source
Residential Electricity Use	31,327	MWh	Central Maine Power
Commercial Electricity Use	20,788	MWh	
Industrial Electricity Use	80,221	MWh	
Grid Loss Factor	0.051	Decimal	EPA eGRID 2022, NEWE Subregion
CO_2 Emissions Factor	536.4	lbs / MWh	
CH_4 Emissions Factor	63	lbs / GWh	
N_2O Emissions Factor	8	lbs / GWh	

Methodology:

- Add EPA eGRID emissions factors to the Factor Sets in ClearPath.
- Obtain residential, commercial, and industrial electricity consumption from Central Maine Power.
- Input electricity use into ClearPath using the "Emissions from Electric Power Transmission and Distribution Losses" calculator.
- Select the EPA eGRID 2022 NEWE emissions factors in the ClearPath calculator.
- Input 0.051 as the Grid Loss Factor per the EPA eGRID 2022 NEWE Subregion.
- The ClearPath tool will multiply electricity loss by eGRID emissions factors to output emissions.

Pathways Analysis

BAU Forecast

The business-as-usual forecast is designed here to incorporate likely changes that will influence the background rate of emissions and set the conditions for how reduction strategies may perform over time. Overall, the approach to developing the forecast is to apply growth projections for

population and jobs to indicators of emissions generating activities derived from the 2022 baseline inventory.

Population, Jobs, and VMT Projections

Several factors related to GHG generation rates will change over a nearly 30-year planning horizon. Detailed projections over that period would involve significant speculation, but with some relatively simple inputs, the overall magnitude of expected changes can be anticipated. Key inputs to the BAU projection include the following:

- Population follows the Maine City and Town Population Projections through 2040.[3]
- Jobs follow the statewide employment projections detailed in the Maine.gov Workforce Outlook.[4]

Existing Activity Growth

The baseline rate of activity per capita, job, or VMT for each inventory item was developed from the City's 2022 GHG inventory (Table 1). The activity per year for each inventory item was then calculated from this baseline activity rate and the respective population or VMT projections from 2023 to 2050. The table below details each inventory item and the associated basis of growth.

Table 1. Business-As-Usual Growth Factors Applied to Each Inventory Item

Sector	Sub-Sector	Source	BAU Growth Factor
Buildings	Residential Buildings	Electricity	Population-Based
		Natural Gas	Population-Based
		Fuel Oil	Population-Based
		Propane	Population-Based
		Wood	Population-Based
	Commercial Buildings	Electricity	Job-Based
		Natural Gas	Job-Based
		Fuel Oil	Job-Based
	Industrial Buildings	Electricity	No Growth
		Natural Gas	No Growth
Transportation	Passenger Vehicles	Gasoline	Population-Based
		Diesel	Population-Based
	Light Trucks	Gasoline	Population-Based
		Diesel	Population-Based
	Heavy Trucks	Gasoline	Population-Based
		Diesel	Population-Based
	Motorcycles	Gasoline	Population-Based
	Shuttle Bus	Gasoline	No Growth

[3] Maine City and Town Population Projections 2040, Maine Department of Administrative and Financial Services (2023).
[4] Workforce Outlook: Employment and Job Openings in Maine in 2022 and Projected 2032, Maine.gov Center for Workforce Research and Information (2023).

	Trolley	Gasoline	No Growth
Solid Waste	MSW Collection	Waste Landfilled	Population-Based
		Waste Composted	Population-Based
		Landfilled Gas Flared	No Growth
Water & Wastewater	Wastewater Treatment Facilities	Electricity	Population-Based
		Natural Gas	Population-Based
		Fugitive N2O	Population-Based
	Water Treatment Facilities	Electricity	Population-Based
Upstream Impacts	Residential Grid Loss	Electricity	Population-Based
	Commercial Grid Loss	Electricity	Job-Based
	Industrial Grid Loss	Electricity	No Growth

Changes in Emissions Intensity

The baseline rate of emissions per unit of activity for each inventory item was derived from the City's 2022 GHG inventory. The 2022 baseline emissions intensities for all non-electricity-sourced inventory items were held constant through 2050.

A significant variable in GHG reduction outcomes is the emissions intensity of grid electricity. While there are state policies in place to impact the carbon intensity of the grid, these policies also play out in an interconnected region that determines the actual mix of generation sources used. Future scenarios of grid carbon intensity are complex and uncertain.

Scenarios developed by the National Renewable Energy Lab Cambium project provide the most realistic estimates of how change will occur to this variable, incorporating likely influences of state and federal policy, technology change, and transmissions constraints. The City's BAU forecast follows the grid carbon intensity values projected by the NREL Cambium Model under the 95% decarbonization by 2050 scenario – assuming that further progressive policies at the state and federal level will result in near-zero emissions intensities by 2050.[5]

Projected Emissions

Emissions of each inventory item were projected from 2023 to 2050 based on the projected changes in the levels of GHG-generating activities and, where relevant, changes to the emissions intensities per year for each year.

GHG Reduction Pathways

Reduction pathways are inherently a simplification of reality and are intended to be representative of the magnitude of change necessary to produce different outcomes for GHG reduction scenarios. It is likely that many of the assumptions underpinning these calculations will change in short order and that should be kept in mind for interpretation of the results and considerations for how rapidly

[5] Cambium 2023 Scenario Viewer, National Renewable Energy Laboratory.

changing technologies and policy landscapes at the state and federal levels will change the trajectory of sources of GHGs in Bath.

Building & Energy

Electrification of Residential Buildings

Residential building emissions reductions were based on the impact of electrifying buildings with natural gas, fuel oil, and propane heating and applying high efficiency retrofits. Calculations are based on the differences in Energy Utilization Index (EUI) values between the base-case buildings and the EUI values for the same buildings operating with the upgraded measure packages detailed in the NREL ResStock End Use Savings Shapes datasets.[6] Changes in EUIs were calculated to determine the electricity rebound that would occur when fossil fuels were removed.

The mix of energy conservation measures for households is assumed to be split between standard weatherization (EUSS Package 1) and standard weatherization + high-efficiency electrification (EUSS Package 9) as detailed in Table 2. This split allows for deep reductions in GHGs through full decarbonization of a targeted share of homes each year while utilizing weatherization retrofits to reduce energy use and associated GHGs in the interim.

Table 2. Implementation Schedule for Residential Building Retrofits

Retrofit	2030	2040	2050
No Action	80%	20%	0%
Standard Weatherization (EUSS Package 1)	0%	0%	0%
Standard Weatherization + High-Efficiency Electrification (EUSS Package 9)	20%	80%	100%

Methodology:

- Obtain energy consumption intensities of single-family residential buildings by heating type per the ResStock baseline dataset filtered to Maine.
- Obtain energy consumption intensities of single-family residential buildings by heating type per the ResStock *Standard Weatherization* Package 1 filtered to Maine.
- Obtain energy consumption intensities of single-family residential buildings by heating type per the ResStock *Standard Weatherization + High -Efficiency Electrification* Package 9 filtered to Maine.
- Determine the percent changes in the energy use intensities (EUIs) of natural gas, fuel oil, propane, and electricity heated buildings (respectively) between the baseline and the two ResStock scenarios.
- Create implementation schedules for existing residential buildings detailing the percent of respective units upgraded to Package 1 and Package 9 by each target year (2030, 2040, and 2050).
- Apply the ResStock scenario-specific percent reductions in natural gas, fuel oil, and propane consumption and the percent rebound of electricity to the City's projected energy

[6] End Use Savings Shapes (EUSS) TMY3 2022.1 Release, NREL ResStock.

usages of existing residential buildings for each target year per the respective implementation schedules.
- Convert the projected reductions in fuel consumption of existing residential buildings to $MTCO_2e$ to determine the respective GHG emissions savings.

Electrification of Commercial Buildings

Commercial building emissions reductions were based on the impact of electrifying buildings with natural gas and fuel oil heating and applying high efficiency retrofits. Calculations are based on the differences in Energy Use Intensity (EUI) values per building type for the base-case compared to the EUI values of the same buildings operating with the upgraded measure packages detailed in the Buildings Sector Report, A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study (Figures 22, 24, and 27).[7] Changes in EUIs per building type were calculated to determine the electricity rebound that would occur when fossil fuels were removed.

While there will likely be a range of implementation levels, for simplicity of modeling and communicating reduction potentials from the sector, only the most aggressive level of building interventions was applied, which was the ECM4 package. This package includes best-in-class equipment for electrification, insulation and shell improvement to passive house standards, and best-in-class appliances and controls. Commercial building emissions reductions were based on the share of building area electrified according to the implementation schedule detailed in Table 3.

Table 3. Implementation Schedule for Commercial Building Retrofits

Sub-Sector	2030	2040	2050
Commercial Buildings	10%	80%	100%

Methodology:

- Estimate the baseline energy use intensities and the EUIs of buildings operating under the Energy Conservation Measure (ECM) package 4 upgrade (per commercial building type) as detailed in the MA Buildings Sector Report.
- Determine the percentage changes in the energy use intensities of fossil fuels and electricity between the baseline and the ECM4 upgrade.
- Create an implementation schedule for existing commercial buildings detailing the percent of building area updated to the ECM4 upgrade by each target year (2030, 2040, and 2050).
- Apply the ECM4 package percent reductions in fossil fuel consumption and the percent rebound of electricity to the City's projected energy usages of commercial buildings for each target year per the implementation schedule.
- Convert the projected reductions in fuel consumption to $MTCO_2e$ to determine GHG emissions savings.

[7] Buildings Sector Report: A Technical Report of the Massachusetts 2050 Decarbonization Roadmap Study, Commonwealth of Massachusetts (2020).

Transportation

Electrification of Bath-Registered Vehicles

Emissions reductions from Bath-registered vehicles were based on the EV conversion schedules per vehicle type detailed in Table 4. These shares were primarily determined by iterating to reach desired reduction targets as increased EV adoption faces among the fewest physical barriers to scaling up quickly as compared to other actions. For comparison, it should be noted that the Massachusetts 2030 Clean Energy and Climate Plan only targets 19.2% uptake of electric passenger vehicles by 2030.[8]

Table 4. Implementation Schedule for EV Adoption

Sub-Sector	2030	2040	2050
Passenger Vehicles	10%	80%	100%
Light Trucks	10%	80%	100%
Heavy Trucks	5%	43%	80%
Motorcycles	10%	80%	100%

Solid Waste

Increased Diversion Rate

The following waste reduction rates were applied to the baseline MSW landfilled: 30% by 2030, 60% by 2040, and 90% by 2050. These reductions were made to stay in sync with a reduction in waste disposed from the baseline according to the Massachusetts Solid Waste Master Plan.[9] The value of the reduction was calculated from the difference in projected waste generation from the BAU forecast.

Additional Calculations

Additional calculations were made for the exploration of specific strategies that were not applied directly to the Pathways Analysis due to assumption constraints or overlap with existing scenarios. In the case of local solar expansion, the contribution of new generation was not applied to the pathways due to recognition of very common solar financing strategies which transfer the renewable energy attributes to a third party, which leads to double counting of those benefits.

Rooftop Solar

The City of Bath estimates that 40% of current buildings are viable for rooftop solar. The pathways analysis assumes that the City of Bath will reach 100% of this potential by 2040. The 2050 target was increased to 60% viable rooftop space, assuming that new technologies will increase the potential of current buildings.

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[8] Appendices to the Massachusetts Clean Energy and Climate Plans for 2025 and 2030: Transportation Sector Metrics, Commonwealth of Massachusetts (2022).

[9] Massachusetts 2030 Solid Waste Master Plan: Working Together Toward Zero Waste, Mass DEP (2021).

The potential of rooftop solar generation was estimated in this analysis with the use of Google Project Sunroof.[10] At the time of this analysis, the City of Bath was not modeled in Project Sunroof; as a result, the City of Lewiston, ME was used as a comparable proxy. Project Sunroof estimates an average system size of 10.2 kW and an annual production of 11,200 kWh per roof in Lewiston.

Table 5. Solar Generation Potential

	2030	2040	2050
Total Number of Buildings	3,225	3,225	3,225
% of Buildings with Viable Rooftop Space	10%	40%	60%
Solar Systems Installed	323	1,290	1,935
Average Systems per Year	40	97	65
Local Energy Produced (MWh)	3,612	14,448	21,672

Average production from this quantity of solar was compared to projected electricity use in each benchmark year as both building energy and transportation are transitioned to this energy source. Results of this analysis indicate that with rooftop solar alone, Bath could self-supply approximately 34% of the 2050 electricity demand in residential and commercial buildings. This is likely a conservative estimate as it does not include potential generation from parking canopies. It also does not incorporate any improvement in solar efficiency which is likely to improve over the time period as well.

Accessory Dwelling Units

At the time of the writing of the Resilient Bath Climate Action Plan, an update to the Bath Zoning Code was underway which is likely to support allowances for expanded housing opportunities within Bath, enabling more live-work opportunities and consequently fewer commuting miles among new residents.

Due to uncertainty around the extent of the zoning update and the number of units anticipated, this impact was not incorporated into the analysis used for the final plan, however these results may have some additional utility in further discussions around adding housing density of any kind within Bath.

Estimating current commuting miles was performed using the US Census Longitudinal Employer Household Dynamics Survey, which provides estimates of the home location for workers in Bath of 21 miles[11].

Assuming a 240 workday per year schedule, every worker that could be accommodated within Bath would avoid approximately 9,990 miles per year, in a 24 mpg vehicle that would avoid 417 gallons of

[10] Data Explorer, Google Project Sunroof (2024).

[11] U.S. Census Bureau. LEHD Origin-Destination Employment Statistics Data (2002-2021) Longitudinal-Employer Household Dynamics Program. https://onthemap.ces.census.gov/

gasoline and approximately 4 MTCO2e per year. These values could be scaled in the future depending on the number of ADU or other missing middle housing is planned for Bath.

GEI Consultants

Consulting
Engineers and
Scientists

Flood Vulnerability Assessment

Bath, Maine

Submitted to:
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\\geiconsultants.com\data\Data_Storage\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\01_ADMIN\Flood Vulnerability Report\Bath Vulnerability Assessment Report_Rev 2023-03-29.docx

Executive Summary

The City of Bath, Maine retained GEI Consultants, Inc. to assess the vulnerability of infrastructure and open spaces (i.e., wetlands and conserved land) to flooding from storm surge, sea level rise, and extreme riverine events. The purpose of the work was to evaluate present-day flood risk, flood risk in 2050, and flood risk in 2100 and recommend next steps towards adaptation, including timelines for when adaptation measures should be in place to limit the impact flooding may have on people, places, and infrastructure within the City.

GEI's work on this project included the development of a 2-dimensional (2D) hydraulic model of the lower Kennebec and Androscoggin rivers to simulate 15 flood scenarios, including average daily tidal conditions at present day sea levels, and average daily tidal conditions for intermediate and high rates of sea level rise in the years 2050 and 2100. Additionally, we developed the model to simulate flooding due to 1% annual chance storm surge and 1% annual chance riverine events for present-day and future sea levels. The hydraulic model was developed using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center – River Analysis System (HEC-RAS) Version 6.3 (USACE, 2022).

The results (i.e., water surface elevation, depth and extent of inundation, duration of inundation) of the flood vulnerability assessment were compiled and organized by land use: transportation, buildings, industries, public safety, power, pump stations, open spaces, and ports. The results for the 15 flood scenarios are summarized in the report and its attachments (figures, tables, and appendices). This study identified the following key assets that warrant adaptation in the near-term based on two critical flood scenarios:

- For present-day sea levels, approximately 1.1 miles of roadways, 44 residential buildings, 4 remediation sites, 4 pump stations, and 146.2 acres of wetland not likely already experiencing flooding due to average daily tides would likely be inundated during combined 1% annual chance ("100-yr") coastal storms and riverine events.

- For average daily tides and average daily streamflows in the year 2050 and assuming 1.5 ft of sea level rise, approximately 0.1 miles of roadways, 13 residential buildings, 2 remediation sites, and 73.8 acres of wetland not likely already experiencing flooding due to average daily tides would likely be inundated during high tides.

The model results were used to identify at-risk locations and develop adaptation timelines for roadways, pump stations, and remediation sites. Based on the results of the flood

vulnerability assessment, we suggest the following locations be prioritized for adaptation efforts due to their present-day risk of flooding:

- Washington Street near the Harward Street intersection, including the eastern end of Harward Street.
- Butler Head Road and Varney Mill Road near the intersection of the two.
- Washington Street near the Hunt Street intersection.
- Commercial Street.
- Hawkes Lane (a private road).
- North Bath Road east of the Varney Mill Road intersection.
- Ridge Road near the Hawkes Lane intersection.
- The Freight Shed Property, Kennebec Tavern and Marina, Dry Cleaning and Dyeing (Brackett's Market), and Old Shipyard remediation sites.
- The Hunt Street, Commercial Street, Harward Street, and the BIW North Yard pump stations.

Additionally, building owners with buildings identified in Figs. 5 and 6 as likely within the limits of flood inundation should consider adapting to flood risk through elevating, flood-proofing, or relocating.

Flood adaptation options for roadways, suggestions for next steps for remediation sites and pump stations and building flood-proofing measures are provided in this report.

1. Introduction

This report presents the methods and findings of a flood vulnerability assessment for the City of Bath, Maine (the "City"). The goal of the study was to assess the vulnerability of public and private infrastructure and open spaces to flood inundation due to coastal storm surge, sea level rise (SLR), and extreme riverine events and identify timeframes for when adaptation measures should be taken to increase the resiliency of the City to the impacts of flooding.

A two-dimensional (2D) hydraulic model of the lower Androscoggin and Kennebec Rivers was developed using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center – River Analysis System (HEC-RAS) software, Version 6.3.0 (USACE, 2022) to simulate flood scenarios due to tidal and riverine events (Fig. 1). The model simulated 15 scenarios to evaluate flood risk, including present-day flood risk, flood risk in 2050, and flood risk in 2100 under both the "commit to manage" and "prepare to manage" SLR scenarios identified by the Maine Climate Council (Maine Climate Council, 2020). The City of Bath is situated along the banks of the Kennebec River, which subjects the City to both extreme tidal events from coastal storms and extreme riverine events that occur along the lower Kennebec and Androscoggin Rivers. Flood risk was evaluated due to extreme coastal events, extreme riverine events, and the combination of the two events for each of the three timeframes identified above.

This project was funded with a Community Action Grant through the Governor's Office of Policy Innovation and the Future (GOPIF) Community Resilience Partnership. While this project was underway, the City of Bath procured funding through the Maine Coastal Program Coastal Communities Grant to enhance the community and stakeholder engagement process around the results and implications from the flood vulnerability analysis and to advance decision-making around flood adaptation. The report provides the technical methods, findings, and recommendations as part of the GOPIF-funded vulnerability assessment. Forthcoming will be an interactive, online ArcGIS StoryMap of the results of the study created by the Gulf of Maine Research Institute (GMRI).

The North American Vertical Datum of 1988 (NAVD88) was the reference datum for elevations in this report and the hydraulic model unless otherwise specified.

2. Project Background

In 2019, the City of Bath adopted a Climate Action Plan that highlights the impacts sea level rise could have on the City of Bath (Kyzivat, 2019). In August 2022, the City of Bath adopted a resolution for a commitment to strengthen climate action, citing a need for committing and preparing to manage for sea level rise, and directed the Climate Action Commission with updating the 2019 Climate Action Plan to meet or exceed goals identified in the Maine Climate Council's 2020 "Maine Won't Wait" Climate Action Plan (City of Bath, 2022a). The City applied for a GOPIF Community Action Grant to advance their goals in climate action. The grant was awarded in 2022 and used to fund this study.

The City of Bath has a history of flooding, including most recently during a December 2022 coastal storm event that inundated roadways in the City for several hours during the high tide at the peak of the storm (Photo 1). The tidal nature of the lower Kennebec River puts the City of Bath at risk of flood inundation during storm surge events.

Photo 1 - December 23, 2022 Flooding near Commercial Street

The City of Bath is located along the western bank of the lower Kennebec River and extends from Merrymeeting Bay, where the Androscoggin River meets the Kennebec River, to the confluence of the Winnegance Creek into the Kennebec River. The downtown area of the City is located near the Sagadahoc Bridge (Route 1 Bridge) crossing. Both the Kennebec and Androscoggin Rivers are influenced by tidal action in the lower reaches of the rivers near the extents of the City of Bath.

The tidal nature of the rivers means that flooding in the area can occur from riverine events, coastal events, or a combination of the two. The Federal Emergency Management Agency's (FEMA) Flood Insurance Rate Maps (FIRMs) provide estimates for 1% annual chance ("100-yr") base flood elevations and flood extents due to coastal events. The FIRMs for the City of Bath specify a flood zone of AE 8, which corresponds to a coastally influenced zone of elevation 8.0 ft NAVD88 (FEMA, 2015a). The impact of a riverine event occurring coincidentally to a coastal storm is not considered in FEMA's study nor is the effect of sea level rise. Existing studies assessing the impact of riverine flooding and the impact of combined riverine and coastal flooding are not readily-available for the City of Bath.

3. Hydrologic and Hydraulic Data

The 2D hydraulic model developed for this study uses tide data measured in the Kennebec River, streamflow measurements from the Kennebec and Androscoggin Rivers, sea level rise projections developed by the National Oceanic and Atmospheric Administration (NOAA) and recommended by the Maine Climate Council, and storm surge data provided by the Federal Emergency Management Agency (FEMA). The data sources are described in further detail below.

3.1 Tidal Data

In November 2022, a Hohonu water level monitor was installed in the Kennebec River near the Maine Maritime Museum located at 243 Washington Street in Bath (Hohonu, 2022). The installation of this monitor was not part of this project; however, water level readings were readily available for download and used in developing tidal hydrographs for use in the hydraulic model. Water level measurements were downloaded for the period between December 4, 2022, and December 6, 2022, and used to develop average daily tidal hydrographs. The water level measurements during this period indicated a peak water surface during high tide of elevation (El.) 4.6 ft and a minimum water surface during low tide of El. -3.1 ft. For reference, the NOAA Tide Gage in Portland, ME, indicated a Mean Higher-High Water (MHHW) elevation of 4.65 ft and a Mean Lower-Low Water (MLLW) elevation of -5.26 ft (NOAA, 2023). The MHHW and MLLW are the average height of the highest and lowest tide recorded at a given tide station each day during the recording period.

Water level measurements from December 22, 2022, to December 25, 2022, were downloaded to use in the development of a tidal hydrograph inclusive of a coastal storm event at an order of magnitude of the December 23, 2022 storm. A peak water surface El. of 7.2 ft was measured at the Hohonu water level monitor in the Kennebec River during the December 2022 storm event. The NOAA Tide Gage in Portland, ME measured a peak water surface elevation of 8.46 ft during the December 2022 storm event.

To develop the 1% annual chance ("100-yr") storm tidal hydrograph, the time series of water level measurements during the December 2022 storm period were scaled up by 1.2 ft so that the peak water surface elevation matched FEMA's 100-yr still water elevation (SWEL) of 8.3 ft for the Kennebec River near Bath, Maine, as indicated by the FEMA Flood Insurance Study (FIS) for Sagadahoc County, Maine (FEMA, 2015b).

The average daily tidal hydrograph and the 100-yr storm tidal hydrograph developed for this study are presented in Fig. 2. To account for sea level rise, each of the hydrographs was scaled by adding a constant value, equivalent to the sea level rise amount used in this study,

to the time series of data used to create theoretical average daily tidal hydrographs and 100-yr storm tidal hydrographs for the years 2050 and 2100.

3.2 Sea Level Rise

The Maine Climate Council recommendations for sea level rise for the years 2050 and 2100 were used as guidance for projected sea level rise estimates to use in this study (Maine Climate Council, 2020). For each timeframe, both "commit to manage" and "prepare to manage" sea level rise amounts were evaluated, for a total of four sea level rise values included as part of this study, summarized in Table 1.

Table 1. Sea Level Rise Estimates for 2050 and 2100

Timeframe	Commit to Manage SLR Amount (ft)	Prepare to Manage SLR Amount (ft)
2050	1.5	3.0
2100	4.0	8.8

3.3 Streamflow Data

The City of Bath is on the western banks of the lower Kennebec River downstream of the confluence with the Androscoggin River. The northern end of Bath is on the banks of Merrymeeting Bay, which is at the confluence of the Androscoggin River with the Kennebec River.

Streamflow values for both rivers were estimated for use in this study.

Average daily river flows and 1% annual chance ("100-yr") river flows were estimated based on U.S. Geological Survey (USGS) stream gage data for the Androscoggin and Kennebec Rivers, the FEMA FIS for Sagadahoc County (FEMA, 2015b), and a study on future peak streamflows in coastal Maine rivers (USGS, 2013).

Average riverine flows for the Kennebec and Androscoggin rivers were developed using mean annual flow values estimated by StreamStats (USGS, 2023a) at the USGS Gage 01049265 (Kennebec River at North Sidney, ME) (USGS, 2023b) and USGS Gage 0105900 (Androscoggin River near Auburn, ME) (USGS, 2023c). The average riverine flows were prorated to get an estimate of streamflow values near the downstream ends of the Androscoggin and Kennebec Rivers, near the City of Bath. The average riverine flows were prorated by the scale factors of 1.2 and 1.1 for the Kennebec and Androscoggin, respectively. The scale factors were based on the ratio of 100-yr streamflow events provided by FEMA for the downstream ends of each river and the 100-yr streamflow event estimated using the USGS flood frequency software PeakFQ (USGS, 2019) at the two USGS gages mentioned above.

The FEMA FIS for Sagadahoc County provides 100-yr peak discharges for the Kennebec River at the inlet to Merrymeeting Bay and for the Androscoggin River at the State Route 201 bridge. The 100-yr discharges provided by FEMA for the Kennebec and Androscoggin Rivers are 233,000 cfs and 106,960 cfs, respectively (FEMA, 2015b).

For the 2050 and 2100 time horizons, 100-yr streamflow values for the Kennebec and Androscoggin Rivers were scaled to account for a likely increase in peak river flows due to climate change. The 2013 USGS report titled "Modeled Future Peak Streamflows in Four Coastal Maine Rivers" (USGS, 2013) estimates that by 2050, peak flows would be evenly distributed between increases and decreases of 25 percent for the four coastal Maine basins studied. For this study, we used a 25% increase in peak streamflow values to estimate streamflows in 2050 during 100-yr riverine events and a 50% increase in peak streamflow values to estimate streamflows in 2100 during 100-yr riverine events. A summary of the average and 100-yr streamflow values for the two rivers and the three time horizons included in this study is provided in Table 2 below.

Table 2. Streamflow Values Used in the Hydraulic Model

River	Present-Day Average Daily Flows (cfs)	Present-Day 100-yr Flows (cfs)	2050 100-yr Flows (cfs)	2100 100-yr Flows (cfs)
Kennebec	12,000	233,000	291,250	349,500
Androscoggin	7,500	106,960	133,700	160,440

Note: Flow values estimated for each river near their discharge into Merrymeeting Bay.

3.4 Flood Scenarios

Fifteen flood scenarios were developed to evaluate the flood risk in the City of Bath. The scenarios incorporated estimates for present-day conditions, estimated 2050 conditions, and estimated 2100 conditions. For each timeframe, three combinations of tidal and streamflow events were used: average daily tides and average riverine flows, 100-yr coastal storm tides and average daily river flows, and 100-yr coastal storm tides combined with 100-yr riverine flows. For the 2050 and 2100 time horizons, two scenarios of sea level rise were included in order to estimate flood risk under both the "commit to manage" and "prepare to manage" sea level rise scenario. A matrix of the 15 flood scenarios used as part of this study is provided in Table 3. The results tables in the later sections of this report correspond to the numbered mapping scenarios in Table 3. Mapping scenarios 1, 4, 7, 10, and 13 correspond with the average tidal conditions and average riverine flows. Areas inundated for these scenarios would likely experience flooding during average daily high tides.

Table 3. Flood Scenarios

Timeframe	SLR Amount (ft)	Tidal Conditions	Riverine Flows	Mapping Scenario
Present Day	0	Average	Average	1
		100-yr	Average	2
		100-yr	100-yr	3
2050	1.5 "Commit to Manage"	Average	Average	4
		100-yr	Average	5
		100-yr	100-yr[1]	6
2050	3.0 "Prepare to Manage"	Average	Average	7
		100-yr	Average	8
		100-yr	100-yr[2]	9
2100	4.0 "Commit to Manage"	Average	Average	10
		100-yr	Average	11
		100-yr	100-yr[1]	12
2100	8.8 "Prepare to Manage"	Average	Average	13
		100-yr	Average	14
		100-yr	100-yr[2]	15

Notes:
1. River flows increased by 25%.
2. River flows increased by 50%.
3. "Commit to Manage" and "Prepare to Manage" sea level rise recommendations from the Maine Climate Council (2020).
4. "100-yr" tidal conditions and riverine flows correspond to the 1% annual chance events.

4. Flood Exposure Methods

4.1 GIS Asset Data

We compiled a GIS database of the assets that were included as part of this vulnerability assessment using data provided by the City of Bath and data from publicly available data sources. The data was organized into nine categories for the vulnerability analysis: transportation, buildings, education, public safety, power, port facilities, industries, open space, and pump stations.

The GIS assets within the transportation category include roads, bridges, transit lines, sidewalks, railroads, and parking lots. Data for roads, sidewalks, and parking lots were provided by the City of Bath. The parking lot data was extracted using the tax parcel map layer. Bridge and railroad data were downloaded from the Maine GeoLibrary (State of Maine, 2022). Data for the Bath City Bus transit lines was digitized using bus routes provided on the City Bus website (City of Bath, 2022b).

The City of Bath provided GIS data for buildings and a tax parcel map with land use categories. These two data sources were used to categorize buildings as commercial, industrial, institutional, municipal, residential, or state-owned. The buildings data was used to identify schools and childcare centers, the library, non-profit organizations, and public safety buildings.

Public safety data consisted of law enforcement and fire station buildings, landfill sites, and remediation sites in a range of stages of remediation. The remediation sites were downloaded from the Maine Department of Environmental Protection (DEP) GIS website (Maine DEP, 2022).

Power data included streetlight and control box locations provided by the City of Bath. Central Maine Power facilities, such as substations, were extracted using the tax parcel database. Locations of port facilities were digitized by GEI based on aerial imagery. For the category of industries, Bath Iron Works (BIW) and the Maine Maritime Museum were included in this study. Their facilities were identified using the tax parcel database.

Open space data consisted of wetlands, city/conservation parcel data, and Kennebec Estuary Land Trust (KELT) data layers. Wetland data was acquired for the state of Maine from the National Wetlands Inventory (U.S. FWS, 2022). City/conservation parcel data and KELT-owned land was extracted from the City's tax parcel database. Additionally, KELT trail data was provided by KELT.

4.2 Hydraulic Model

GEI developed a two-dimensional (2D) hydraulic model of the lower Androscoggin and Kennebec Rivers to simulate the 15 flood scenarios included as part of this study. The model was developed using the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center – River Analysis System (HEC-RAS) software, Version 6.3.0 (USACE, 2022). The model simulates 2D flows using an unsteady analysis, the diffusion equation set, and a 20-second fixed computation interval.

The model simulates flow over an area of approximately 49.2 square miles and along a 10.9-mile reach of the Kennebec River starting at the upstream end of Merrymeeting Bay and continuing to the confluence of Winnegance Creek. The model also includes an 8.4-mile stretch of the Androscoggin River starting upstream near the Route-196 Brunswick-Topsham Bypass Bridge and continuing downstream through Merrymeeting Bay to where it joins the Kennebec River (Fig. 1). The model includes two hydraulic structures: the Sagadahoc Bridge (Route 1 Bridge) and the Carlton Bridge (the old Route 1 Bridge). We also incorporated the effect of smaller structures by hydro-reinforcing the terrain to represent the hydraulic conveyance at several small culverts and bridges. The purpose of the 2D model was to simulate tidal and riverine flow conditions along the Kennebec River for the 15 flood scenarios that were evaluated to estimate peak water surface elevations, flood extents, depths of flooding, and duration of flood inundation at specific locations. The model used stage hydrographs representative of the tidal hydrographs developed for this study at the downstream end of the model and constant flows for the streamflows of the Androscoggin and Kennebec Rivers at the upstream ends of the models. The model grid size was set to 50 ft by 50 ft to optimize for model accuracy, stability, and run time, with a refined area near downtown with cell sizes of 20 ft by 20 ft. Breaklines were input to align the cell faces of the mesh with linear features such as the two bridges and the shoreline of downtown Bath.

The digital elevation model (DEM) (i.e., terrain) for the model was compiled from the following data sources: a 1-meter LiDAR survey downloaded from USGS (USGS, 2020) and a 3-meter resolution NOAA that includes digitized bathymetry data of the Kennebec River (NOAA, 2022). The terrain was modified to include buildings using the buildings shapefile provided to us in the GIS data by the City of Bath. The DEM elevations were referenced to NAVD88.

The 2D flow area included spatially varied Manning's n-values based on the 2016 National Land Cover Database (NLCD) for the Conterminous United States (MRLC, 2019). Manning's n-values were assigned to land cover groups based on Chow (1959) and our engineering judgment.

5. Transportation Flood Exposure Results

The flood exposure of transportation-related infrastructure was evaluated for the 15 flood scenarios, outlined in Table 3, using the methods described in Section 4. The mileages of roads, bus routes, sidewalks, and railroads likely to be inundated under the scenarios included in this study are summarized in Table 4. The acreage of parking lots likely to be inundated during each scenario is summarized in Table 5. The likelihood of bridges and/or bridge approaches being overtopped for each flood scenario evaluated is summarized in Table 6.

For a combined 100-yr coastal storm and riverine event for present-day water levels (Scenario 3), approximately 1.1 miles of roadway are likely to be inundated. By 2050, approximately 0.1 miles of roadway are likely to be inundated during high tides of average daily tide cycles for the "commit to manage" sea level rise estimate and 0.6 miles for the "prepare to manage" sea level rise estimate. During coastal storms and extreme riverine events, estimates for miles of roadways inundated increase, as seen in Table 4.

Maps showing model results of inundated road segments for average daily conditions and combined 100-yr coastal storm and riverine flooding events for the 2050 and 2100 timeframes can be seen in Figs. 3 and 4. In addition to displaying inundated road segments, these figures show the estimated flood extents in 2050 and 2100 due to the combined 100-yr and coastal and riverine event under the "commit to manage" (Fig. 3) and "prepare to manage" (Fig. 4) sea level rise scenario.

Details of the model results for the 15 flood scenarios for each road likely to be inundated are provided in Appendix A. These results include approximate length of roadway inundated, peak water surface elevation, depth of flooding, and duration of flooding during one tide cycle (i.e., a 12-hr time period) that includes the peak water surface elevation. For roads and flood scenarios where higher depths of flooding are predicted to occur, the roads would also likely flood during tide cycles leading up to and following the peak of the storm event.

Table 4. Transportation Flood Exposure Summary (Miles Inundated)

Transportation Asset	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Roads	-	0.7	1.1	0.1	1.5	2.3	0.6	2.8	3.0	0.9	3.0	3.3	3.4	4.9	5.4
Bus Routes	-	0.2	0.3	<0.1	0.5	0.7	0.2	0.9	0.9	0.3	0.9	1.0	1.0	1.3	1.3
Sidewalks	-	0.3	0.4	0.1	0.7	1.1	0.2	1.5	1.6	0.4	1.7	1.7	1.8	2.5	2.6
Railroads	-	0.1	0.1	<0.1	0.2	0.3	<0.1	0.5	0.5	0.1	0.5	0.5	0.5	0.6	0.6

The flood exposure assessment for parking lots included surface parking lots identified in the City tax parcel data. Parking spots along streets and garage parking were not included as part of this study. The model results suggest that less than 0.1 acres of parking lots are estimated

to be inundated during a combined 100-yr coastal storm and riverine event during present-day sea levels. By 2050, approximately 1.0 acres of parking lots are likely to be inundated during combined 100-yr coastal storm and riverine events for the "commit to manage" sea level rise scenario and approximately 1.9 acres for combined 100-yr storm conditions and the "prepare to manage" sea level rise scenario. By 2100, the estimated area of parking lots inundated increases to up to 2.7 acres inundated for combined 100-yr storm conditions and the "prepare to manage" sea level rise scenario.

Many of the parking lots likely to be inundated are in the downtown area along Water Street, Commercial Street, and near King Street as seen in Figs. 3e and 4e.

Table 5. Parking Lots Flood Exposure Summary

Parking Lots	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Acres Inundated	-	-	<0.1	-	0.1	1.0	-	1.7	1.9	-	2.0	2.1	2.2	2.7	2.7

There are eighteen bridges in the City of Bath based on the Maine DOT bridge GIS data (State of Maine, 2022). The model results suggest that two of the bridges would likely be inundated for the flood scenarios evaluated as part of this study: the Whiskeag Bridge (Figs. 3c and 4c) and the Winnegance Bridge. A summary of exposure for each of these bridges is provided in Table 6.

Table 6. Bridge Flood Exposure Summary (Approach and/or Bridge Inundated)

Bridge Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Whiskeag	-	-	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Winnegance	-	-	-	-	-	-	-	-	-	-	-	-	Yes	Yes	Yes

6. Buildings Flood Exposure Results

The flood exposure of building structures in the City of Bath was evaluated for the 15 flood scenarios, outlined in Table 3, using the method described in Section 4 of this report. Building locations and uses (residential, commercial, etc.) were based on GIS buildings data and tax parcel information provided by the City of Bath. A building was considered flooded if the inundation touched the structures. The accuracy of the flood exposure assessment for buildings depends on the accuracy of the GIS data. In some cases, building structures such as garages, sheds, or other non-residential structures were included in the residential buildings count due to the classification method of the GIS data, which could lead to the results over-estimating the number of buildings inundated. In the case of the Bath Iron Works (BIW) property, the buildings GIS data included many structures that may have been temporary at the time, which has possibly overestimated the number of buildings at risk of flood exposure for the "Industrial" use category. Re-classifying the buildings data was beyond the scope of this study. These results should be considered approximate.

Table 7 provides a summary of the flood exposure results for the buildings in the City of Bath, broken down into building use.

The model results for inundated buildings for average daily conditions and combined 100-yr coastal storm and riverine flood events in 2050 and 2100 can be seen in Fig. 5 ("commit to manage") and Fig. 6 ("prepare to manage"). In addition to displaying inundated buildings, these figures show the estimated flood extents due to the combined 100-yr coastal storm and riverine event under the "commit to manage" and "prepare to manage" sea level rise scenario for 2050 and 2100 .

Table 7. Buildings Flood Exposures Summary (Number Inundated)

Buildings	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Buildings Total	***-***	***84***	***92***	***27***	***158***	***187***	***58***	***221***	***233***	***88***	***240***	***251***	***263***	***361***	***377***
Commercial	-	9	9	3	15	22	9	33	35	9	36	37	40	44	44
Industrial (BIW)	-	32	32	10	71	81	19	86	87	32	88	89	89	93	94
Institutional	-	2	2	1	2	3	2	5	5	2	6	6	8	21	21
Municipal	-	4	5	-	7	10	3	10	10	5	10	10	10	15	16
Residential	-	37	44	13	62	70	25	86	95	40	99	108	115	187	201
State	-	-	-	-	1	1	-	1	1	-	1	1	1	1	1

The model results suggest that for combined 100-yr coastal storm and riverine events for present-day sea levels, approximately 92 buildings are likely to experience flooding, which

includes 44 residential building, 9 commercial buildings, 4 municipal buildings, 2 institutional buildings, and 32 industrial buildings. By 2050, approximately 27 buildings are likely to experience flooding during high tides due to the "commit to manage" sea level rise estimate, which includes 13 residential buildings and 10 industrial buildings. The estimates for approximate buildings inundated increases for increased sea level rise and combined coastal and riverine storm events in the 2050 and 2100 time horizons.

This study includes a summary of flood exposure results for buildings owned by Bath Housing, charity organizations, and churches (Table 8). Buildings owned by Bath Housing and buildings classified as churches in the tax parcel data are not likely to experience flood inundation until 2100 during 100-yr storm events under the "prepare to manage" sea level rise scenario. One building listed as a charity organization would be likely to experience flooding in 2050 during 100-yr storm events under the "prepare to manage" sea level rise scenario. This estimate increases to 10 for the 2100 "prepare to manage" sea level rise scenario.

Table 8. Bath Housing, Churches, and Charity Buildings Flood Exposure Summary (Number Inundated)

Buildings	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Bath Housing Buildings	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Churches	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Charity Buildings	-	-	-	-	-	-	-	1	1	-	2	2	2	10	10

Buildings related to education and childcare, such as schools and daycares, were included in this study but the model results suggest that these buildings are not likely to experience flood inundation under the 15 flood scenarios that were evaluated.

7. Industries Flood Exposure Results

Bath Iron Works (BIW) and the Maine Maritime Museum (MMM) were the two industries included as part of this study. Table 9 provides a summary of flood exposure for land parcels associated with these industries and includes land area impacted and an estimated number of buildings inundated. The area for these properties is based on the tax parcel information provided by the City. Note that only the impacted area was included in the totals, not the entire area of the parcel, if only part of the parcel would be inundated.

Table 9. Industries Flood Exposure Summary

Industry	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BIW Area Inundated (acre)	-	7.5	9.1	0.5	28.7	30.9	4.4	33.3	34.1	9.3	34.8	35.0	35.9	39.5	39.8
BIW Area Inundated (%)	-	6.0	7.3	0.4	23.0	24.8	3.5	26.7	27.3	7.4	27.9	28.1	28.8	31.6	31.9
BIW Buildings (# Inundated)	-	32	32	10	71	81	19	86	87	32	88	89	89	93	94
MM Museum Area Inundated (acre)	-	3.2	3.3	1.7	3.8	3.8	2.8	4.3	4.3	3.3	4.6	4.7	5.0	6.6	6.8
MM Museum Area Inundated (%)	-	21.5	22.0	11.8	25.5	25.9	18.8	28.8	29.2	22.6	31.2	31.6	33.7	44.9	45.8
MM Museum Buildings (# Inundated)	-	2	2	1	2	2	2	3	3	2	3	3	3	6	6

The estimated flood extents and buildings impacted for BIW are shown on Figs. 5e-5f and Figs. 6e-6f for the “commit to manage” and “prepare to manage” sea level rise scenarios, respectively. The estimated flood extents and buildings impacted for the MMM are shown on Fig. 5g and Fig. 6g for the “commit to manage” and “prepare to manage” sea level rise scenarios, respectively.

The model results suggest that approximately 9.1 acres of BIW property (representing 7.3% of the BIW property) and 3.3 acres of the MMM property (representing 22.0% of the MMM property) would be likely to experience flood inundation during a combined 100-yr coastal and riverine event under present-day sea levels, impacting approximately 32 and 2 buildings, respectively. By 2050, approximately 0.5 acres and 10 buildings on BIW property and 1.7 acres and 1 building on MMM property would be likely to experience flooding during high tides under the “commit to manage” sea level rise scenario. The estimates for area and buildings impacted increases for increased sea level rise and combined coastal and riverine storm events in the 2050 and 2100 time horizons.

8. Public Safety Flood Exposure Results

This study included an evaluation of the impact to public safety for the 15 flood scenarios. Public safety buildings included law enforcement buildings and the fire station. Areas related to public safety included the landfill site and Maine DEP remediation sites in all stages of remediation. Table 10 provides a summary of the flood exposure results for buildings and areas that may impact public safety.

Table 10. Public Safety Flood Exposure Summary

Public Safety	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Law Enforcement (Yes/No)	-	-	-	-	-	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Fire Station (Yes/No)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Landfill (Yes/No)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Remediation Sites (# Inundated)	-	4	4	2	5	8	4	12	12	4	12	12	13	16	17

The model results suggest that the City of Bath Police Department, along with the parking lot where police vehicles are often parked, is at risk of flooding by 2050 under combined 100-yr coastal storm and riverine events and the "commit to manage" sea level rise scenario (Figs. 5f and 6f). The model results suggest that the fire station and landfill are not likely to experience flood inundation under the flood scenarios evaluated as part of this study.

For remediation sites included as part of the Maine DEP database, four sites are likely to experience flood inundation due to 100-yr storm events for present-day sea levels. By 2050, two sites are likely to experience flooding during high tides due to the "commit to manage" sea level rise scenario and four sites for the "prepare to manage" sea level rise scenario. The estimated number of remediation sites that would likely experience flood inundation increases to 17 sites for a combined 100-yr coastal storm and riverine event in 2100 for the "prepare to manage" sea level rise scenario. Remediation sites are of interest for their potential to expose or release harmful constituents.

A detailed list of the remediation sites, their remediation status, and their estimated flood exposure for the 15 flood scenarios is provided in Appendix B.

9. Power Flood Exposure Results

The flood exposure for power-related assets was evaluated for the 15 flood scenarios described in Table 3. A summary of the flood exposure results is provided in Table 11. The power-related assets included as part of this study were CMP-owned parcels, control boxes, and streetlights.

Table 11. Power Assets Flood Exposure Summary (# Inundated)

Power Asset	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Control Boxes (# Inundated)	-	1	2	-	2	3	-	5	5	1	5	5	5	6	6
Streetlights (# Inundated)	-	41	47	5	73	104	26	127	134	46	142	145	150	171	178
CMP Parcels (# Inundated)	-	1	1	1	1	2	1	3	3	1	3	3	3	3	3
CMP Area Inundated (acres)	-	2.2	2.5	1.8	2.6	3.6	2.0	3.8	4.4	2.2	4.3	4.8	4.9	6.3	6.6
CMP Percent Inundated (%)	-	2.8	3.3	2.3	3.3	4.7	2.7	5.0	5.8	2.9	5.6	6.3	6.4	8.2	8.6

The model results suggest that for a combined 100-yr coastal storm and riverine event for present-day sea levels, 47 streetlights, 2 control boxes, and 2.5 acres of CMP property would be within inundated areas. By 2050 for the "commit to manage" sea level rise scenario, 5 streetlights and 1.8 acres of CMP property would likely experience flooding during high tides and 3 control boxes, 104 streetlights, and 3.6 acres of CMP property would likely be within flood extents of a combined 100-yr coastal storm and riverine event. The estimates for the number of power-related assets within the flood extents increases with higher rates of sea level rise as shown in results summarized in Table 11.

The CMP substation near Washington Street and Castine Avenue can be seen alongside predicted flood extents in 2050 and 2100 for combined 100-yr coastal storm and riverine events under the "commit to manage" and "prepare to manage" sea level rise scenarios in Figs. 5h and 6h, respectively. The property would be likely to be inundated for storm events under both time horizons.

It is important to note that the elevations used to determine if these power assets are within predicted flood boundaries are based on ground-surface elevations from LIDAR data. The actual elevations of electrical equipment, such as control boxes, or components of substations that could be damaged due to flooding, may be higher than the predicted peak water surface elevations from the model results in the event the power assets are, for example, on elevated concrete pads or pole mounted. Field survey of vulnerable electrical equipment should be performed to determine elevations.

10. Pump Station Flood Exposure Results

The potential flood exposure of pump stations within the City of Bath was evaluated for the 15 flood scenarios outlined in Table 3. Table 12 presents a summary of pump stations that would be expected to be inundated during the 15 scenarios. Pump stations within the City-provided GIS database that were not included in this table were not estimated to be impacted during the flood scenarios evaluated in this study.

Table 12. Pump Stations Flood Exposure Summary (Y/N)

Pump Stations	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total Impacted	-	***4***	***4***	-	***4***	***5***	***2***	***6***	***6***	***4***	***7***	***7***	***7***	***9***	***9***
Hunt St	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Commercial St	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Harward St	-	Y	Y	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y
Private - BIW North Yard	-	Y	Y	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y
Castine Ave	-	-	-	-	-	Y	-	Y	Y	-	Y	Y	Y	Y	Y
Riverview Rd	-	-	-	-	-	-	-	Y	Y	-	Y	Y	Y	Y	Y
Private - Bath Canning Co	-	-	-	-	-	-	-	-	-	-	Y	Y	Y	Y	Y
Bridge St	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	Y
Farrin Place	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	Y

The model results suggest that there are four pump stations likely to be within the flood extents for 100-yr coastal storm events for present-day sea levels: the Hunt Street, Commercial Street, Harward Street, and the BIW North Yard pump stations. By 2050, the Hunt Street and Commercial Street pump stations are estimated to be susceptible to flooding during high tides for the "prepare to manage" sea level rise scenario. By 2100, seven pump stations would be likely to experience flooding during high tides for the "prepare to manage" sea level rise scenario.

It is important to note that the elevations used to determine if these pump stations are within predicted flood boundaries are based on ground-surface elevation from LIDAR data. The actual elevations of the components of the pump stations that may be damaged due to flood inundation or impact the operability of the pump station may be different (i.e., lower or higher) than what was used and alter the flood exposure results. Field survey should be performed to confirm pertinent elevations of the pump stations.

11. Open Space Flood Exposure Results

The flood exposure of open spaces in the City of Bath was evaluated for the 15 flood scenarios included as part of this study. Open spaces included Kennebec Estuary Land Trust (KELT) trails and property, wetlands from the National Wetlands Inventory database (U.S. FWS, 2022), and "City/Conservation" parcels from the City of Bath tax parcel database. Many of the wetlands in the database were within coastal areas and therefore within the extent of present-day average tidal boundaries. For this study, we wanted to see the area of wetlands subjected to coastal flooding that are not likely already experiencing daily tidal action. For the results, we have presented the area inundated as the difference between the area within the predicted flood extents for each scenario and the area within the boundary of average tides and average daily streamflows for present-day conditions. A summary the flood exposure results for open spaces is provided in Table 13.

Table 13. Open Space Flood Exposure Summary

Inundation Open Space	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
KELT Trails (miles)	-	0.1	0.1	<0.1	0.1	0.3	0.1	0.3	0.3	0.1	0.3	0.4	0.4	0.8	1.0
KELT Area (acre)	-	7.9	9.1	5.5	9.9	11.7	7.2	12.0	13.6	8.4	13.4	14.9	15.0	20.6	22.7
KELT Area (%)	-	1.6	1.8	1.1	2.0	2.4	1.5	2.4	2.8	1.7	2.7	3.0	3.0	4.2	4.6
Wetlands Area (acre)	-	116.0	146.2	73.8	153.8	178.0	114.1	178.0	190.6	142.9	184.2	197.4	198.9	223.1	229.4
Wetlands Area (%)	-	26.1	32.9	16.6	34.6	40.1	25.7	40.1	42.9	32.2	41.5	44.4	44.8	50.2	51.6
Conservation Parcels	-	26	27	25	30	37	26	38	39	27	39	39	40	44	44
Conservation Area (acre)	-	26.1	29.5	16.7	33.2	39.1	22.6	41.2	45.1	27.8	44.9	48.7	49.0	65.3	72.3
Conservation Area (%)	-	5.0	5.7	3.2	6.4	7.5	4.3	7.9	8.7	5.3	8.6	9.3	9.4	12.5	13.9

The model results suggest that for a combined 100-yr coastal storm and riverine events for present-day sea levels, 9.1 acres of KELT property, 146.2 acres of wetland, and 29.5 acres of City/Conservation parcels would likely be inundated. By 2050, 5.5 acres of KELT property, 73.8 acres of wetland not currently subjected to tidal action due to average daily tides, and 16.7 acres of City/Conservation parcels would likely be subjected to flooding during high tides for the "commit to manage" sea level rise scenario. For the "prepare to manage" sea level rise scenario in 2050, approximately 25.7% of the wetlands not presently subjected to daily inundation due to average daily tidal action would likely experience "nuisance flooding."

For future sea levels, wetlands would likely be subjected to a process known as “coastal squeeze” where coastal wetlands are lost due to increasing depths of water and wetlands are limited in their inland migration due to the presence of impervious infrastructure and/or slopes that are not conducive to wetland migration.

12. Ports Flood Exposure Results

Port facilities included in the flood exposure assessment included the North End Boat Launch (Figs. 5e and 6e), the Waterfront Park Pier (Figs. 5f and 6f), and the South End Boat Launch (Figs. 5j and 6j). Private Port facilities, including those part of Bath Iron Works and the Maine Maritime Museum, were not evaluated as part of this study. A summary of the flood exposure results for ports can be seen in Table 14. A boat launch off Anchor Road near Morse High School was included in the evaluation, but the model results suggested that inundation would not be likely under the flood scenarios included as part of this study. We chose to perform the flood exposure assessment on the top of the ramp/and or pier for each of the locations. Boat ramps and piers are unlikely to be damaged during flood inundation, however, periods of inundation may limit the times when the facilities are usable.

Table 14. Ports Flood Exposure Summary (Y/N)

Ports	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
North End Boat Launch (Top of Ramp)	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
South End Boat Launch (Top of Pier)	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Waterfront Park Pier	-	Y	Y	-	Y	Y	-	Y	Y	Y	Y	Y	Y	Y	Y

For the three facilities likely to be impacted, the model results suggest that they would likely experience flood inundation under present-day sea levels for the combined 100-yr coastal storm and riverine event. By 2050, the North and South End Boat Launches would likely experience flood inundation during average high tides for average daily tidal conditions and average riverine flows under the “prepare to manage” sea level rise scenario. By 2100, the three facilities would likely experience flood inundation during average high tides for average daily tidal conditions and average riverine flows under the “commit to manage” sea level rise scenario. During the periods of inundation, the use of the facilities would likely be limited.

13. Flood Adaptation Recommendations

Measures taken to increase the flood resiliency of a community and adapt to flood risk can fall within a few categories, such as: fortify (keep water out), retreat (move the land use or infrastructure out of the flood inundation extents) or adapt (design the land use or infrastructure to accommodate the water). 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. There is an element of public safety concern that would require forecasting and deployment of road closures during flood events. 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 suggested timelines for adaptation for specific roadways and have provided several adaptation options for the key roadways at risk for flooding in the near-term time horizon. We have also highlighted specific pump stations and remediation sites that are at a risk of flood exposure in the near-term, medium-term, and the long-term time horizon for follow-up field investigation and survey. In addition to the specific roadways, pump station, and remediation sites, we have provided general flood adaptation guidelines and resources for building owners. It is possible that actual storm events could result in unanticipated adverse conditions not accounted for in this study.

13.1 Flood Adaptation Recommendations for Road Networks

We have suggested timelines for road adaptation based on the risk of flood exposure and the impact inundation would have on community members, such as the number of buildings that would be inaccessible if a roadway was blocked due to flooding and if alternate routes are available. Roadways have a relatively low sensitivity to flooding and our recommendations assume that roads would remain operable after experiencing flood inundation. This study does not provide guidance on public safety concerns during inundation, and we recommend that the City develop a plan to address potential public safety issues such as flooding along roads.

Tables 15, 16, and 17 provide our recommendations for near-term, medium-term, and long-term road adaptation priorities. We have included the time horizon when the roadway would likely experience flooding due to combined 100-yr coastal storm and riverine events and for when the roadway would likely experience flooding due to average daily tides and average

riverine flows. We have also included whether an alternate route exists for roadway travelers to avoid the inundated segment, the approximate number of buildings that would be impacted due to inundation, and other considerations.

Following the tables of timeline recommendations, we have included adaptation alternatives for the near-term road recommendations.

Table 15. Near-Term Road Recommendations

Road Name	Timeline for 100-yr Storm Flooding[1]	Timeline for Flooding During Average Daily High Tides	Alternate Route?[2]	Approximate # of Buildings Impacted[3]	Other Considerations
Washington Street and Harward Street near the intersection of the two	Present-Day	2050, *Prepare* 2100, *Commit*	No	60	
Butler Head Road	Present-Day	2050, *Commit*	No	14	Access to road dependent on access to Varney Mill Road and either Ridge Road or both North Bath Road and Whiskeag Road.
Varney Mill Road near Butler Head Road Intersection	Present-Day	*2100, Commit*	No	45	Access to road dependent on access to either Ridge Road or North Bath Road and Whiskeag Road.
Washington Street near Hunt Street Intersection	Present-Day	2050, *Prepare* 2100, *Commit*	Yes	7	
Commercial Street north of Route 1 Bridge including Summer, Arch, Broad, and Lambard Streets	Present-Day	2050, *Commit*	Yes	8-20	Buildings impacted are located along Commercial Street and the number of buildings impacted depends on the flood scenario.
Commercial Street and Vine Street, south of Route 1 Bridge	Present-Day	2100, *Commit*	Yes[4]	2 [5]	If this area is inaccessible, access to Water Street from the South would be impacted, but Water Street would likely remain accessible via Centre Street, Elm Street, and Front Street for present-day flood scenarios.

Road Name	Timeline for 100-yr Storm Flooding[1]	Timeline for Flooding During Average Daily High Tides	Alternate Route?[2]	Approximate # of Buildings Impacted[3]	Other Considerations
Hawkes Lane (private)	Present-Day	2100, *Commit*	No	10	Access to road dependent on access to Ridge Road, which is estimated to be accessible during present-day 100-yr storm flooding.
North Bath Road	Present-Day	2100, *Commit*	Yes	4	Access to road dependent on access to Ridge Road and/or Whiskeag Road, which are estimated to be accessible during present-day flood scenarios.
Ridge Road near Hawkes Lane Intersection	2050, *Commit*	2100, *Commit*	No[6]	>150	For flood scenarios where Ridge Road is inaccessible, North Bath Road would likely be inaccessible, cutting off access to Butler Head via North Bath Road and Ridge Roads.

Notes:
1. "100-yr Storm" refers to a combination of a 1% annual chance coastal and riverine event.
2. Alternate routes refers to if the road can be avoided by other travelers coming from non-inundated areas, but alternate routes would likely not be available to areas directly alongside impacted sections of the roads.
3. Number of buildings approximated based on GIS buildings layer and aerial imagery.
4. For present-day flood scenarios, alternate routes available via Centre Street, Elm Street, and Front Street.
5. Assuming access still available via Centre Street, Elm Street, and/or Front Street.
6. The alternate route for the Butler Head Area would be North Bath Road, which would likely be inaccessible during flood scenarios when Ridge Road would be inaccessible.

Table 16. Medium-Term Road Recommendations

Road Name	Timeline for 100-yr Storm Flooding[1]	Timeline for Flooding During Average Daily High Tides	Alternate Route?[2]	Approximate # of Buildings Impacted[3]	Other Considerations
Front Street	2050, *Commit*	2100, *Prepare*	Yes	50	These streets, together with Commercial Street[4], encompass the "downtown" area of the City north of the Route 1 Bridge. The approximate number of buildings impacted assumes these roads would be inundated at the same time.
Water Street					
Centre Street					
Elm Street					
Washington Street between School Street and Centre Street					
King Street	2050, *Commit*	2100, *Prepare*	Yes	2	
Whiskeag Road near Whiskeag Creek	2050, *Commit*	2100, *Prepare*	Yes	6	This section of road includes a culvert between Whiskeag Creek and Whiskeag Pond. The capacity of the culvert for combined coastal and riverine events should be considered for future adaptation measures.
Washington Street near Castine Avenue and including the eastern end of Spring and Hinckley Streets	2050, *Commit*	2100, *Prepare*	Yes	5	Impacted buildings and areas include BIW property and the CMP Substation.
Castine Avenue including southern end of Middle Street	2050, *Commit*	2100, *Prepare*	Yes	6	Included in the likely inundation along Castine Avenue is the CMP Substation at the intersection of Castine Avenue and Washington Street.

Notes:
1. "100-yr Storm" refers to a combination of a 1% annual chance coastal and riverine event.
2. Alternate routes refers to if the road can be avoided by other travelers coming from non-inundated areas, but alternate routes would likely not be available to areas directly alongside impacted sections of the roads.
3. Number of buildings approximated based on GIS buildings layer and aerial imagery.
4. Including connector streets to Commercial Street, such as Summer, Arch, Broad, and Lambard Streets.

Table 17. Long-Term Road Recommendations

Road Name	Timeline for 100-yr Storm Flooding[1]	Timeline for Flooding During Average Daily High Tides	Alternate Route?[2]	Approximate # of Buildings Impacted[3]	Other Considerations
Washington Street near Thorne Head	2050, Prepare 2100, Commit	2100, Prepare	No	10	Access to and from this area depends on accessibility of Washington Street near the Harward Street Intersection, which would likely be inundated during the flood scenarios when this northern section of Washington Street would be likely to be inundated.
School Street	2050, Prepare 2100, Commit	2100, Prepare	Yes	4	Consider addressing in conjunction with Washington Street near the School Street intersection.
Bridge Street	2050, Prepare 2100, Commit	2100, Prepare	Yes	3	Alternate route assumes Route 209 near intersection of Stoney Brook Road in Phippsburg would not be inundated, the area of which was not included in this study.

Notes:
1. "100-yr Storm" refers to a combination of a 1% annual chance coastal and riverine event.
2. Alternate routes refers to if the road can be avoided by other travelers coming from non-inundated areas, but alternate routes would likely not be available to areas directly alongside impacted sections of the roads.
3. Number of buildings approximated based on GIS buildings layer and aerial imagery.

13.1.1 Washington Street and Harward Street

For present day sea levels, approximately 725 ft of Washington Street and 103 ft of Harward Street, near the intersection of the two, are at risk of inundation during a combined 100-yr coastal and riverine storm event. The peak water surface elevation for the storm event is estimated to be approximately 8.9 ft, which would inundate Washington Street and Harward Street with depths of up to 3.5 ft and 1.2 ft, respectively. Washington Street would likely be inundated between 6 and 7 hours during the peak of the storm, with additional periods of inundation likely during high tides on either end of the peak of the storm. The end of Harward Street near the intersection of Washington Street would likely be inundated between 3 and 4 hours during the peak of the storm, with additional periods of inundation likely during high tides on either end of the peak of the storm.

By 2050, approximately 620 ft of Washington Street and 40 ft of Harward Street, near the intersection of the two, would be likely to be inundated during high tides for the “prepare to manage” sea level rise scenario. Washington Street would likely be inundated by depths up

to 2.2 ft for durations between 5 and 6 hours during peak high tide. Depth, durations, and lengths inundated for the other flood scenarios near this location are summarized in Appendix A and flood extents and sections of roadway inundated for the "commit to manage" and "prepare to manage" sea level rise scenarios can be seen in Figs. 3 and 4, respectively.

There are approximately 60 buildings located along Washington Street north of Harward Street, which are only vehicularly accessible via Washington Street. This includes buildings located along Mast Landing and Mariner's Way. If this eastern end of Harward Street and the section of Washington Street north of the Harward Street intersection becomes impassible, these buildings would become inaccessible to emergency vehicles and building occupants would not be able to evacuate or access emergency services. There are no alternate routes available. We have provided three adaptation options for this area below.

Adaptation Option 1: Do Nothing

If the roadways remain as they are, they would likely be subject to flood inundation under the scenarios described above. During times of inundation, the buildings located north of the Washington Street and Harward Street intersection would likely be inaccessible. The City might urge building occupants who may need access to medical services to temporarily seek shelter elsewhere when large 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.

Adaptation Option 2: Elevate the Roads

Elevating the roads above 8.9 ft (approximately 3.5 ft above the low point of Washington Street and 1.2 ft above the low point of Harward Street) would likely remove the risk of road inundation during combined 100-yr coastal storm and riverine events in the near-term and the risk of flooding during high tide in 2050 for both sea level rise scenarios and 2100 for the "commit to manage" sea level rise scenario. Both roadways would still likely be inundated by up to 1.7 ft and 3.2 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise scenarios, respectively. The inundated roadway sections would likely be impassable for several hours during the peak of the storm. It is not clear if buildings in this area have basements that would also be impacted.

Elevating the roads above 10.6 ft (approximately 5.2 ft above the low point of Washington Street and 2.9 ft above the low point of Harward Street) would likely remove the risk of road inundation due to combined 100-yr coastal storm and riverine events in 2050 under the "commit to manage" sea level rise scenario. The roads would still likely be inundated by up to 1.5 ft during the "prepare to manage" sea level rise scenario.

Elevating the roads above 13.4 ft (approximately 8.0 ft above the low point of Washington Street and 5.7 ft above the low point of Harward Street) would likely remove the risk of flood inundation along the roads due to combined 100-yr coastal storm and riverine events in 2050 for both sea level rise scenarios and in 2100 under the "commit to manage" sea level rise scenario.

Adaptation Option 3: Connect Washington Street to High Street North of Harward Street

For this adaptation option, an alternate route to avoid impassable sections of Washington Street would be created by joining Washington Street to High Street, such as by extending Mast Landing. During times of inundation, the inundated area could be avoided by traveling along the alternate route. This option would likely reduce periods of time when the building occupants along Washington Street north of the Harward Street intersection would lose access to and from their buildings.

13.1.2 Washington Street North of the Intersection with Hunt Street

For present day sea levels, approximately 650 ft of Washington Street north of the intersection with Hunt Street would likely experience flood inundation during a combined 100-yr coastal storm and riverine event. The peak water surface elevation for the storm event would be approximately 8.4 ft, which would inundate the road by up to 2.9 ft for around 5 to 6 hours at the peak of the storm.

By 2050, approximately 560 ft of Washington Street north of the intersection with Hunt Street would be likely to be inundated during high tides under the "prepare to manage" sea level rise scenario. Inundation of up to 2.1 ft for approximately 4 to 5 hours during peak high tide would be likely to occur.

There are approximately 7 buildings located along this stretch of Washington Street north of Hunt Street which would be likely to be inaccessible during periods of inundation. These buildings may also have basements that may be flooded. If this section of the road becomes impassible due to flood inundation, occupants within these buildings would likely be inaccessible to emergency vehicles and occupants themselves would not be able to evacuate using Washington Street. Washington Street would still be accessible from the north via Marshall Street and from the south via Robinson Street.

Depth, durations, and lengths inundated for the other flood scenarios near this location are summarized in Appendix A and flood extents and sections of roadway inundated for the 2050 and 2100 timeframe for the "commit to manage" and "prepare to manage" sea level rise scenarios can be seen in Figs. 3 and 4, respectively.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation under the scenarios described above. During times of inundation, the seven buildings located on Washington Street north of the Washington Street and Hunt Street intersection would likely be inaccessible. The City could issue evacuation notices to these building occupants when extreme coastal storm events are anticipated. 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.

Adaptation Option 2: Elevate the Road

Elevating the section of Washington Avenue in this area above 8.4 ft (approximately 2.9 ft above the low point of the road) would likely remove the risk of inundation during combined 100-yr coastal storm and riverine events in the near-term and the risk of flooding during high tide in 2050 for both sea level rise scenarios and 2100 for the "commit to manage" sea level rise scenario. The road would still likely be inundated by up to 1.6 ft and 3.0 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise scenarios, respectively. The roadway would likely be impassable for several hours during the peak of the storm.

Elevating the road above 10.0 ft (approximately 4.4 ft above the low point of the road) would likely remove the risk of flood inundation due to combined 100-yr coastal storm and riverine events in 2050 under the "commit to manage" sea level rise scenario and could provide increased flood protection for buildings located on the west side of the road. The road would still likely be inundated by up to 1.4 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "prepare to manage" sea level rise scenario.

Elevating the road above 12.5 ft (approximately 7.0 ft above the low point of the road) would likely remove the risk of flood inundation due to combined 100-yr coastal storm and riverine events in 2050 under the "prepare to manage" sea level rise scenario and in 2100 under the "commit to manage" sea level rise scenario and could provide increased flood protection for buildings located on the west side of the road.

Adaptation Option 3: Abandon the Road

For this option, the City could explore converting Washington Street north of Hunt Street and south of the Maine Maritime Museum from a roadway into a flood control structure using a combination of gray and green infrastructure methods. The Maine Maritime Museum would still be accessible along Washington Street from the north and Hunt Street could still be used to access Washington Street to the south of the Hunt Street intersection. Alternate access to buildings between Hunt Street and the Maine Maritime Museum could be established from Middle Street.

13.1.3 Butler Head Road and Varney Mill Road

For present day sea levels, approximately 1,315 ft of Butler Head Road and 586 ft of Varney Mill Road, near the intersection of the two, would likely experience flood inundation during a combined 100-yr coastal storm and riverine event. The peak water surface elevation for the combined storm event would be approximately 9.9 ft along Butler Head Road and 9.4 ft along Varney Mill Road, which would inundate the roads by up to 4.3 ft and 1.8 ft, respectively. Butler Head Road would likely be inundated between 6 and 7 hours during the peak of the storm event and Varney Mill Road would likely be inundated between 4 and 5 hours during the peak of the storm event. The roads would likely be inundated during high tides leading up to and following the peak high tide.

By 2050, approximately 402 ft of Butler Head Road would be likely at risk of flood inundation during high tides under the "commit to manage" sea level rise scenario. Inundation of up to 0.6 ft would be likely for approximately 2 to 3 hours during high tide. For the "prepare to manage" sea level rise scenario, inundation of up to 2.1 ft would be likely for approximately 5 to 6 hours during high tide of the average daily tide cycle.

Varney Mill Road would be likely to experience flooding during high tide by 2100 under the "commit to manage" sea level rise estimate. Under this scenario, inundation up to 1.0 ft for approximately 2 to 3 hours during high tide would be likely to occur.

There are approximately 45 buildings for which Varney Mill Road is the sole access, 14 of which stem from Butler Head Road. If Butler Head Road becomes impassible due to flood inundation, the 14 buildings located along the road would be inaccessible to emergency vehicles and building occupants themselves would not be able to evacuate using Butler Head Road. If Varney Mill Road near the intersection of Butler Head Road becomes impassible due to flood inundation, the 45 buildings, including the 14 along Butler Head Road, would be inaccessible to emergency vehicles and building occupants themselves would not be able to evacuate using Varney Mill Road. There are no alternate routes available to these areas.

Depth, durations, and lengths inundated for the other flood scenarios near this location are summarized in Appendix A and flood extents and sections of roadway inundated for the 2050 and 2100 timeframe for the "commit to manage" and "prepare to manage" sea level rise scenarios can be seen in Figs. 3 and 4, respectively.

Adaptation Option 1: Do Nothing

If the roadways remain as they are, they would likely be subject to flood inundation under the scenarios described above. During times of inundation, the 45 buildings accessed from Varney Mill Road, including the 14 buildings accessed solely from Butler Head Road, would likely be inaccessible. The City could issue evacuation notices to these occupants 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.

Adaptation Option 2: Elevate the Roads

Elevating Butler Head Road above 9.9 ft (approximately 4.3 ft above the low point along the road) and Varney Mill Road above 9.4 ft (approximately 1.8 ft above the low point along the road) would likely remove the risk of inundation during combined 100-yr coastal storm and riverine events in the near-term and the risk of flooding during high tide in 2050 under both sea level rise scenarios and 2100 under the "commit to manage" sea level rise scenario.

Butler Head Road would still likely be inundated by up to 2.2 ft and 3.4 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise estimates, respectively. Varney Mill Road would still likely be inundated by up to 2.0 ft and 3.3 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise estimates, respectively. The inundated roadway sections would likely be impassable for several hours during the peak of the storm.

Elevating Butler Head Road above 12.1 ft (approximately 6.5 ft above the low point of Butler Head Road) and Varney Mill Road above 11.4 ft (approximately 3.8 ft above the low point of Varney Mill Road) would likely remove the risk of flooding due to combined 100-yr coastal storm and riverine events in 2050 under the "commit to manage" sea level rise scenario. Butler Head Road would still likely be inundated by up to 1.2 ft and Varney Mill Road by up to 1.3 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 under the "prepare to manage" sea level rise scenario.

Elevating Butler Head Road above 15.0 ft (approximately 9.4 ft above the low point of the road) and Varney Mill Road above 14.3 ft (approximately 6.7 ft above the low point of the road) would likely remove the risk of flood inundation along these roads due to combined 100-yr coastal storm and riverine events in 2050 under both sea level rise scenarios and 2100 under the "commit to manage" sea level rise scenario.

Adaptation Option 3: Re-Route Butler Head Road and Elevate Varney Mill Road

Puffin Lane, located off Blackwater Cove Road (a private road), could be connected to Mallard Road in order to provide alternate access to the buildings along Butler Head Road. Varney Mill Road could be elevated following the recommendations described above. The section of Butler Head Road at risk of flood inundation under the flood scenarios evaluated for this study would remain at risk of flood inundation. During periods of flooding, building occupants located along Butler Head Road could travel south along Mallard Road to Puffin Lane to Blackwater Cove Road. Varney Mill Road, if elevated, could be used to access the

areas along Varney Mill Road north of the Varney Mill Road and Butler Head Road intersection.

13.1.4 Commercial Street

In the near-term, our model results suggest that Commercial Street would have the highest risk of flood exposure for the downtown area. The "downtown area" refers to the general area of flood inundation within Figs. 3e and 4e., which stems from the intersection of Commercial Street and Front Street to the north down to just south of the Route 1 bridge to the south and inland to Middle Street. There are approximately 50 buildings of mainly commercial use that would be impacted by flood inundation in this area and several areas of surface parking lots. This area also includes Bath City Hall, the Bath City Police Department, the Bath Water District, the Bath Area Food Bank, the Neighborhood Café Soup Kitchen, the Washington House Apartments, and the Mid Coast Medical Group Endocrinology and Diabetes facility. Our near-term flood adaptation recommendations for the downtown area are focused on Commercial Street. It would be likely that by adapting areas of Commercial Street, the flood risk to other roads in the "Downtown Area" that are at risk in the 2050 and 2100 timeframes would be reduced.

For present-day water levels, Commercial Street, Summer Street, and Vine Street would likely experience flood inundation during coastal storm events. Approximately 1,481 ft of Commercial Street, including 1,171 ft from the Hampton Inn to Broad Street, and 310 ft on south of Route 1, would be at risk of flood inundation during a combined 100-yr coastal storm and riverine event. Along the northern end of Commercial Street near the waterfront, water depths up to 3.3 ft are estimated to occur for the peak water surface elevation of approximately 8.7 ft. Inundation would occur for approximately 6 to 7 hours during the peak of the storm event. For the combined 100-yr coastal storm and riverine event scenario, 125 ft of the eastern end of Summer Street would also likely experience flood inundation with depths up to 2.3 ft.

Along the southern end of Commercial Street, south of the Route 1 Bridge, the peak water surface elevation would be approximately 7.8 ft for a combined 100-yr coastal storm and riverine event for present-day water levels. This would likely inundate Commercial Street in this area by up to 1.1 ft for approximately 2-3 hours. During the peak of the storm, in addition to 310 ft of Commercial Street in this area, approximately 77 ft of Vine Street would likely experience flood inundation, with depths up to 0.4 ft.

By 2050, approximately 235 ft of Commercial Street, north of the Summer Street intersection, would likely be at risk of flood inundation during high tides under the "commit to manage" sea level rise scenario. Inundation would be likely for approximately 2 to 3 hours during high tide with flood depths up to 0.8 ft. For the "prepare to manage" sea level rise scenario, approximately 752 ft of Commercial Street would likely be inundated with depths up to 2.3 ft north of the Summer Street intersection

Depth, durations, and lengths inundated for the other flood scenarios near this location are summarized in Appendix A and flood extents and sections of roadway inundated for the 2050 and 2100 timeframe for the "commit to manage" and "prepare to manage" sea level rise scenarios can be seen in Figs. 3 and 4, respectively.

Adaptation Option 1: Do Nothing

If the roadway remains as it is, it would likely be subject to flood inundation under the scenarios described above. In the near-term, portions of Commercial Street and neighboring buildings would likely be inaccessible during coastal storm events. During the times of inundation, up to approximately 22 buildings along Commercial Street would be inaccessible. The City could issue evacuation notices for these buildings and temporarily close portions of these streets when large 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.

Adaptation Option 2: Elevate Commercial Street and Side Connector Streets

Commercial Street, if elevated, could reduce the risk of flood exposure along Commercial Street and could act as a flood barrier to roads to the west of Commercial Street in the downtown area. Elevating Commercial Street along the waterfront above 8.7 ft (approximately 3.3 ft above the low point along the road) and along the section south of the Route 1 Bridge to 8.0 ft (approximately 1.3 ft above the low point of the road) would likely remove the risk of flood inundation during a combined 100-yr coastal storm and riverine event in the near-term, the risk of flooding during high tide in 2050 for both sea level rise scenarios, and the risk of flooding during high tide in 2100 for the "commit to manage" sea level rise scenario. Commercial Street would still likely be inundated in 2050 for a combined 100-yr coastal storm and riverine event by up to 1.7 ft and 3.1 ft for the "commit to manage" and "prepare to manage" sea level rise scenarios, respectively. South of the Route 1 Bridge, Commercial Street would still likely be inundated by 2050 during a combined 100-yr coastal and riverine event by up to 2.2 ft and 3.7 ft for the "commit to manage" and "prepare to manage" sea level rise scenarios, respectively.

Elevating Commercial Street (and the eastern ends of Summer Street, Arch Street, and Broad Street) above 10.4 ft (approximately 5.0 ft above the low point of the road near the waterfront and 3.7 ft above the low point of the road south of the Route 1 Bridge) would likely remove the risk of flooding along Commercial Street during a combined 100-yr coastal and riverine event in 2050 under the "commit to manage" sea level rise scenario. This may also reduce and/or remove the risk of flood inundation along other streets in the downtown area.

Commercial Street would still likely be inundated by up to 1.4 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "prepare to manage" sea level rise scenario. The inundated roadway sections would likely be impassable for several

hours during the peak of the storm. If Commercial Street is elevated, drainage should be considered for the area west and north of the road to avoid prolonged ponding due to overtopping of the road during storm conditions in the 2050 time horizon. The eastern ends of Summer Street, Arch Street, and Broad Street could be elevated to meet the final grade of Commercial Street. The inundated roadway sections would likely be impassable for several hours during the peak of the storm events.

Adaptation Option 3: Flood Barrier

A flood barrier system along the waterfront near the Kennebec Tavern and Marina, which is near the low point of Commercial Street, could provide protection again flood inundation during extreme coastal events. A flood barrier in this area could reduce the risk of flood inundation along Commercial Street for combined 100-yr coastal storm and riverine events for present day sea levels and flooding during high tides in 2050 for both sea level rise scenarios evaluated. To reduce the risk of flooding due to coastal storm events in 2050, the flood barrier system would likely need to extend along the waterfront for the length of Commercial Street.

13.1.5 North Bath Road

For present day water levels, approximately 230 ft of North Bath Road, east of Varney Mill Road, would likely experience inundation during a combined 100-yr coastal storm and riverine event. The peak water surface elevation for the combined storm event would be approximately 9.0 ft, which would inundate the road by up to 1.6 ft for approximately 5-6 hours. The road would likely be inundated during high tides leading up to and following the peak high tide.

By 2100, approximately 20 ft of North Bath Road would be likely at risk of flood inundation during high tides under the “commit to manage” sea level rise scenario. Inundation of up to 0.9 ft would be likely for approximately 3 to 4 hours during high tide.

There are approximately four buildings that would be impacted. North Bath Road and Ridge Road provide access to the Butler Head area. Ridge Road would likely be accessible during combined 100-yr coastal storm and riverine events for present-day water levels and for average daily tides in 2050 so it could serve as an alternate route to the Butler Head area if North Bath Road were to be inundated.

Depth, durations, and lengths inundated for the other flood scenarios near this location are summarized in Appendix A and flood extents and sections of roadway inundated for the 2050 and 2100 timeframe for the “commit to manage” and “prepare to manage” sea level rise scenarios can be seen in Figs. 3 and 4, respectively.

Adaptation Option 1: Do Nothing

If the roadway remains as is, it would likely be subject to flood inundation under the scenarios described above. During times of inundation, the four buildings impacted would likely be inaccessible. The City could issue evacuation notices to these occupants of these buildings when extreme coastal storm events are anticipated to occur. Ridge Road could be used as an alternate route to the Butler Head area during times of flood inundation. The City could deploy temporary signs directing vehicles away from the inundated areas. 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.

Adaptation Option 2: Elevate the Road

Elevating North Bath Road above 9.0 ft (approximately 1.6 ft above the low point of the road) would likely remove the risk of inundation during combined 100-yr coastal storm and riverine events in the near-term and the risk of flooding during high tide in 2050 for both sea level rise scenarios. Flooding during high tide would still be likely by 2100 for the "prepare to manage" sea level rise scenario. The road would still likely be inundated by up to 2.1 ft and 3.5 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise scenarios, respectively. The roadway would likely be impassable for several hours during the peak of the storm. Ridge Road would likely be inundated for a combined 100-yr coastal storm and riverine event in 2050 for both sea level rise scenarios and so could not provide an alternate route to Butler Head under this scenario.

Elevating the road above 11.1 ft (approximately 3.7 ft above the low point of the road) would likely remove the risk of flood inundation due to combined 100-yr coastal storm and riverine events in 2050 under the "commit to manage" sea level rise scenario. North Bath Road could be used to access the Butler Head Area under this flood scenario. However, the road would still likely be inundated by up to 1.4 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "prepare to manage" sea level rise scenario. Ridge Road would likely be inundated under these latter flood scenarios which would cut off access to the Butler Head area.

Elevating the road above 14.0 ft (approximately 6.6 ft above the low point of the road) would likely remove the risk of flood inundation due to combined 100-yr coastal storm and riverine events in 2050 under the "prepare to manage" sea level rise scenario and in 2100 under the "commit to manage" sea level rise scenario. North Bath Road could be used to access the Butler Head Area under these flood scenarios.

Adaptation Option 3: Convert the Road to a Bridge

The section of North Bath Road at risk of flood inundation currently impounds a body of water to the south of the road. If the road were to be elevated, the City should consider the impacts of converting the road to a bridge and increasing the capacity of the hydraulic connection north and south of the bridge. There would likely be implications for inundation extents on the southern side of the crossing. The City should engage with an engineering professional to study this adaptation option further if it is a desired option. The level of flood risk reduction would depend on the elevation of the bridge. The impacts on flood risk of various design elevations are provided in **Adaptation Option 2: Elevate the Road**.

13.1.6 Ridge Road and Hawkes Lane

For present day sea levels, approximately 342 ft of Hawkes Lane (a private road) near the intersection with Ridge Road would likely experience flood inundation during a combined 100-yr coastal storm and riverine event. The peak water surface elevation for the combined storm event would be approximately 7.5 ft, which would inundate the road by up to 1.0 ft for approximately 7 to 8 hours during the peak of the storm. The road would likely be inundated during high tides leading up to and following the peak high tide. Ridge Road would not likely experience flood inundation in the near-term for the flood scenarios included as part of this study.

For a combined 100-yr coastal storm and riverine event in 2050, Hawkes Lane would likely be inundated by up to 3.8 ft and Ridge Road would likely be inundated by up to 2.8 ft for the "commit to manage" sea level rise scenario. For the "prepare to manage" sea level rise scenario and a combined 100-yr coastal storm and riverine event, Hawkes Lane would likely be inundated by up to 5.6 ft and Ridge Road would likely be inundated by up to 4.6 ft. The roads would likely be inundated during high tides leading up to and following the peak high tide.

There are approximately 10 buildings for which Hawkes Road is the sole access. If Hawkes Lane becomes impassible due to flood inundation, the 10 buildings located along the road would be inaccessible to emergency vehicles and occupants of these buildings would not be able to evacuate using Hawkes Lane. Ridge Road leads to Varney Mill Road and the Butler Head area. North Bath Road would be an alternate route to Varney Mill Road and the Butler Head area, however, for most of the scenarios when Ridge Road would likely be inundated, North Bath Road would also likely be inundated, which would cut off access to over 150 buildings in the area.

Depth, durations, and lengths inundated for the other flood scenarios near this location are summarized in Appendix A and flood extents and sections of roadway inundated for the 2050 and 2100 timeframe for the "commit to manage" and "prepare to manage" sea level rise scenarios can be seen in Figs. 3 and 4, respectively.

Adaptation Option 1: Do Nothing

If the roadways remain as they are, they would likely be subject to flood inundation under the scenarios described above. During times of inundation, the 150 buildings accessed from Ridge Road and North Bath Road, including the 10 buildings from the private Hawkes Lane, would likely be inaccessible. The City could issue evacuation notices to these occupants of these buildings 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.

Adaptation Option 2: Elevate the Roads

Elevating Hawkes Lane above 7.5 ft (approximately 1.0 ft above the low point along the road) would likely remove the risk of inundation during combined 100-yr coastal storm and riverine events in the near-term. The road would still likely experience flooding during high tide in 2100 under both sea level rise scenarios. Ridge Road would not likely experience flood inundation in the near-term due to the flood scenarios evaluated as part of this study.

Hawkes Lane would still likely be inundated by up to 2.7 ft and 4.5 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise estimates, respectively. Ridge Road would still likely be inundated by up to 2.8 ft and 4.6 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 for the "commit to manage" and "prepare to manage" sea level rise estimates, respectively. The inundated roadway sections would likely be impassable for several hours during the peak of the storm.

Elevating Hawkes Lane and Ridge Road above 10.2 ft (approximately 3.8 ft above the low point of Hawkes Lane and 2.8 ft above the low point of Ridge Road) would likely remove the risk of flooding due to combined 100-yr coastal storm and riverine events in 2050 under the "commit to manage" sea level rise scenario. Both roads would still likely be inundated by up to 1.8 ft during the peak high tide of a combined 100-yr coastal storm and riverine event in 2050 under the "prepare to manage" sea level rise scenario.

Elevating Hawkes Lane and Ridge Road above 13.9 ft (approximately 7.4 above the low point of Hawkes Lane and 6.4 ft above the low point of Ridge Road) would likely remove the risk of flood inundation along these roads due to combined 100-yr coastal storm and riverine events in 2050 under both sea level rise scenarios and 2100 under the "commit to manage" sea level rise scenario.

13.2 Prioritization for Further Investigation of Remediation Sites

Remediation sites included in this study have been categorized into near-term, medium-term, and long-term risk of flood exposure based on the results of the hydraulic model. The estimated timeframes for flood exposure are summarized in Table 18.

In the near-term, we recommend that the City of Bath engages environmental scientists and/or remediation specialists to examine the remediation methods used for the sites at risk of flood exposure in the near-term with remedies currently in place (Freight Shed Property, Kennebec Tavern and Marina, and the Old Shipyard) and assess whether those methods can withstand flood inundation without releasing hazardous substances.

The Dry Cleaning and Dyeing (Brackett's Market) site is listed as in the remediation stage. For this site, we recommend that the City of Bath engages with the remediation specialists who work on the site cleanup to ensure that the remediation methods can withstand flood inundation without releasing hazardous substances.

For sites where flood inundation may release hazardous substances, we recommend that the City and/or State DEP works with remediation specialists to put new solutions in place to reduce the risk of releasing hazardous substances.

Table 18. Flood Risk Time Horizons for Remediation Sites

Remediation Site Name	Remediation Status[1]	Timeline for 100-yr Storm Flooding[2]	Timeline for Flooding During Average Daily High Tides
Near-Term Concerns			
Freight Shed Property	Remedy in place: Closed	Present-Day	2050, *Commit*
Kennebec Tavern and Marina	Remedy in place: Closed	Present-Day	2050, *Commit*
Dry Cleaning and Dyeing (Brackett's Market)	Remediation Stage	Present-Day	2050, *Prepare* 2100, *Commit*
Old Shipyard	Remedy in place: Closed	Present-Day	2050, *Prepare* 2100, *Commit*
Medium-Term Concerns			
Moses and Columbia Block	Remedy in place: Closed	2050, *Commit*	2100, *Prepare*
Bath Iron Works	Remedy in place: Closed	2050, *Commit*	2100, *Prepare*
15 Vine Street	Complaint Investigated	2050, *Commit*	2100, *Prepare*
Stinson Canning Co.	Investigation Stage	2050, *Commit*	2100, *Prepare*
Long-Term Concerns			
Grant Building	Remediation Stage	2050, *Prepare* 2100, *Commit*	2100, *Prepare*

Frank Smith Cleaners	Investigation Stage	2050, *Prepare* 2100, *Commit*	2100, *Prepare*
Coal Pocket	Remediation Stage	2050, *Prepare* 2100, *Commit*	2100, *Prepare*
Prawer Block	Investigation Stage	2050, *Prepare* 2100, *Commit*	2100, *Prepare*

Notes:
1. Remediation status based on ME DEP Remediation Site Database, accessed November 2022.
2. "100-yr Storm" refers to a combination of a 1% annual chance coastal and riverine event.

13.3 Flood Adaptation Recommendations for Pump Stations

The pump stations identified as being at risk of flood exposure under the flood scenarios evaluated as part of this study have been categorized into near-term, medium-term, and long-term time horizons for adaptation measures. These recommendations are based on flood exposure at the ground surface elevation. It is possible that the flood elevation at which a particular pump station could be impacted is higher or lower due to elements elevated above or below ground level. Our recommendations are summarized in Table 19.

For the four pump stations likely at risk of flood exposure in the near-term (Hunt Street, Commercial Street, Harward Street, and the private BIW North Yard Station), we recommend that the City engages with professionals to perform a site assessment of the pump stations to evaluate the limiting elevations that flood water would impact or damage the system (such as the sill of a doorway or the elevation of sensitive electrical equipment). This field survey would help inform the risk of flood exposure of the pump stations.

For pump stations that remain near-term risks, we recommend that the City work with professionals to evaluate adaptation options, such as relocating the pump station, installing a barrier system to keep floodwater out and away, floodproofing the pump station, or elevating the structure.

Pump stations that remain at risk of flooding may contribute to additional localized flooding if the station becomes inoperable. During periods of flood inundation, increased localized flooding may occur.

Table 19. Flood Risk Time Horizons for Pump Stations

Pump Station	Timeline for 100-yr Storm Flooding[1]	Timeline for Flooding During Average Daily High Tides
Near-Term Concerns		
Hunt St	Present-Day	2050, *Prepare* 2100, *Commit*
Commercial St	Present-Day	2050, *Prepare* 2100, *Commit*
Harward St	Present-Day	2100, *Commit*

Private - BIW North Yard	Present-Day	2100, *Commit*
Medium-Term Concerns		
Castine Ave	2050, *Commit*	2100, *Prepare*
Long-Term Concerns		
Riverview Rd	2050, *Prepare*	2100, *Prepare*
Private - Bath Canning Co	2050, *Prepare*	2100, *Prepare*

Notes:
1. "100-yr Storm" refers to a combination of a 1% annual chance coastal and riverine event.

13.4 Flood Adaptation Recommendations for Buildings

There are 92 buildings at risk of flood exposure during combined 100-yr coastal storm and riverine events and 27 buildings at risk of flood exposure during average daily tidal conditions by 2050 under the "commit to manage" sea level rise scenario. We have provided some guidance below on actions building owners can take to increase their resiliency to the damaging effects of flood inundation. For additional guidance, building owners can review the following material provided by FEMA:

1. "Protect Your Home from Flooding" (FEMA, 2020).

2. "Reducing Flood Risk to Residential Buildings that Cannot be Elevated" (FEMA, 2015c).

3. Homeowner's Guide to Retrofitting (FEMA, 2014).

Our first recommendation is for building owners to understand their risk of flood exposure by consulting the tables and flood exposure maps (Figs. 5a-5j and 6a-6j) associated with this report, FEMA Flood Insurance Rate Maps (FIRMs), and the forthcoming ArcGIS StoryMap that will present the results of this study in an interactive, online format.

There are several actions building owners could take to adapt to flood exposure without elevating or relocating the building itself. For buildings at risk of flooding due to extreme events, we recommend building owners elevate indoor and outdoor utilities and electrical system components (such as air conditioners, heat pumps, water meters, electric service panels, outlets, switches) at least one foot above the potential flood elevation. We recommend that building owners secure outdoor fuel storage tanks to limit their potential for mobilization during periods of flood inundation.

Building owners should identify valuable possessions and documents and secure them in an area above the potential floodwater. Additionally, building owners should consider building material when renovating buildings and opt for flood-resistant materials, such as: tile, vinyl, and/or rubber. Basements and foundations should be checked for cracks and sealed to prevent seepage and building-owners should install sump pumps to pump groundwater away

from buildings. This study does not address potential issues related to infrastructure getting wet such as mold.

Buildings at risk of flooding during high tide by 2050 would likely experience daily flood inundation in addition to flooding during extreme coastal events. In addition to the adaptation measures recommended above, these building owners should weigh the options of relocating or elevating the buildings. Building owners would need to consider access to the building and vehicular storage if elevating the building is selected as the adaptation measure.

Using the results of this study, the City of Bath could consider using zoning policies to restrict development in areas at risk of flood exposure, particularly areas at risk of flooding due to flooding during high tide by the year 2050 and/or areas at risk of flooding due to combined 100-yr coastal storm and riverine events due to present-day sea levels.

13.5 Flood Adaptation Recommendations for Wetlands

For future sea levels, wetlands will likely be subjected to a process known as "coastal squeeze" where coastal wetlands are lost due to increasing depths of water and wetlands are limited in their inland migration due to the presence of impervious infrastructure and/or slopes that are not conducive to wetland migration. While the extent of future wetlands may be limited, it is also likely the case that the existing extents of wetlands are the product of land use.

Wetlands migration and development can be facilitated through targeted managed realignment projects on areas of land currently used as grassland or with forests. Even with these efforts, it would be likely that more wetlands could be lost than could be created through managed realignment (McLachlan, 2018). We recommend that the City of Bath engage with a wetlands specialist to review the results from this modeling study and identify areas that would be conducive to managed realignment projects.

14. Limitations

This report presents the results of a flood vulnerability assessment for the City of Bath. The results are based on readily available online information, published references, GIS data provided by the City of Bath, and our professional judgement.

The data, conclusions, and recommendations in this report are based on the data received and reviewed during our analyses. Specifically, elevations of assets are based on ground-surface LIDAR data. Site specific survey should be performed for components of critical infrastructure that are likely above the ground surface (such as control boxes) to determine flood elevations that would cause damage. Additionally, this flood vulnerability assessment included readily available online GIS data and GIS data provided by the City of Bath. This data represents a snapshot in time and assumes that the databases have been maintained with up-to-date information. This study included limited hydraulic analysis and does not include an evaluation of the structural integrity of culverts, bridges, dams, piers, roads, shorelines, and other appurtenances.

The 1% annual chance still water elevation was based on the FEMA FIS for Sagadahoc County (FEMA, 2015b). These model results are limited by the methods FEMA used to develop this value in the lower Kennebec River near the City of Bath. The streamflows were input as constant flows representing the estimated peak flow. The flows during extreme river events would likely build up to the peak and recede back to average conditions over time. Developing storm hydrographs for riverine flows was not included within the scope of this study.

Stormwater infrastructure, such as catch basins, were not included in the hydraulic analysis. Stormwater infrastructure would likely reduce ponding in low lying areas after tide recedes.

Because the methods, procedures, and assumptions used to develop the analysis are approximate, the results should be used only as a guidance. Actual flood inflow volumes, water surface elevations, and flood timing may differ from the results presented in this report.

The professional services for this project have been performed in accordance with generally accepted engineering practices; no warranty, express or implied, is made. Actual conditions are expected to vary from the flood scenarios presented in this report. This study looked at the risk of flood exposure but did not provide a comprehensive assessment of consequences for human health and/or the environment. Our mention of emergency response actions is not meant to be all inclusive but rather to provide an example of where support may be needed such as with local, state, and federal emergency management organizations, public health officials, fire, police, medical professionals, etc.

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

15. References

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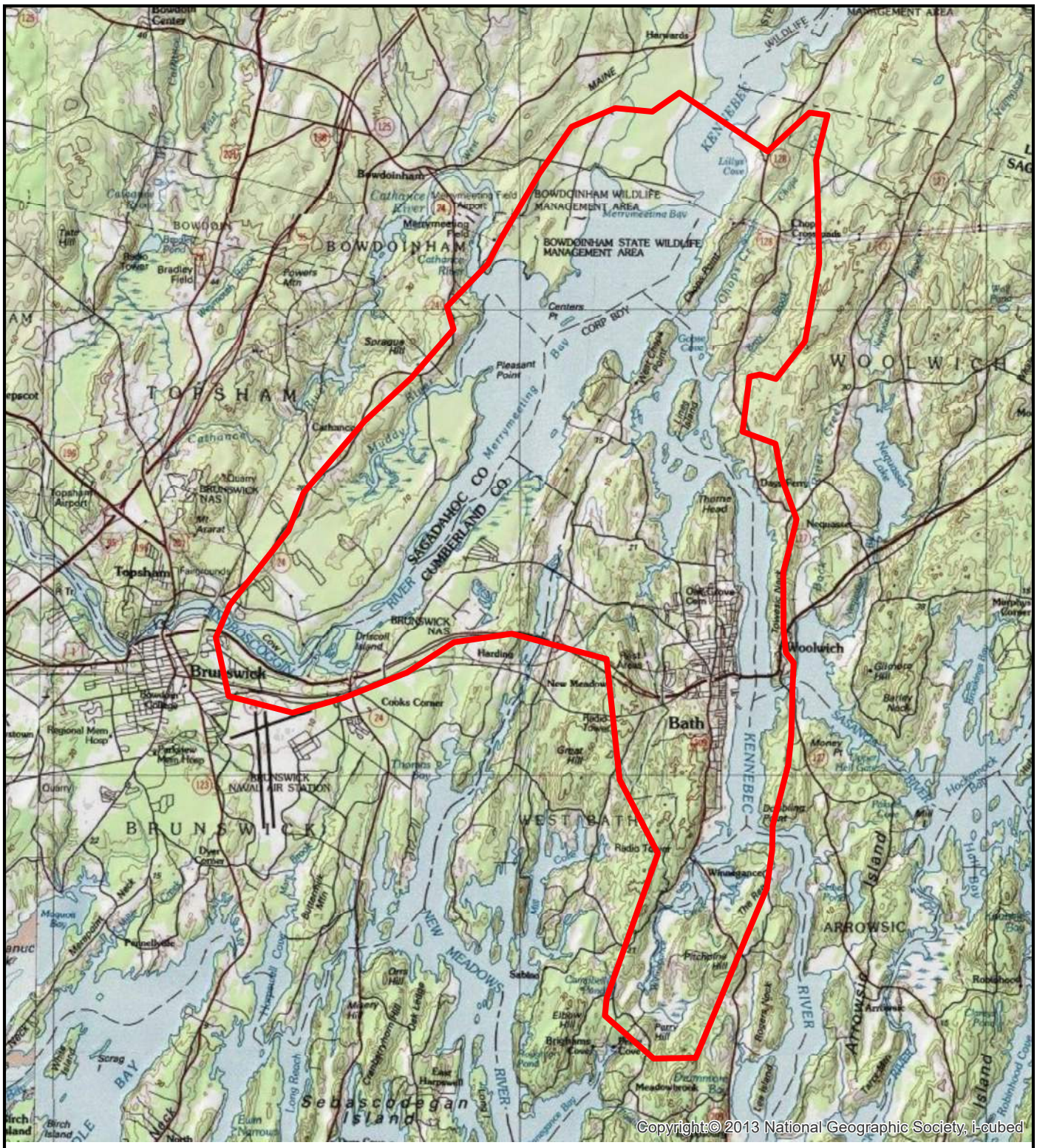
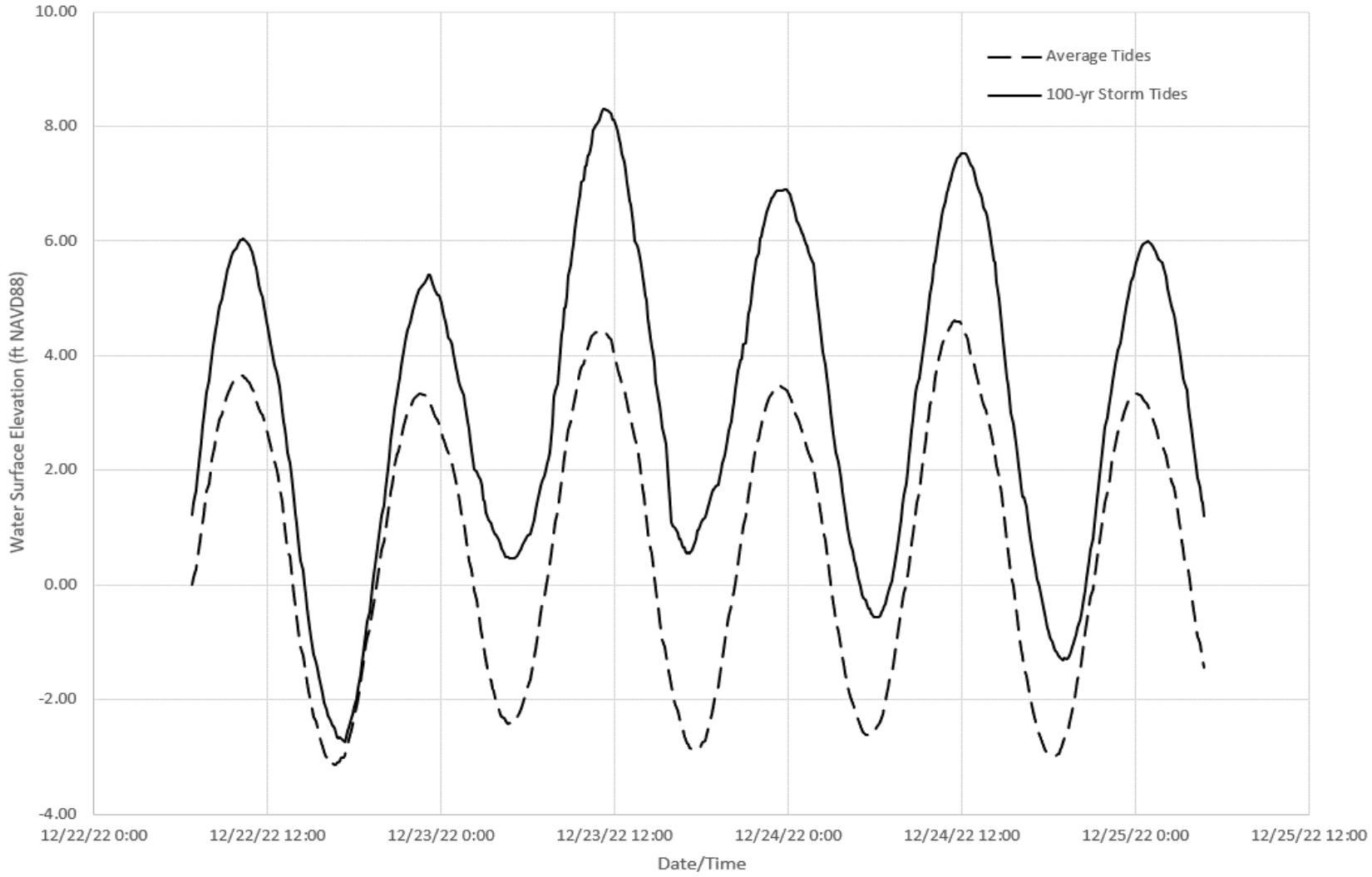
Figures



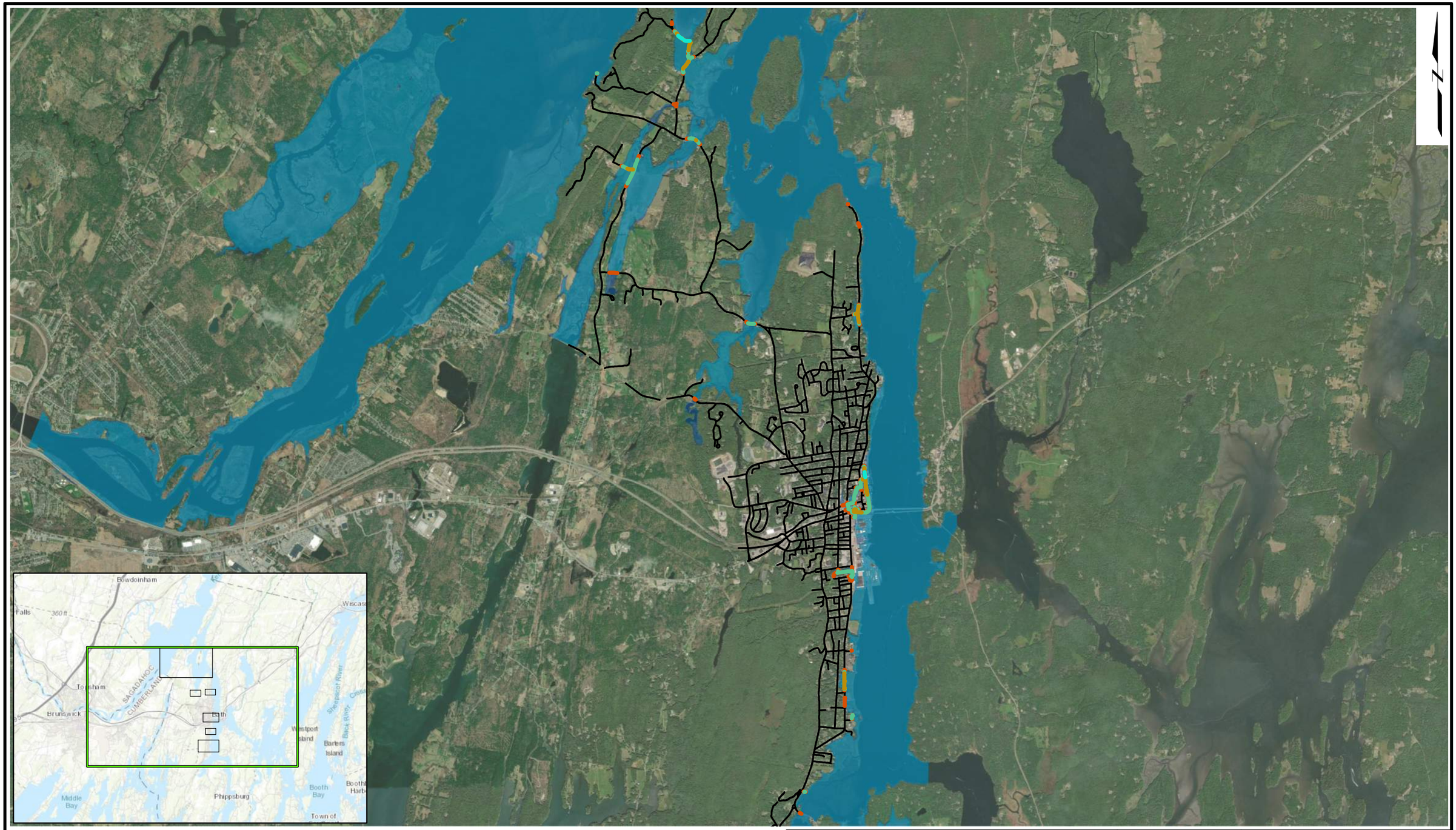
Flood Vulnerability Assessment Bath, Maine	GEI Consultants	2D MODEL AREA AND SITE LOCATION
City of Bath Bath, Maine	Project 2204496	March 2024 Fig. 1

Y:\SHARED\PROJECTS\2022\2204496_Bath_Vulnerability_Study\GIS\Maps\Fig1_2D Model and Site Location.mxd



Flood Vulnerability Assessment **Bath, Maine**	GEI Consultants	**TIDAL HYDROGRAPHS**
City of Bath **Bath, Maine**	**Project 2204496**	**March 2024** **Fig. 2**

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\01_ADMIN\Flood Vulnerability Report\Figures\Figs 2 Tidal Hydrograph.xlsx



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 4000

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

Project 2204496

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

March 2024 Fig. 3a

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_2050_Roads_240319.mxd

Scenario: Max Depth, Duration Flooded
Scenario 4: 0.6 ft, 2-3 hrs
Scenario 6: 6.5 ft, >12 hrs
Scenario 10: 3.1 ft, 5-6 hrs
Scenario 12: 9.5 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 3.8 ft, 8-9 hrs
Scenario 10: 1.0 ft, 2-3 hrs
Scenario 12: 6.7 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 12: 1.8 ft, 3-4 hrs

Scenario: Max Depth, Duration Flooded
Scenario 12: 1.3 ft, 3-4 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 3.8 ft, >12 hrs*
Scenario 10: 0.5 ft, 5-6 hrs*
Scenario 12: 6.7 ft, >12 hrs*

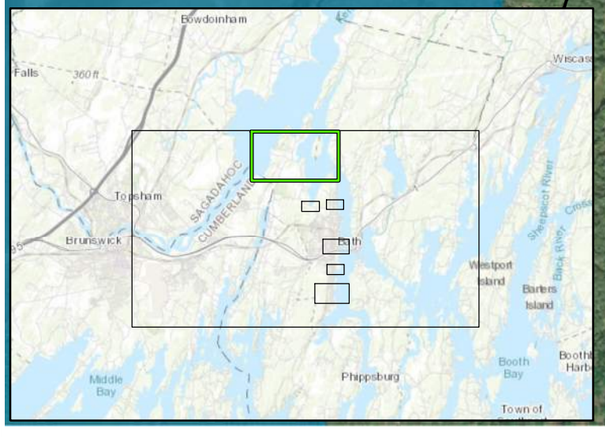
Scenario: Max Depth, Duration Flooded
Scenario 6: 3.7 ft, 9-10 hrs
Scenario 10: 0.9 ft, 3-4 hrs
Scenario 12: 6.6 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 2.8 ft, 10-11 hrs*
Scenario 12: 5.7 ft, >12 hrs*

Butler Head

Lines Island

Osprey Rd
Mallard Rd
Butler Head Rd
Eagle Point Rd
West Chops Point Rd
Puffin Ln
Wren Ln
Cardinal Rd
Blackwater Cove Rd
Varney Mill Rd
Bayshore Rd
Stony Island Rd
Hawkes Ln
Ridge Rd
Rocky Reach Rd
North Bath Rd
Washington St



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 1000
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 3b

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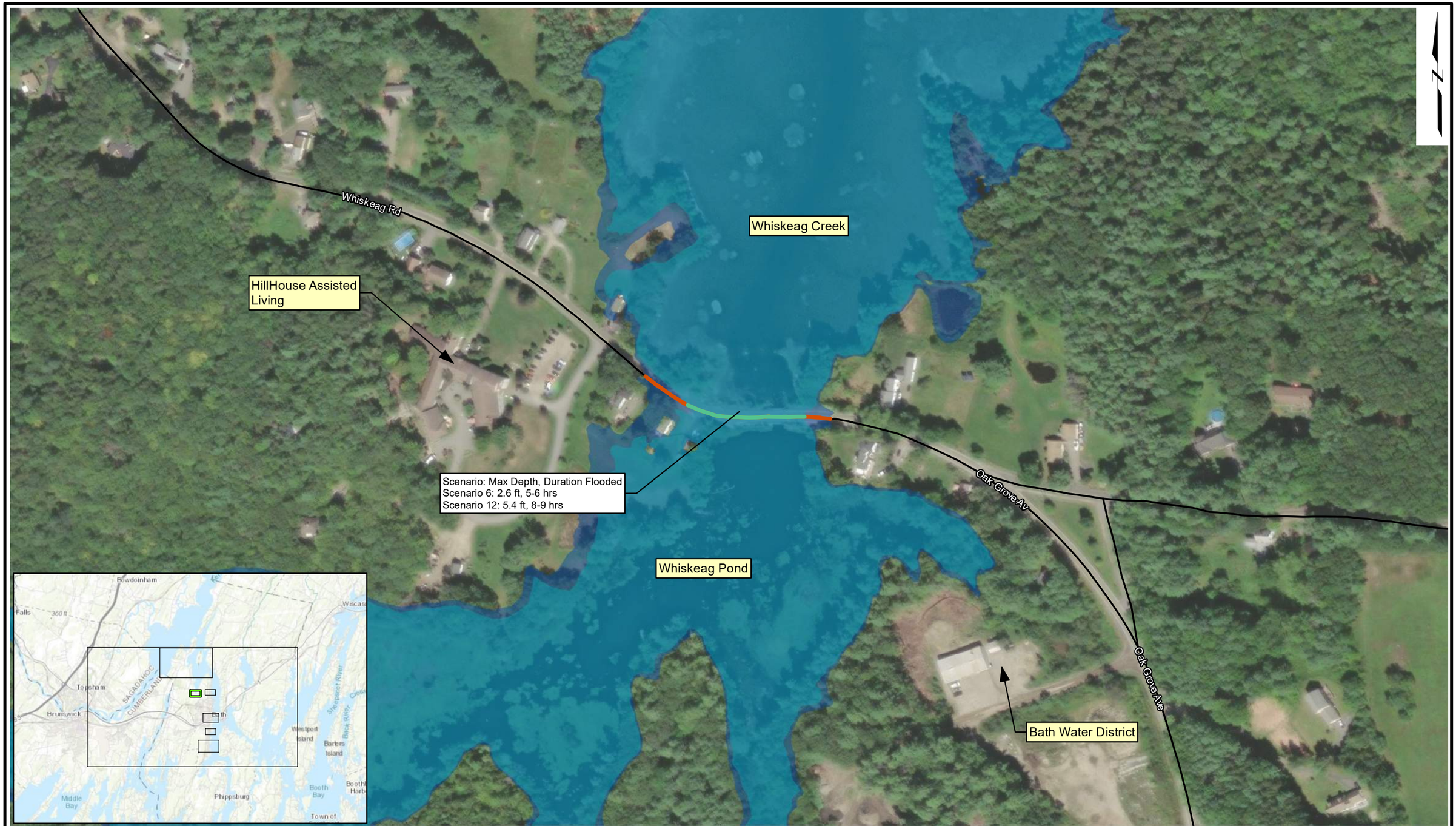


LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 200

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 3c

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_2050_Roads_240319.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

Skyline Dr

Ancona Av

Clearview Av

Calvary Cemetery

Harward St

Barque Rd

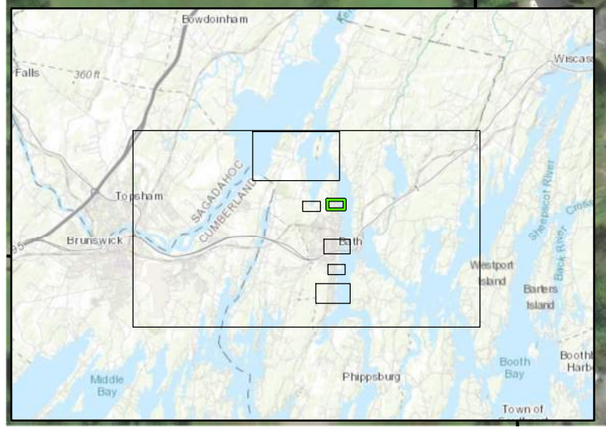
Regatta Ln

Old Sloop Ln

Washington St

Scenario: Max Depth, Duration Flooded
Scenario 6: 2.9 ft, 6-7 hrs
Scenario 10: 0.9 ft, 3-4 hrs
Scenario 12: 5.7 ft, 9-10 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 5.2 ft, 7-8 hrs
Scenario 10: 3.2 ft, 5-6 hrs
Scenario 12: 8.0 ft, >12 hr



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 200

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 3d

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_2050_Roads_240319.mxd

Scenario: Max Depth, Duration Flooded
Scenario 4: 0.8 ft, 2-3 hrs
Scenario 6: 5.0 ft, 8-9 hrs
Scenario 10: 3.3 ft, 7-8 hrs
Scenario 12: 7.7 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 4.0 ft, 7-8 hrs
Scenario 10: 2.1 ft, 5-6 hrs
Scenario 12: 6.7 ft, 11-12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 1.3 ft, 3-4 hrs
Scenario 12: 4.0 ft, 8-9 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 1.3 ft, 3-4 hrs
Scenario 12: 4.1 ft, 6-7 hrs

Scenario: Max Depth, Duration Flooded
Scenario 6: 0.5 ft, 2-3 hrs
Scenario 12: 3.5 ft, 6-7 hrs

Waterfront Park

Scenario: Max Depth, Duration Flooded
Scenario 6: 2.2 ft, 2-3 hrs*
Scenario 12: 5.7 ft, 7-8 hrs*

Bath Water District

Scenario: Max Depth, Duration Flooded
Scenario 12: 1.9 ft, 5-6 hrs

Sagadahoc Bridge
(Route 1 Bridge)

Scenario: Max Depth, Duration Flooded
Scenario 6: 1.3 ft, 2-3 hrs*
Scenario 12: 4.7 ft, 6-7 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 6: 2.9 ft, 4-5 hrs*
Scenario 10: 0.6 ft, 2-3 hrs*
Scenario 12: 5.6 ft, 8-9 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 6: 3.5 ft, 6-7 hrs*
Scenario 10: 1.3 ft, 2-3 hrs*
Scenario 12: 6.2 ft, 8-9 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 6: 1.7 ft, 4-5 hrs
Scenario 12: 4.4 ft, 8-9 hrs

Patten Free Library

Bath Fire and Rescue

Scenario: Max Depth, Duration Flooded
Scenario 6: 0.6 ft, 2-3 hrs*
Scenario 12: 4.1 ft, 9-10 hrs*

Bath City Police Department

Scenario: Max Depth, Duration Flooded
Scenario 6: 1.5 ft, 3-4 hrs*
Scenario 12: 4.8 ft, 7-8 hrs*

Washington House
Appartments

Bath Area Food Bank

Neighborhood Cafe
Soup Kitchen

Bath City Hall

Mid Coast Medical Group
(Endocrinology & Diabetes)

Scenario: Max Depth, Duration Flooded
Scenario 12: 3.2 ft, 6-7 hrs*

Keel St
Bedford St
Garden St
Fremont St
Oak St
Preble Ln
Linden St
Front St
Commercial St
Green St
Summer St
Winter St
Pratt St
Middle St
Winter Street Ct
High St
Chestnut St
Andrews Rd
Elm St
Cobb Rd
Maple St
Page St
Academy St
Arch St
Water St
Broad St
Washington St
Walker St
Centre St
Lambard St
Raymond Ct
Vine St
Off Ramp
School St
Franklin St
King St
Leeman Hwy
Granite St

Bowdoinham
Falls
360 ft
Topsham
Brunswick
SAGADAHOC
CUMBERLAND
Westport Island
Barters Island
Phippsburg
Middle Bay
Booth Bay
Town of

LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 300
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 3e

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_2050_Roads_240319.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

Scenario: Max Depth, Duration Flooded
Scenario 6: 0.6 ft, 2-3 hrs*
Scenario 12: 5.2 ft, 7-8 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 6: 1.8 ft, 4-5 hrs*
Scenario 12: 6.4 ft, 7-8 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 6: 0.9 ft, 3-4 hrs*
Scenario 12: 4.5 ft, 7-8 hrs*

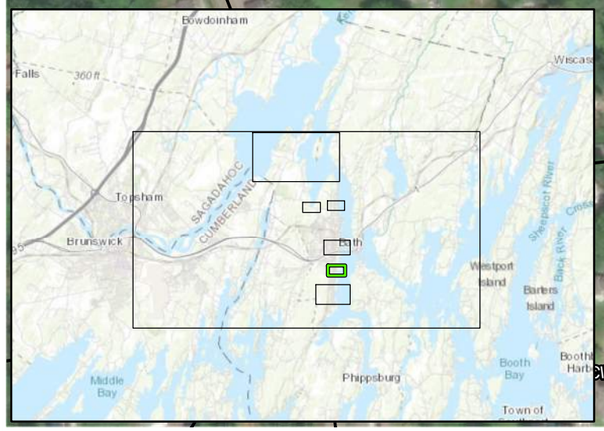
CMP Substation

Scenario: Max Depth, Duration Flooded
Scenario 6: 0.5 ft, 2-3 hrs
Scenario 12: 3.5 ft, 9-10 hrs

General Dynamics
Bath Iron Works

Scenario: Max Depth, Duration Flooded
Scenario 12: 1.4 ft, 3-4 hrs*

Campus Dr
Windlass Ct
Palmer St
Maxwell Street Ct
Nichols Ct
High St
Maxwell St
Middle St
Russell St
Castine Av
Spring St
Hinckley St
Pleasant St
Libby Ct
Shaw St
Pine St
Middle St
Highland St
Washington St
Clifton St



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

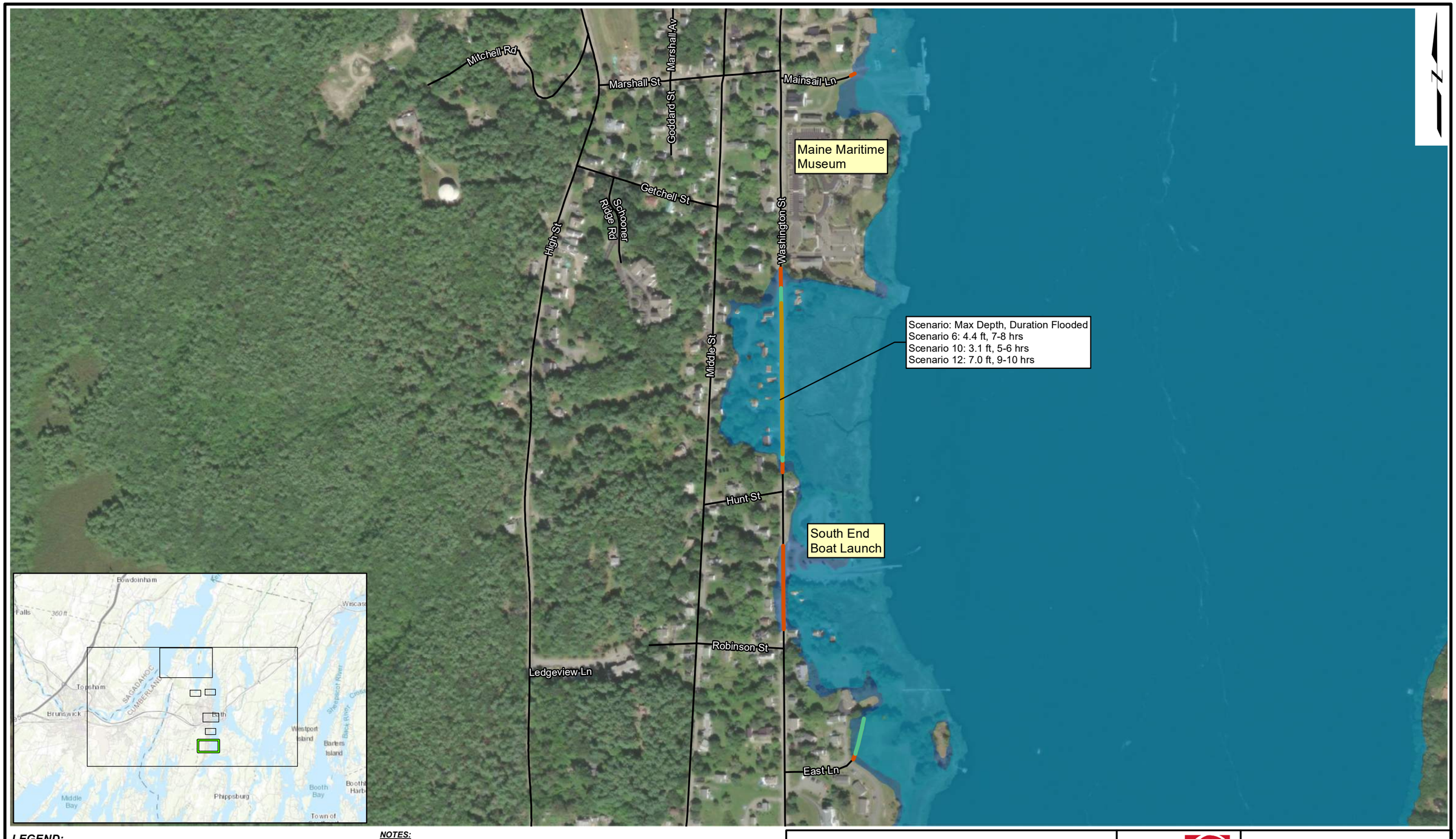
City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 3f

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_2050_Roads_240319.mxd



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundaries shown on map represent Scenario 6 and Scenario 12.
3. Flood durations correspond to time flooded over one tidal cycle (approx. 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 400

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

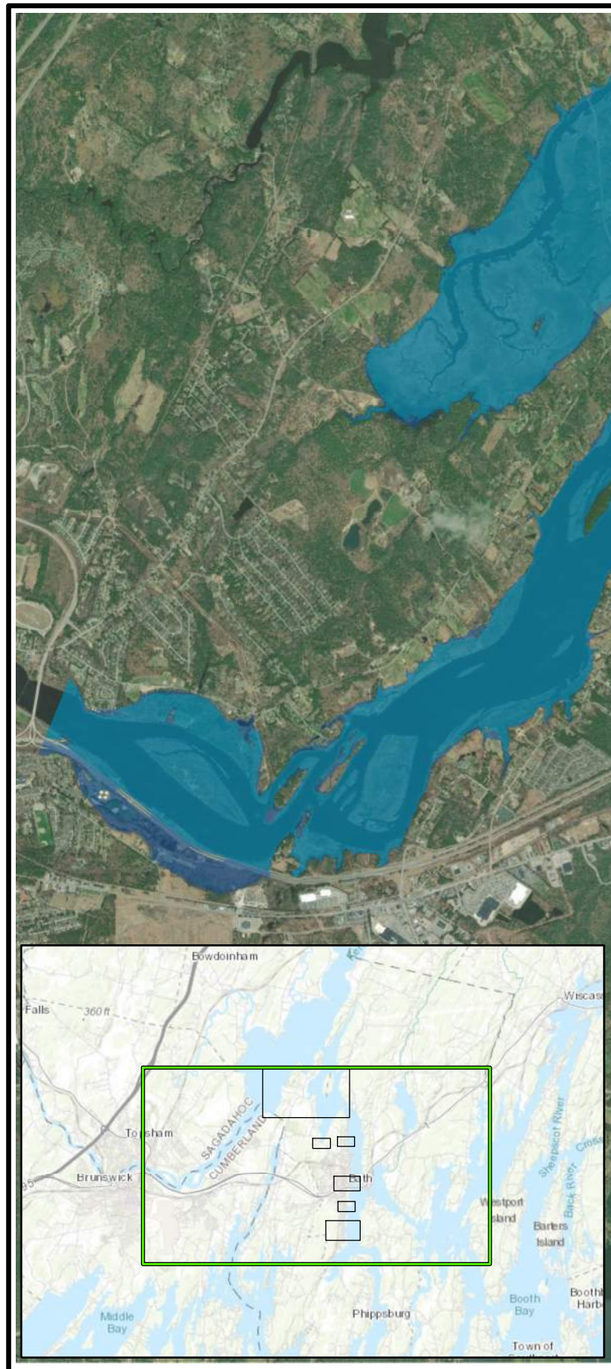
Project 2204496

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

March 2024 Fig. 3g

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_2050_Roads_240319.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage

- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage

- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 4000

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4a

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_Prepare_Roads_240320.mxd

Osprey Rd

Scenario: Max Depth, Duration Flooded
Scenario 15: 2.9 ft, 7-8 hrs

Eagle Point Rd

West Chops Point Rd

Mallard Rd

Scenario: Max Depth, Duration Flooded
Scenario 7: 2.1 ft, 5-6 hrs
Scenario 9: 7.8 ft, >12 hrs
Scenario 13: 7.9 ft, >12 hrs
Scenario 15: 13.6 ft, >12 hrs

Butler Head Rd

Scenario: Max Depth, Duration Flooded
Scenario 15: 2.7 ft, 6-7 hrs

Puffin Ln

Butler Head

Scenario: Max Depth, Duration Flooded
Scenario 9: 5.1 ft, >12 hrs
Scenario 13: 5.8 ft, 9-10 hrs
Scenario 15: 11.0 ft, >12 hrs

Lines Island

Scenario: Max Depth, Duration Flooded
Scenario 13: 1.1 ft, 3-4 hrs
Scenario 15: 6.2 ft, >12 hrs

Cardinal Rd

Blackwater Cove Rd

Varney Mill Rd

Scenario: Max Depth, Duration Flooded
Scenario 13: 0.6 ft, 2-3 hrs
Scenario 15: 5.6 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 15: 5.5 ft, >12 hrs

Bayshore Rd

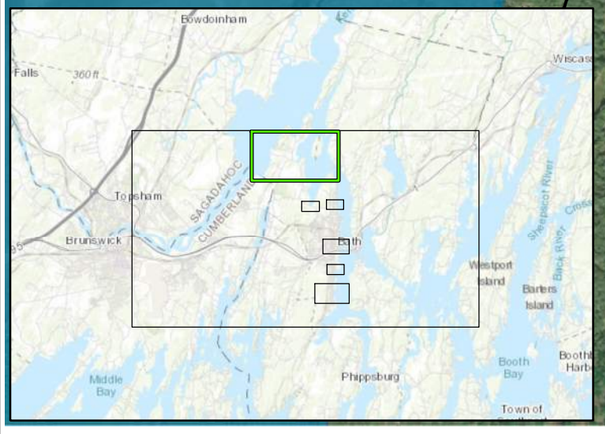
Scenario: Max Depth, Duration Flooded
Scenario 9: 5.6 ft, 11-12 hrs*
Scenario 13: 6.6 ft, >12 hrs*
Scenario 15: 11.9 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 5.1 ft, 11-12 hrs
Scenario 13: 6.0 ft, >12 hrs
Scenario 15: 11.0 ft, >12 hrs

Stony Island Rd

Hawkes Ln

Rocky Reach Rd



Scenario: Max Depth, Duration Flooded
Scenario 9: 4.6 ft, 11-12 hrs*
Scenario 13: 5.6 ft, >12 hrs*
Scenario 15: 10.9 ft, >12 hrs*

North Bath Rd

Ridge Rd

Washington St

LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage

- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage

- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 1000
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

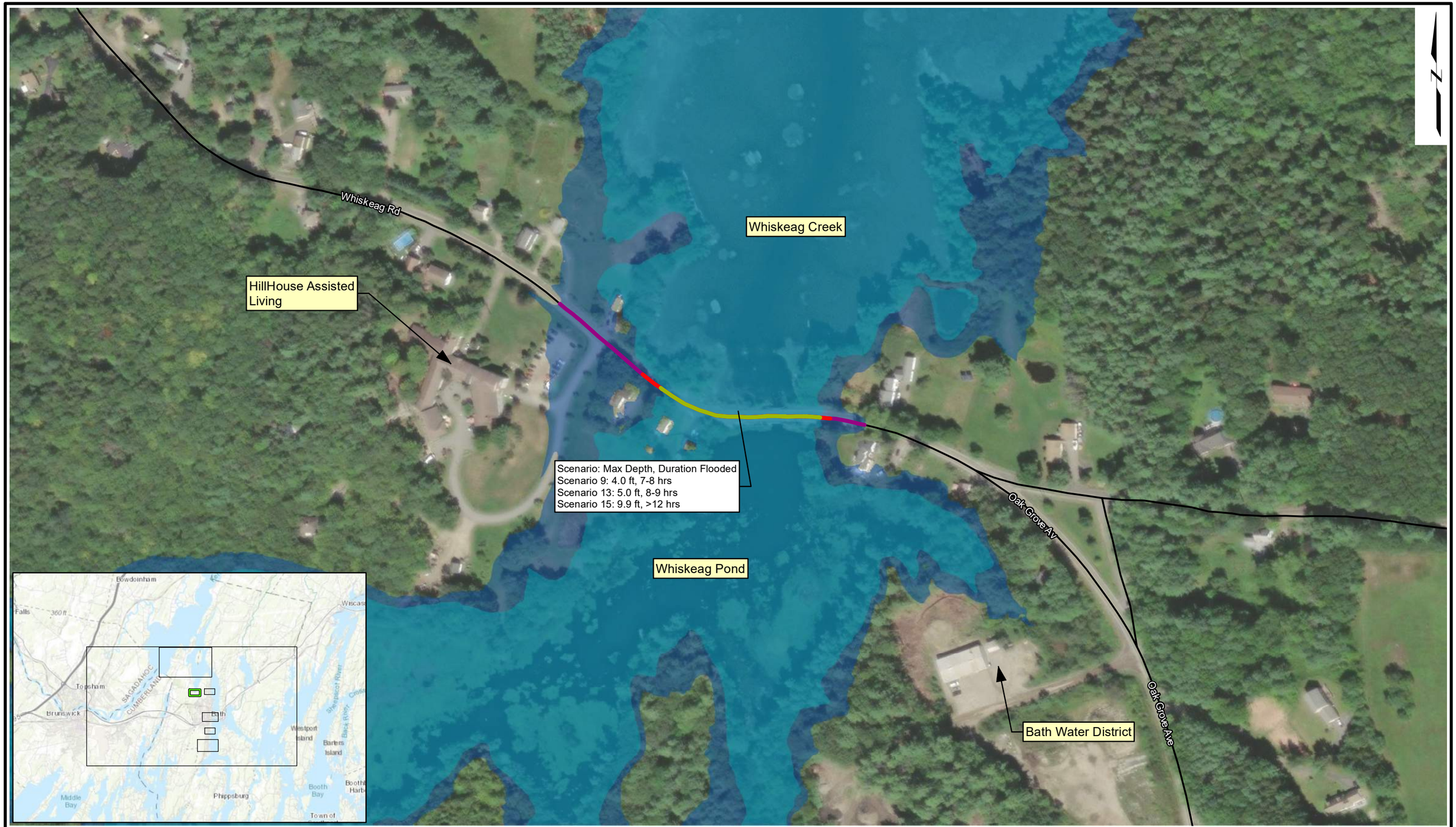
GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4b

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_Prepare_Roads_240320.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4c

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_Prepare_Roads_240320.mxd

LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage

- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage

- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 200

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4d

B:\Working\BATH, CITY OF MAINE\2204496 Bath Vulnerability Study\GIS\Vulnerability_Results_Prepare_Roads_240320.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

Scenario: Max Depth, Duration Flooded
Scenario 7: 2.3 ft, 5-6 hrs
Scenario 9: 6.4 ft, 10-11 hrs
Scenario 13: 8.1 ft, >12 hrs
Scenario 15: 12.3 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 7: 1.1 ft, 3-4 hrs
Scenario 9: 5.4 ft, 8-9 hrs
Scenario 13: 6.9 ft, >12 hrs
Scenario 15: 11.3 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 9: 2.7 ft, 7-8 hrs*
Scenario 13: 4.4 ft, 9-10 hrs*
Scenario 15: 8.6 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 2.8 ft, 5-6 hrs
Scenario 13: 4.3 ft, 7-8 hrs
Scenario 15: 8.6 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 9: 2.0 ft, 4-5 hrs
Scenario 13: 3.5 ft, 7-8 hrs
Scenario 15: 7.8 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 9: 4.5 ft, 6-7 hrs*
Scenario 13: 6.2 ft, 8-9 hrs*
Scenario 15: 10.3 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 13: 2.4 ft, 6-7 hrs
Scenario 15: 6.8 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 9: 3.6 ft, 4-5 hrs*
Scenario 13: 5.1 ft, 6-7 hrs*
Scenario 15: 9.4 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 4.3 ft, 7-8 hrs*
Scenario 13: 5.9 ft, 9-10 hrs*
Scenario 15: 10.2 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 5.0 ft, 7-8 hrs*
Scenario 13: 6.7 ft, 8-9 hrs*
Scenario 15: 10.8 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 3.2 ft, 7-8 hrs
Scenario 13: 4.9 ft, 8-9 hrs
Scenario 15: 9.0 ft, >12 hrs

Scenario: Max Depth, Duration Flooded
Scenario 9: 2.0 ft, 6-7 hrs*
Scenario 13: 3.6 ft, 8-9 hrs*
Scenario 15: 7.9 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 3.6 ft, 6-7 hrs*
Scenario 13: 5.3 ft, 8-9 hrs*
Scenario 15: 9.4 ft, >12 hrs*

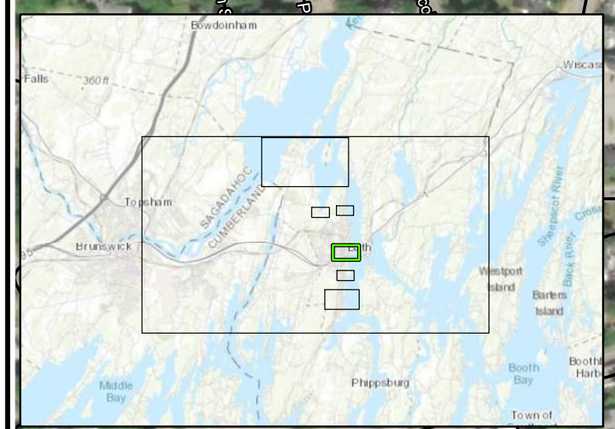
Scenario: Max Depth, Duration Flooded
Scenario 15: 3.6 ft, 6-7 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 15: 2.2 ft, 5-6 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 3 ft, 7-8 hrs*
Scenario 13: 4.6 ft, 9-10 hrs*
Scenario 15: 8.8 ft, >12 hrs*

Patten Free Library
Bath Fire and Rescue
Bath City Police Department
Neighborhood Cafe
Soup Kitchen
Washington House
Appartments
Bath Area Food Bank
Waterfront Park
Bath Water District
Bath City Hall
Sagadahoc Bridge
(Route 1 Bridge)
Mid Coast Medical Group
(Endocrinology & Diabetes)

Keel St
Bedford St
Garden St
Fremont St
Oak St
Preble Ln
Linden St
Green St
Front St
Commercial St
Pratt St
Winter St
Summer St
Winter Street Ct
Middle St
Chestnut St
Andrews Rd
High St
Elm St
Cobb Rd
Page St
Maple St
Academy St
Allen St
Snow Pond Rd
Lincoln St
Walker St
Washington St
Water St
Arch St
Broad St
Centre St
Lambard St
Raymond Ct
School St
Vine St
Off Ramp
Leeman Hwy
Granite St



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 300
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4e

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

Scenario: Max Depth, Duration Flooded
Scenario 15: 1.6 ft, 4-5 hrs

Scenario: Max Depth, Duration Flooded
Scenario 9: 4.1 ft, 5-6 hrs*
Scenario 13: 5.9 ft, 8-9 hrs*
Scenario 15: 9.9 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 5.3 ft, 6-7 hrs*
Scenario 13: 7.2 ft, 9-10 hrs*
Scenario 15: 11.2 ft, >12 hrs*

Scenario: Max Depth, Duration Flooded
Scenario 9: 3.4 ft, 6-7 hrs*
Scenario 13: 5.2 ft, 8-9 hrs*
Scenario 15: 9.2 ft, >12 hrs*

CMP Substation

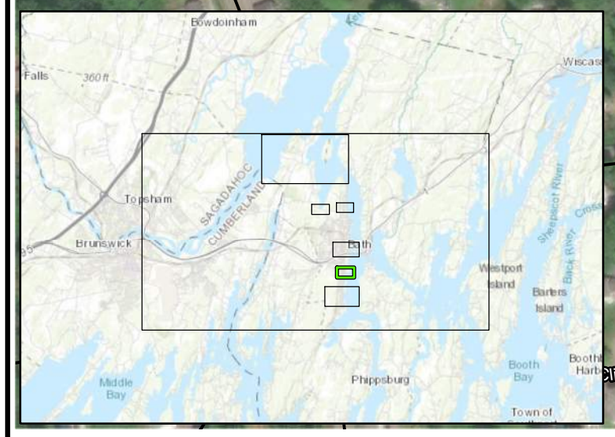
Scenario: Max Depth, Duration Flooded
Scenario 9: 2.3 ft, 7-8 hrs
Scenario 13: 4.2 ft, 9-10 hrs
Scenario 15: 8.2 ft, >12 hrs

General Dynamics
Bath Iron Works

Scenario: Max Depth, Duration Flooded
Scenario 9: 0.2 ft, 1-2 hrs
Scenario 13: 2.1 ft, 4-5 hrs
Scenario 15: 6.1 ft, 9-10 hrs

Scenario: Max Depth, Duration Flooded
Scenario 15: 2.3 ft, 5-6 hrs*

Campus Dr
Windlass Ct
Maxwell St
Palmer St
Maxwell Street Ct
Nichols Ct
High St
Middle St
Russell St
Castine Av
Spring St
Hinckley St
Pleasant St
Libby Ct
Shaw St
Pine St
Middle St
Highland St
Washington St
Clifton St



LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4f

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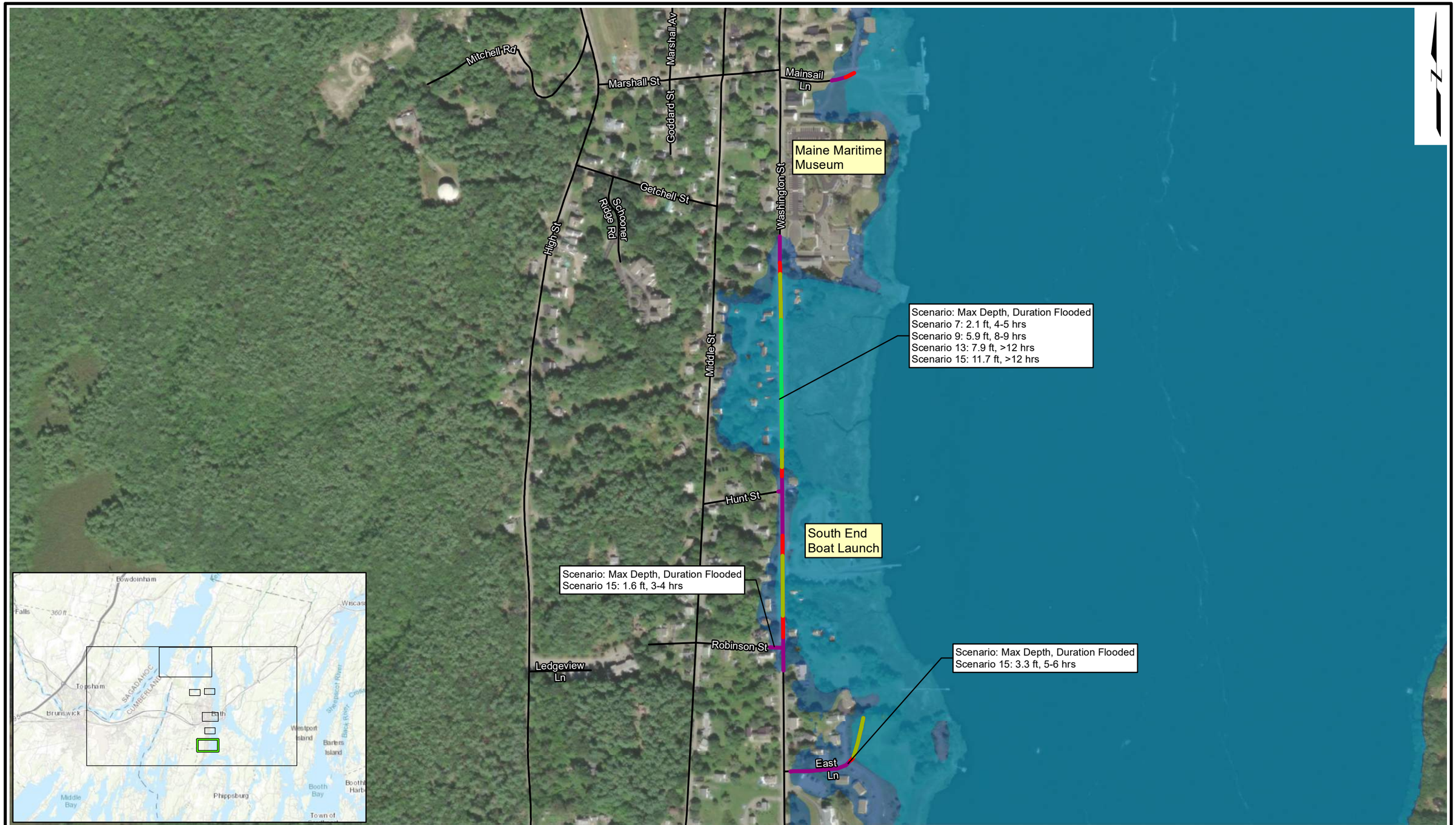

LEGEND:

Scenario Road Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:

1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Flood boundary shown based on Scenario 9 and Scenario 15.
3. Flood durations correspond to time flooded over one tidal cycle (approx, 12 hrs) that includes MHHW or peak of the 100-yr event.
4. Flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

0 400

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF ROADS

Project 2204496 | March 2024 | Fig. 4g

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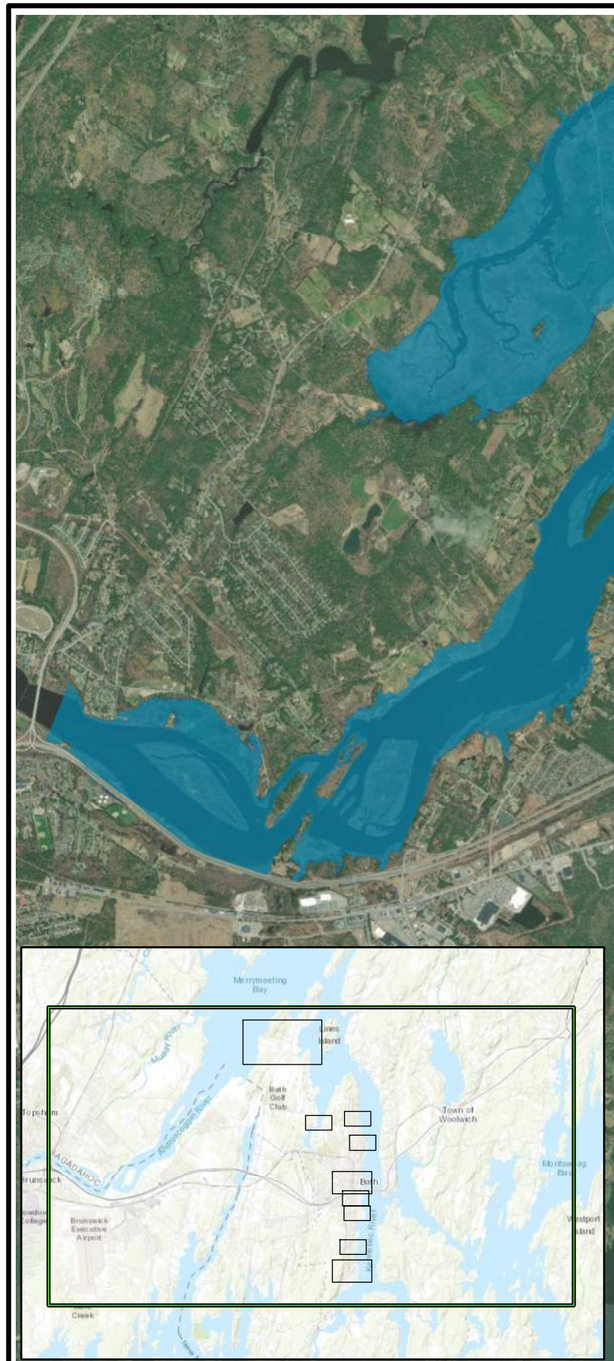
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 4000

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5a

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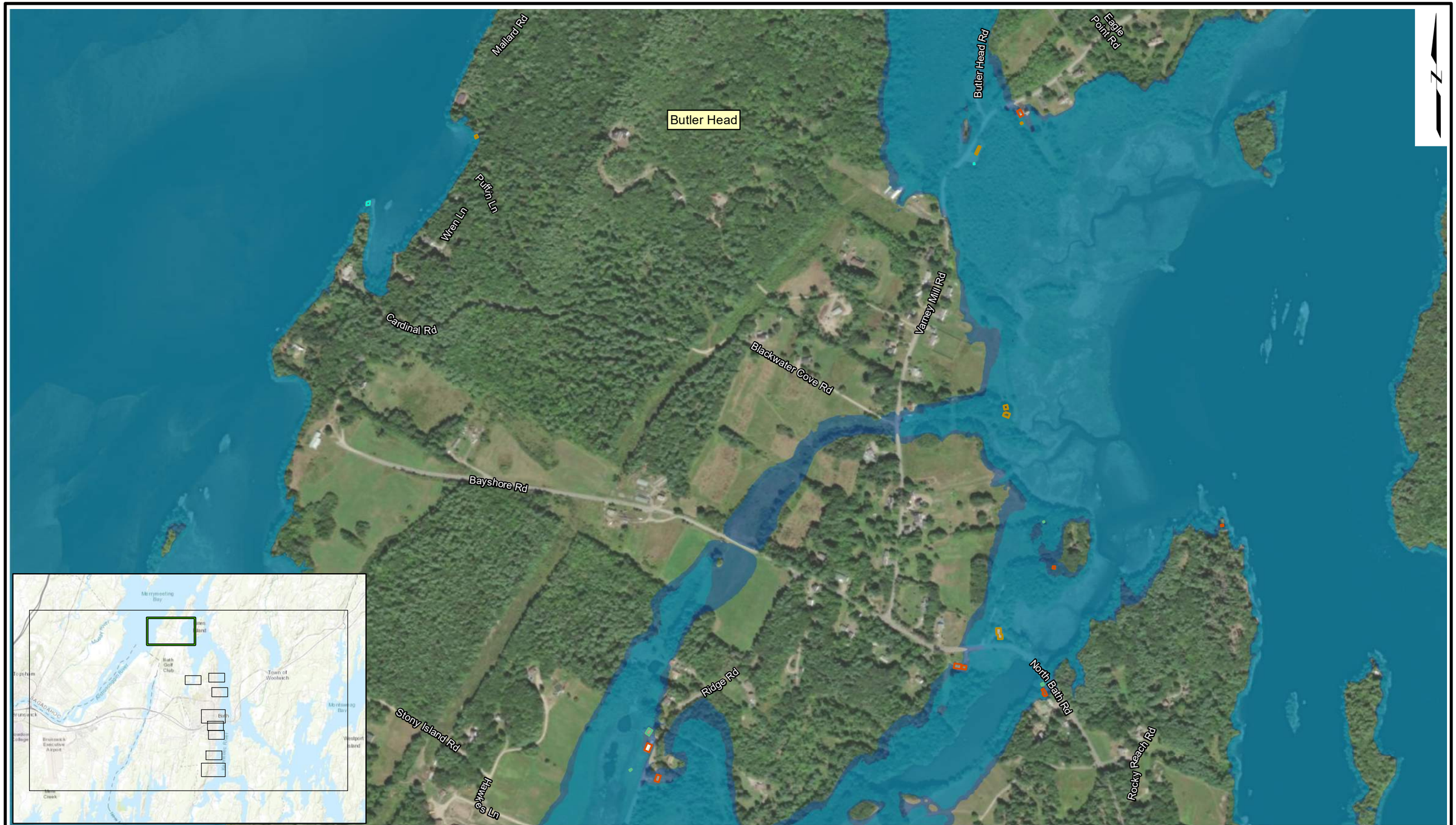
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 600

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5b

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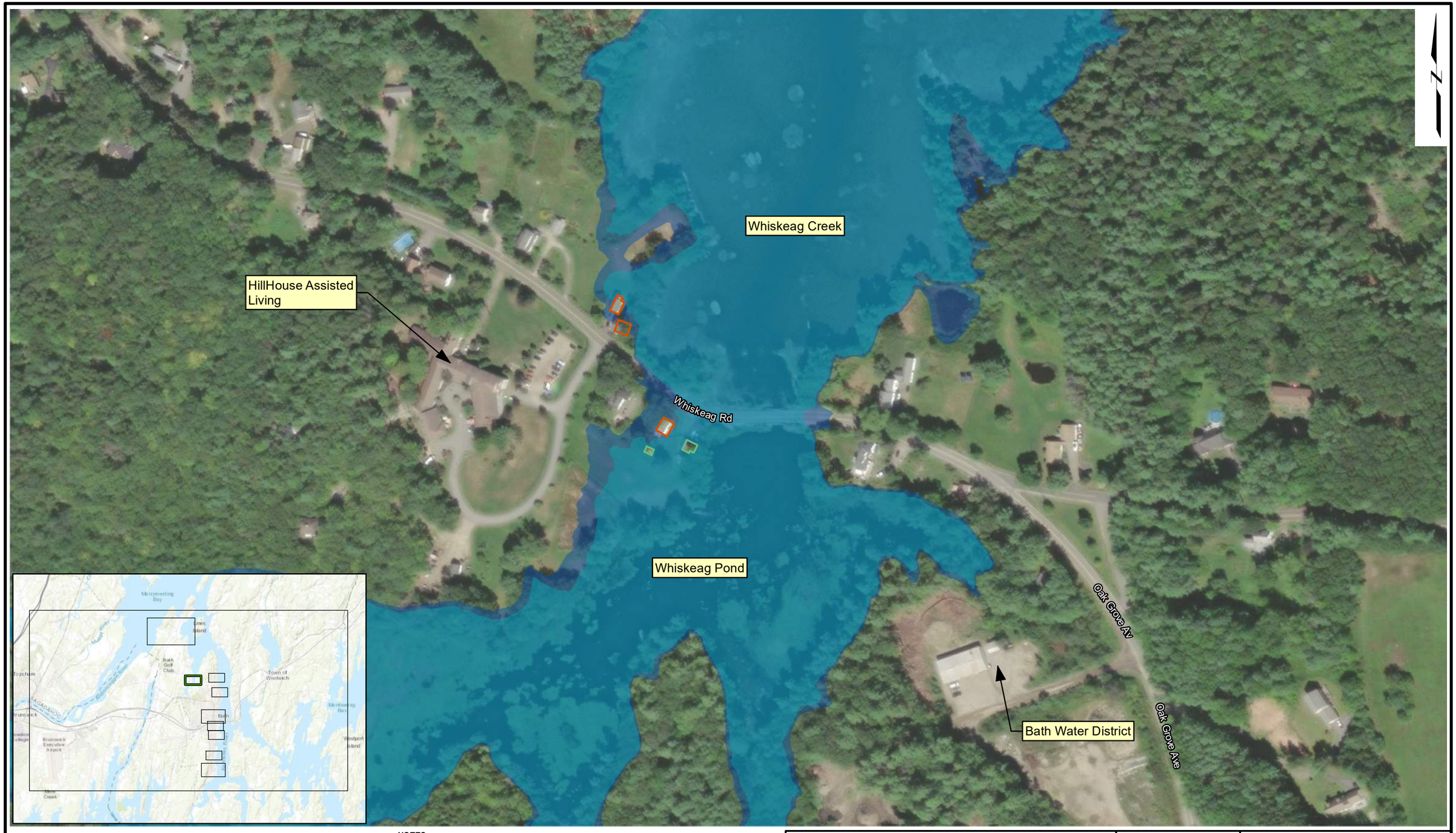

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:
1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5c

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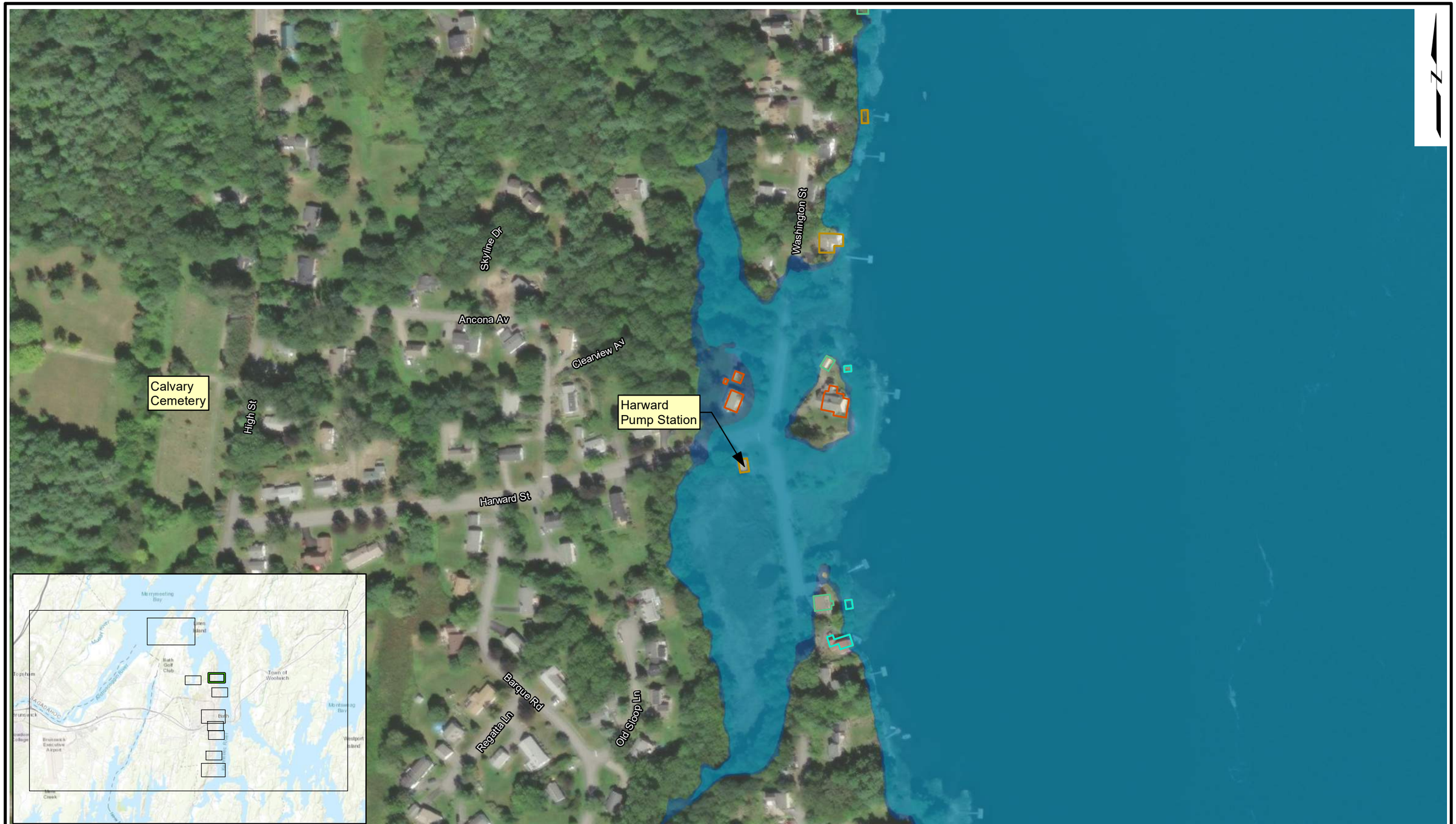

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 200

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5d

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LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 200

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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Project 2204496

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

March 2024 Fig. 5e

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:
1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 300
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE" FLOOD VULNERABILITY OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5f

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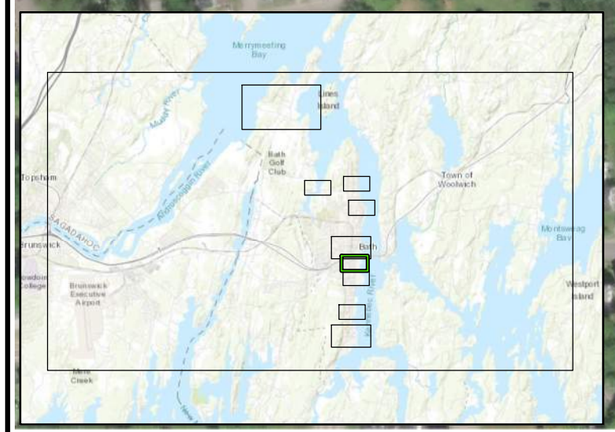
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

Centre St
Court St
Sagahahoc County Sheriff
School St
Water St
Vine St
Off Ramp
Commercial St
Commercial Pump Station
Franklin St
King St
Leeman Hwy
Post Office
Granite St
High St
Stacey St
Old South Pl
Union Street Ct
Union St
Middle St
Washington St
General Dynamics
Bath Iron Works
Fisher Ct
Liberty St
Wesley Street Ct
Wesley St
Shepard St
South St
Bath St



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:
1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5g

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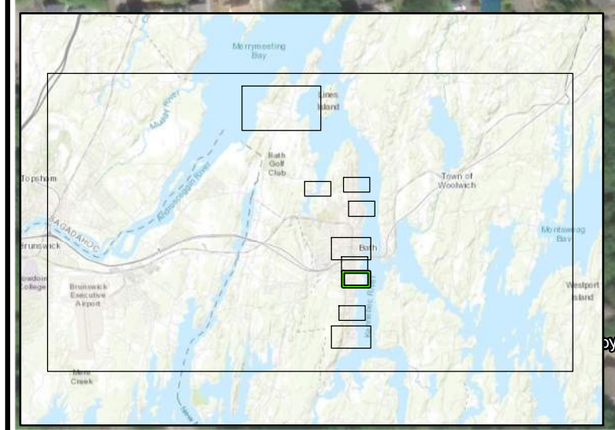
Hyde Dr
Crooker St
Fisher Mitchell School
Middle St
Castine Pump Station
Russell St
Campus Dr
High St
Windlass Ct
Maxwell St
Castine Av
Washington St
CMP Substation
Spring St
Hinckley St
Pleasant St
Shaw St
General Dynamics
Bath Iron Works



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:
1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5h

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage
- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage
- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:
1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5i

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LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Commit to Manage

- Scenario 4: Average Conditions
- Scenario 6: 100-yr Conditions

2100: Commit to Manage

- Scenario 10: Average Conditions
- Scenario 12: 100-yr Conditions

NOTES:

1. Commit to Manage scenarios reference 1.5 ft and 4.0 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundaries shown on map represent Scenario 6 and Scenario 12.

0 300

Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"COMMIT TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 5j

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:
1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 4000
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 6a

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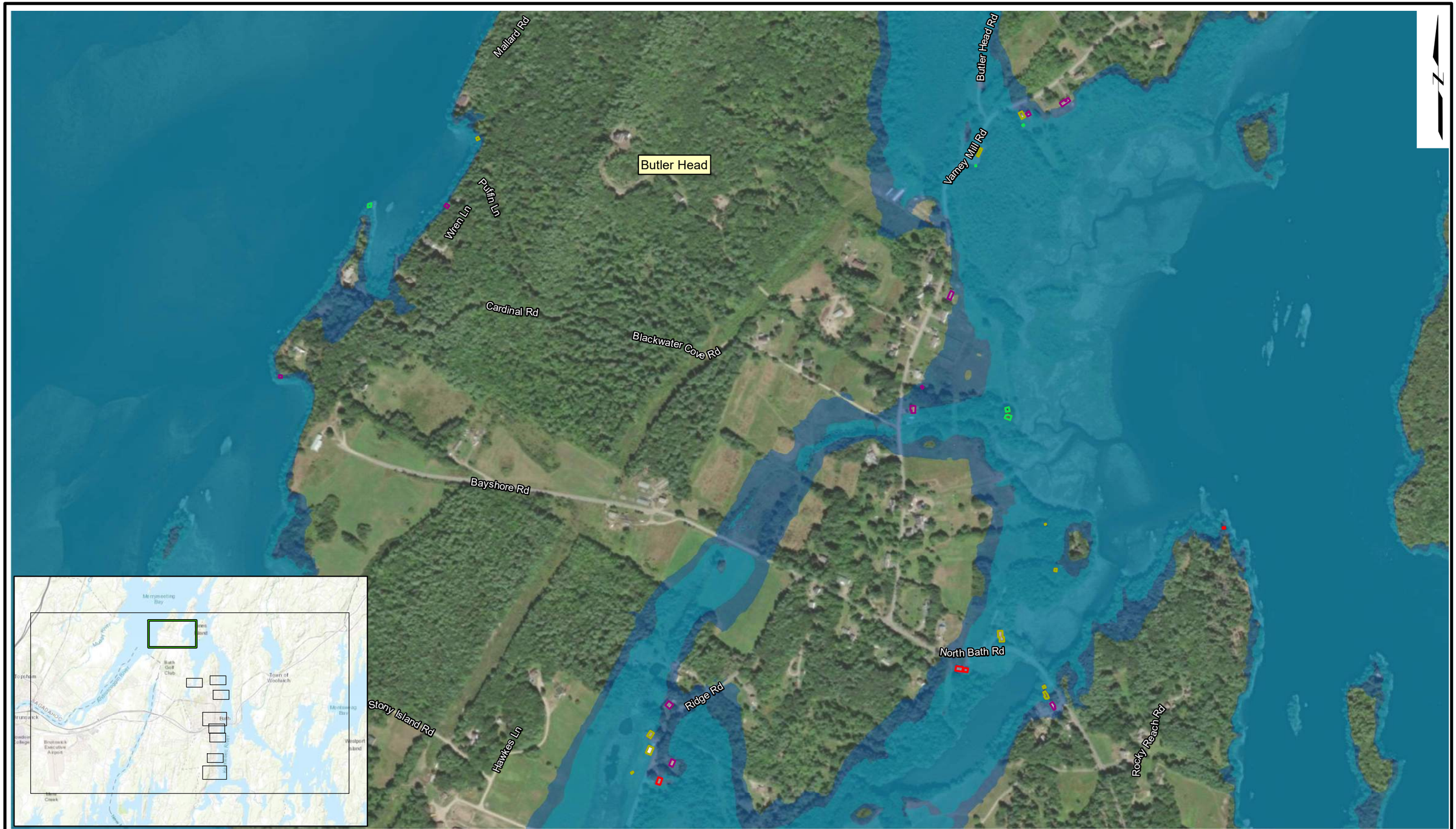

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:
1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 600
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

GEI Consultants

"PREPARE TO MANAGE"
FLOOD VULNERABILITY
OF BUILDINGS

Project 2204496 | March 2024 | Fig. 6b

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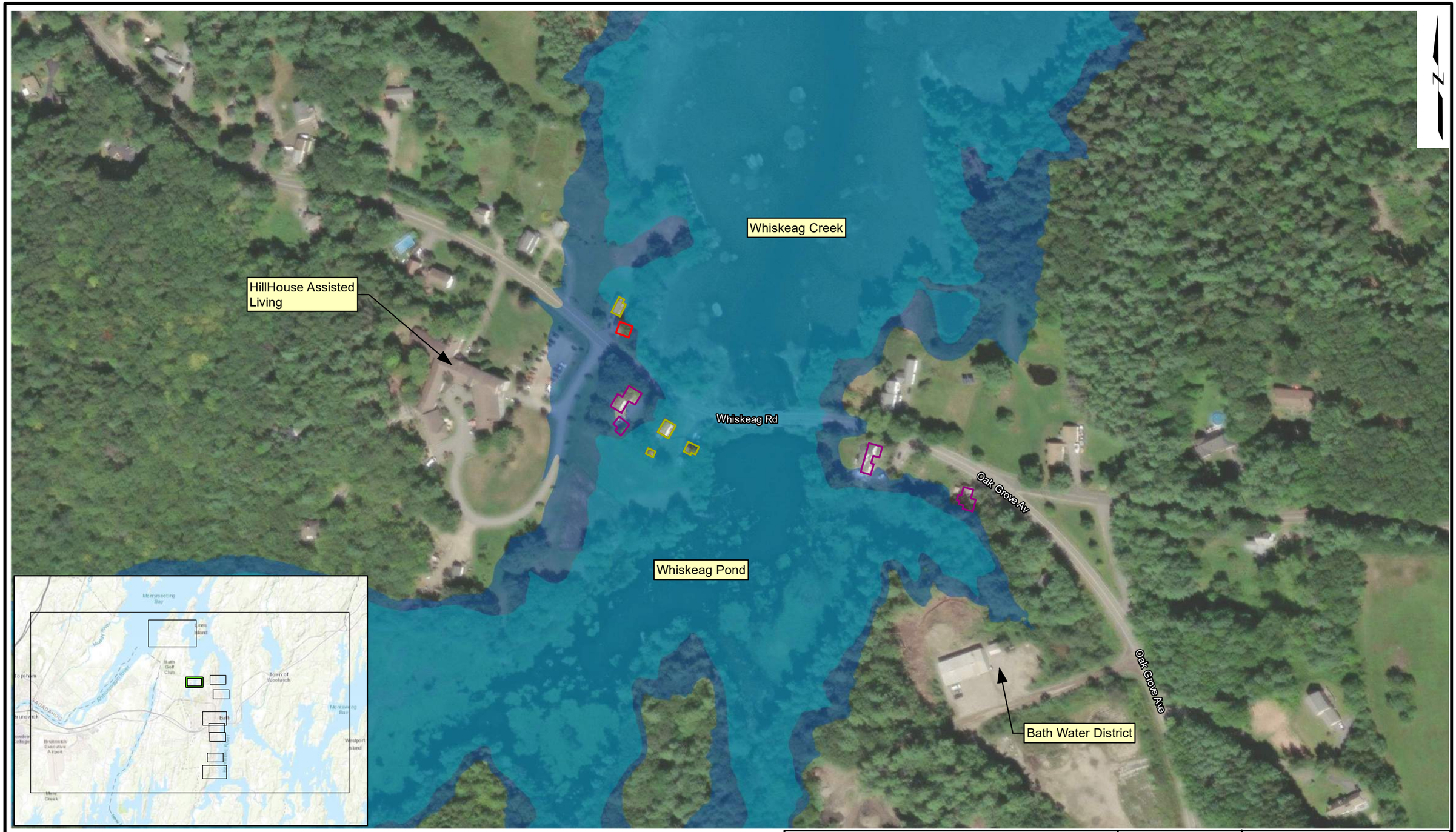
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:
1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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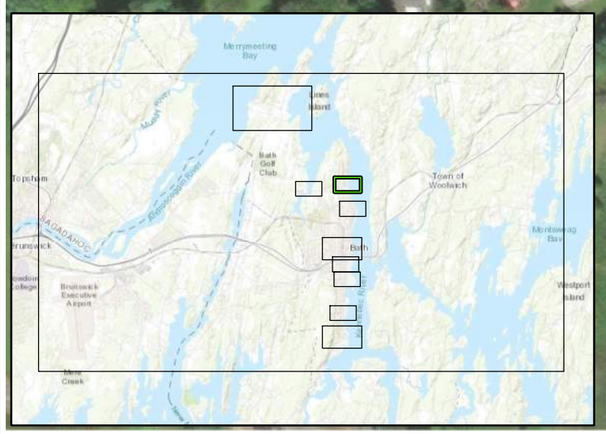
Skyline Dr
Washington St
Ancona Av
Clearview Av
Calvary Cemetery
Harward Pump Station
Harward St
Barque Rd
Regatta Ln
Old Sloop Ln



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

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3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 200
Feet

Flood Vulnerability Assessment
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FLOOD VULNERABILITY
OF BUILDINGS

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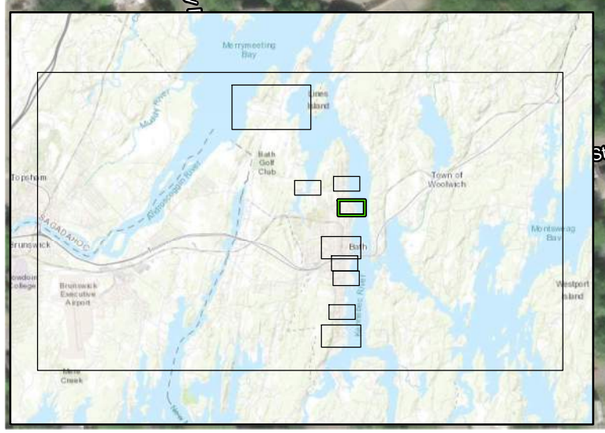
Park St
Juniper St
Prospect St
Dikes Landing Rd
E. Milan St
W. Milan St
Washington St
Trufant Street Ct
Trufant St
Drummond Pt
Mechanic St
Oliver Street Ct
Valley St
Carriage House Ln
Cummings St
Beacon St
Somerset Pl
Bowery St
Town Landing Rd

North End
Boat Launch

Bath Wastewater
Treatment Plant

Former Site of
Stinsons Fish Cannery



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:
1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

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Bath, Maine

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LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:
1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
2. Average and 100-year scenarios reference average tides and riverine flows and combined 100-yr coastal and riverine events, respectively.
3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 300
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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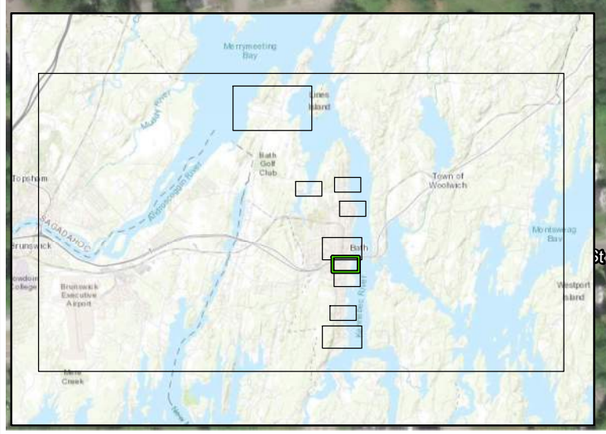
Commercial Pump Station
Sagadahoc County Sheriff
Post Office
General Dynamics
Bath Iron Works
School St
Water St
Vine St
Off Ramp
Commercial St
King St
Centre St
Court St
Franklin St
Leeman Hwy
Granite St
Stacey St
High St
Old South Pl
Union Street Ct
Union St
Fisher Ct
Washington St
Liberty St
Middle St
Wesley Street Ct
Wesley St
Shepard St



LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
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4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
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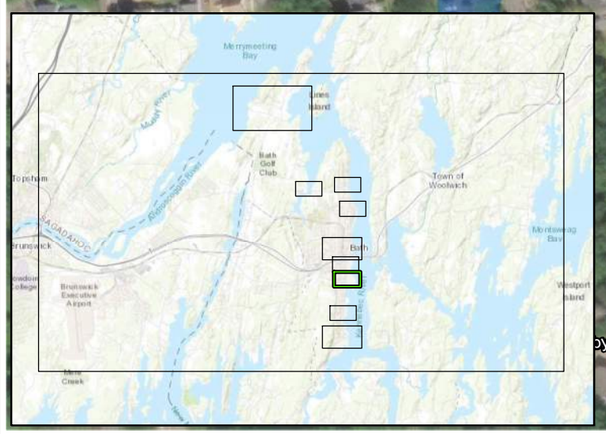
Hyde Dr
Crooker St
Fisher Mitchell School
High St
Middle St
Washington St
Russell St
Campus Dr
Castine Pump Station
Castine Av
Windlass Ct
Maxwell St
CMP Substation
Spring St
Hinckley St
Pleasant St
Shaw St
General Dynamics
Bath Iron Works



LEGEND:

Scenario Building Inundation Likely to Occur:

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- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

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3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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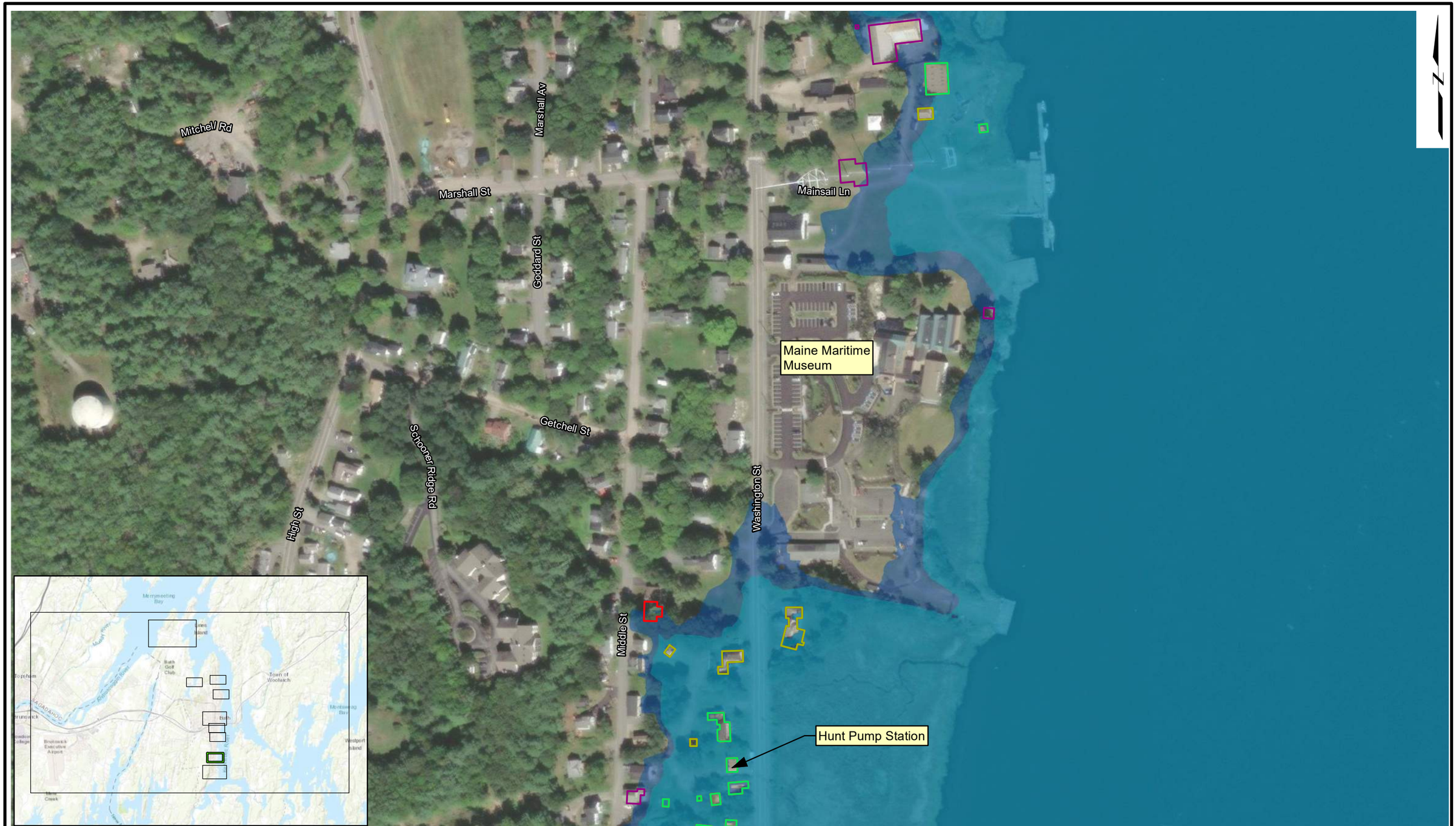

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

NOTES:
1. Prepare to Manage scenarios reference 3.0 ft and 8.8 ft of sea level rise by 2050 and 2100, respectively.
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3. Model results based on HECRAS and USGS (2020) LiDAR.
4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 200
Feet

Flood Vulnerability Assessment
Bath, Maine

City of Bath
Bath, Maine

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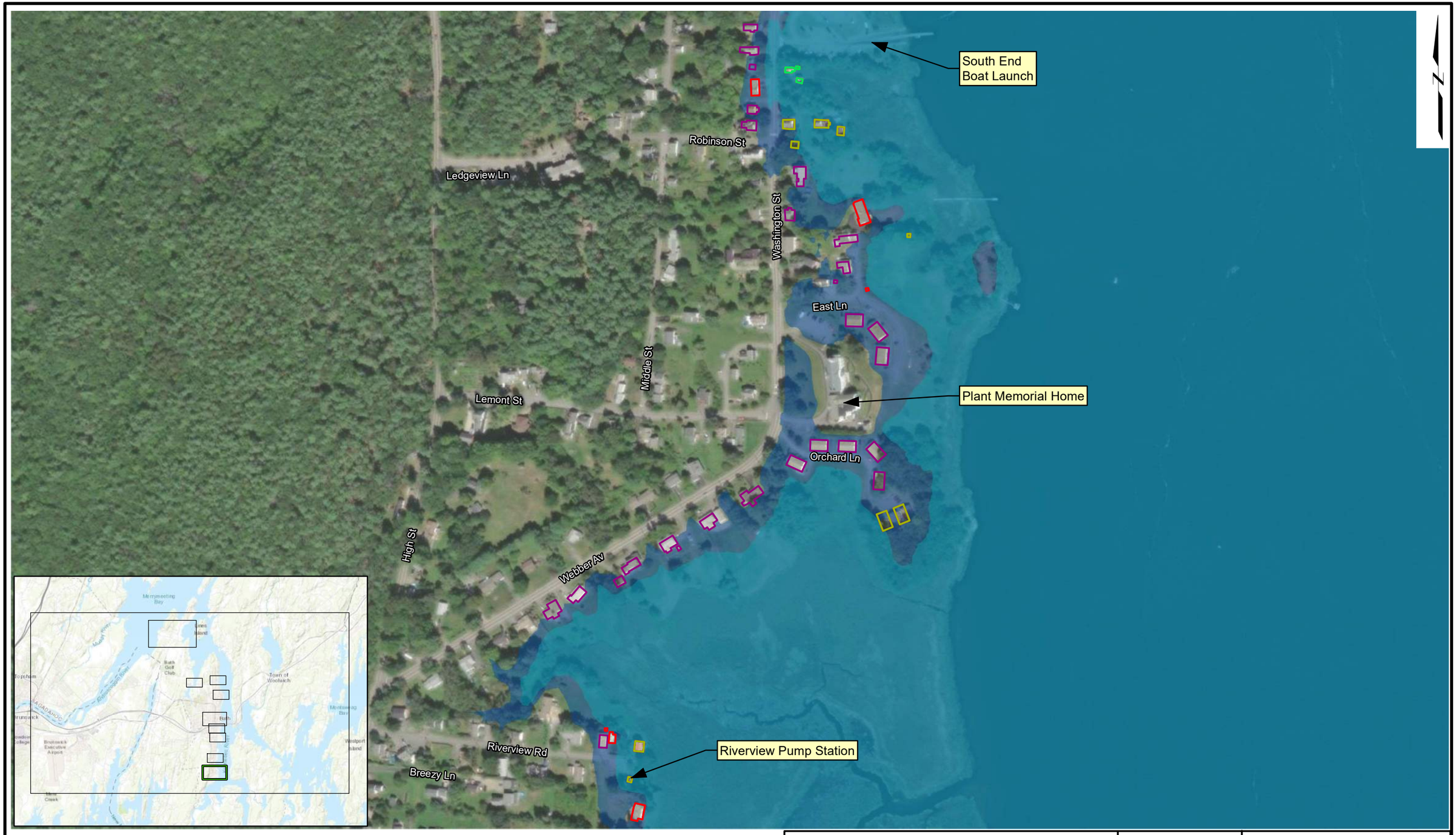

LEGEND:

Scenario Building Inundation Likely to Occur:

2050: Prepare to Manage
- Scenario 7: Average Conditions
- Scenario 9: 100-yr Conditions

2100: Prepare to Manage
- Scenario 13: Average Conditions
- Scenario 15: 100-yr Conditions

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4. Flood boundary shown based on Scenario 9 and Scenario 15.

0 300
Feet

Flood Vulnerability Assessment
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Appendix A

Road Model Results

	Present-Day			2050 (1.5 ft SLR) Commit to Manage			2050 (3.0 ft SLR) Prepare to Manage			2100 (4.0 ft SLR) Commit to Manage			2100 (8.8 ft SLR) Prepare to Manage		
	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Arch Street															
Total Length Inundated (ft)	-	-	-	-	36	44	-	59	69	-	78	87	101	164	171
Peak Water Surface Elevation (ft)	-	-	-	-	9.7	10.2	-	11.2	11.7	-	12.2	13.0	13.2	17.0	17.5
Max Depth of Inundation (ft)	-	-	-	-	0.8	1.3	-	2.3	2.8	-	3.3	4.1	4.3	8.1	8.6
Duration of Inundation (hrs)[3]	-	-	-	-	2-3	3-4	-	4-5	5-6	-	6-7	6-7	7-8	>12	>12
Bayshore Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	312	365
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.0	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	4.1	5.5
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	7-8	>12
Blackwater Cove Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	133	131	206	243
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	14.0	13.3	17.1	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	1.8	1.1	4.8	6.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	3-4	3-4	8-9	>12
Bridge Street															
Total Length Inundated (ft)	-	-	-	-	-	-	-	46	47	-	88	91	132	285	288
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	11.2	11.2	-	12.0	12.1	13.4	17.1	17.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	2.8	2.7	-	3.6	3.7	5.0	8.7	8.8
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	7-8	7-8	-	9-10	9-10	>12	>12	>12
Broad Street															
Total Length Inundated (ft)	-	-	-	-	-	38	-	48	54	-	61	66	75	118	124
Peak Water Surface Elevation (ft)	-	-	-	-	-	10.0	-	11.0	11.5	-	12.0	13.0	13.0	16.8	17.3
Max Depth of Inundation (ft)	-	-	-	-	-	0.5	-	1.5	2.0	-	2.5	3.5	3.5	7.3	7.8
Duration of Inundation (hrs)[3]	-	-	-	-	-	2-3	-	4-5	4-5	-	5-6	6-7	7-8	>12	>12

Notes:

1. "Avg." refers to average daily tidal conditions and average daily riverine flows, "100-yr T" refers to 1% annual chance coastal storm flood scenarios, and "100-yr T & R" refe to combined 1% annual chance coastal storm and riverine event flood scenarios
2. Peak Water Surface Elevations reference NAVD88.
3. Flood durations correspond to the duration that the the area of the road experiencing the max flood depth is inundated over one tidal cycle that includes the peak water surface elevation (approximately a 12-hr period) and flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

	Present-Day			2050 (1.5 ft SLR) Commit to Manage			2050 (3.0 ft SLR) Prepare to Manage			2100 (4.0 ft SLR) Commit to Manage			2100 (8.8 ft SLR) Prepare to Manage		
	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Butler Head Road															
Total Length Inundated (ft)	-	1,116	1,315	402	1,331	1,508	1,064	1,461	1,595	1,136	1,538	1,696	1,622	1,737	1,762
Peak Water Surface Elevation (ft)	-	8.3	9.9	6.1	9.8	12.1	7.6	11.3	13.3	8.6	12.3	15.0	13.4	17.1	19.1
Max Depth of Inundation (ft)	-	2.8	4.3	0.6	4.3	6.5	2.1	5.7	7.8	3.1	6.7	9.5	7.9	11.6	13.6
Duration of Inundation (hrs)[3]	-	5-6	9-10	2-3	7-8	>12	5-6	8-9	>12	5-6	11-12	>12	>12	>12	>12
Cardinal Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	151	464
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	19.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	2.7
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	2-3	6-7
Castine Avenue															
Total Length Inundated (ft)	-	-	-	-	-	657	-	881	890	-	900	903	910	910	910
Peak Water Surface Elevation (ft)	-	-	-	-	-	8.1	-	11.1	11.6	-	12.3	12.6	13.4	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	1.8	-	4.9	5.3	-	6.1	6.4	7.2	10.9	11.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	4-5*	-	5-6*	6-7*	-	7-8*	7-8*	9-10*	>12*	>12*
Centre Street															
Total Length Inundated (ft)	-	-	-	-	-	212	-	510	532	-	557	574	599	717	730
Peak Water Surface Elevation (ft)	-	-	-	-	-	9.3	-	11.2	11.6	-	12.2	12.7	13.1	17.0	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	1.3	-	3.2	3.6	-	4.2	4.7	5.1	9.0	9.4
Duration of Inundation (hrs)[3]	-	-	-	-	-	2-3*	-	3-4*	4-5*	-	5-6*	6-7*	6-7*	9-10*	>12*
Commercial Street															
Total Length Inundated (ft)	-	955	1,481	235	2,437	2,610	752	2,735	2,754	1,431	2,776	2,796	2,838	2,893	2,900
Section 1: North of Summer Street															
Peak Water Surface Elevation (ft)	-	8.3	8.7	6.1	9.8	10.4	7.6	11.3	11.8	8.6	12.3	13.0	13.4	17.1	17.6
Max Depth of Inundation (ft)	-	2.9	3.3	0.8	4.4	5.0	2.3	5.9	6.4	3.3	6.9	7.7	8.1	11.8	12.3
Duration of Inundation (hrs)[3]	-	5-6	6-7	2-3	6-7	8-9	5-6	9-10	10-11	7-8	10-11	>12	>12	>12	>12

Notes:

1. "Avg." refers to average daily tidal conditions and average daily riverine flows, "100-yr T" refers to 1% annual chance coastal storm flood scenarios, and "100-yr T & R" refe to combined 1% annual chance coastal storm and riverine event flood scenarios
2. Peak Water Surface Elevations reference NAVD88.
3. Flood durations correspond to the duration that the the area of the road experiencing the max flood depth is inundated over one tidal cycle that includes the peak wat surface elevation (approximately a 12-hr period) and flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

	Present-Day			2050 (1.5 ft SLR) Commit to Manage			2050 (3.0 ft SLR) Prepare to Manage			2100 (4.0 ft SLR) Commit to Manage			2100 (8.8 ft SLR) Prepare to Manage		
	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Commercial Street															
Total Length Inundated (ft)	-	955	1,481	235	2,437	2,610	752	2,735	2,754	1,431	2,776	2,796	2,838	2,893	2,900
Section 2: South of Route 1 Bridge															
Peak Water Surface Elevation (ft)	-	-	7.8	-	9.8	10.2	-	11.3	11.7	8.0	12.3	12.9	13.4	17.1	17.5
Max Depth of Inundation (ft)	-	-	1.1	-	3.1	3.5	-	4.6	5.0	1.3	5.6	6.2	6.7	10.4	10.8
Duration of Inundation (hrs)[3]	-	-	2-3*	-	5-6*	6-7*	-	7-8*	7-8*	2-3*	7-8*	8-9*	8-9*	>12*	>12*
Creekside Ln															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	204
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.3
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6*
East Lane															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	469	470
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	3.3
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6*	5-6*
Elm Street															
Total Length Inundated (ft)	-	-	-	-	-	166	-	218	224	-	231	236	244	283	288
Peak Water Surface Elevation (ft)	-	-	-	-	-	9.4	-	11.3	11.7	-	12.3	12.9	13.2	17.1	17.6
Max Depth of Inundation (ft)	-	-	-	-	-	0.6	-	2.5	2.9	-	3.5	4.1	4.4	8.3	8.8
Duration of Inundation (hrs)[3]	-	-	-	-	-	2-3*	-	6-7*	7-8*	-	7-8*	9-10*	9-10*	>12*	>12*
Front Street															
Total Length Inundated (ft)	-	-	-	-	137	226	-	341	371	-	395	413	435	554	571
Peak Water Surface Elevation (ft)	-	-	-	-	9.8	10.3	-	11.3	11.8	-	12.3	13.0	13.4	17.1	17.6
Max Depth of Inundation (ft)	-	-	-	-	0.8	1.3	-	2.2	2.7	-	3.3	4.0	4.4	8.1	8.6
Duration of Inundation (hrs)[3]	-	-	-	-	2-3*	3-4*	-	7-8*	7-8*	-	8-9*	8-9*	9-10*	>12*	>12*

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	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Harward Street															
Total Length Inundated (ft)	-	75	103	-	127	145	-	156	169	91	173	184	189	230	239
Peak Water Surface Elevation (ft)	-	8.3	8.9	-	9.8	10.6	-	11.3	12.1	8.6	12.3	13.4	13.2	17.1	17.9
Max Depth of Inundation (ft)	-	0.6	1.2	-	2.1	2.9	-	3.6	4.4	0.9	4.6	5.7	5.5	9.4	10.2
Duration of Inundation (hrs)[3]	-	2-3	3-4	-	4-5	6-7	-	5-6	8-9	3-4	7-8	9-10	9-10	>12	>12
Hawkes Lane															
Total Length Inundated (ft)	-	-	342	-	378	520	-	504	558	181	545	577	575	630	648
Peak Water Surface Elevation (ft)	-	-	7.5	-	7.7	10.2	-	9.8	12.0	7.0	11.3	13.9	13.1	17.0	18.4
Max Depth of Inundation (ft)	-	-	1.0	-	1.2	3.8	-	3.3	5.6	0.5	4.8	7.4	6.6	10.5	11.9
Duration of Inundation (hrs)[3]	-	-	7-8*	-	8-9*	>12*	-	11-12*	11-12*	5-6*	>12*	>12*	>12*	>12*	>12*
Hinckley Street															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	37	-	67	77	102	185	189
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	11.5	-	12.3	12.7	13.4	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	0.2	-	1.0	1.4	2.1	5.8	6.1
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	1-2	-	2-3	3-4	4-5	8-9	9-10
King Street															
Total Length Inundated (ft)	-	-	-	-	116	131	-	155	164	-	175	182	196	263	268
Peak Water Surface Elevation (ft)	-	-	-	-	9.8	10.2	-	11.3	11.7	-	12.3	12.9	13.4	17.1	17.5
Max Depth of Inundation (ft)	-	-	-	-	1.3	1.7	-	2.8	3.2	-	3.8	4.4	4.9	8.6	9.0
Duration of Inundation (hrs)[3]	-	-	-	-	3-4	4-5	-	6-7	7-8	-	7-8	8-9	8-9	>12	>12
Lambard Street															
Total Length Inundated (ft)	-	-	-	-	-	-	-	31	34	-	39	43	49	90	96
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	11.5	12.0	-	12.5	12.9	13.4	17.3	17.8
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	0.5	1.0	-	1.5	1.9	2.4	6.3	6.8
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	2-3	2-3	-	3-4	5-6	6-7	10-11	>12

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	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Lenfest Lane															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	242
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.3
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6
Middle Street															
Total Length Inundated (ft)	-	-	-	-	-	52	-	111	117	-	125	128	134	860	893
Section 1: Near Walker Street Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.5
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	3.6
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6	6-7
Section 2: Near Castine Avenue Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	8.1	-	11.1	11.6	-	12.3	12.7	13.4	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	0.6	-	3.6	4.1	-	4.8	5.2	5.9	9.6	9.9
Duration of Inundation (hrs)[3]	-	-	-	-	-	2-3*	-	5-6*	5-6*	-	6-7*	7-8*	8-9*	>12*	>12*
North Bath Road															
Total Length Inundated (ft)	-	-	230	-	332	492	-	504	612	20	591	675	670	868	929
Peak Water Surface Elevation (ft)	-	-	9.0	-	9.6	11.1	-	11.2	12.5	8.3	12.2	14.0	13.4	17.1	18.4
Max Depth of Inundation (ft)	-	-	1.6	-	2.2	3.7	-	3.8	5.1	0.9	4.8	6.6	6.0	9.7	11.0
Duration of Inundation (hrs)[3]		-	5-6	-	5-6	9-10	-	8-9	11-12	3-4	9-10	>12	>12	>12	>12
Old Brunswick Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	607	726
Section 1: Near Ridge Road Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	15.1	18.3
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	7.6
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6*	6-7*

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	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Old Brunswick Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	607	726
Section 2: Near Lenfest Lane Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18.3
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.1
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2-3*
Section 3: Near Creekside Lane Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	18.3
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5	6.7
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	>12*	>12*
Orchard Lane															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	6	447	448
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	13.4	17.1	17.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	0.3	4.0	4.0
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	2-3	6-7	6-7
Osprey Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	202	281
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	19.1
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	2.9
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	2-3	7-8
Ridge Road															
Total Length Inundated (ft)	-	-	-	-	-	1,140	-	1,095	1,340	-	1,272	1,442	1,434	2,161	2,554
Section 1: Near Hawks Lane Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	10.2	-	9.8	12.0	-	11.3	13.9	13.0	17.0	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	2.8	-	2.3	4.6	-	3.8	6.4	5.6	9.5	10.9
Duration of Inundation (hrs)[3]	-	-	-	-	-	10-11*	-	9-10*	11-12*	-	10-11*	>12*	>12*	>12*	>12*

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Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ridge Road															
Total Length Inundated (ft)	-	-	-	-	-	1,140	-	1,095	1,340	-	1,272	1,442	1,434	2,161	2,554
Section 2: Near Old Brunswick Road Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	15.2	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	3.8
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	2-3*	9-10*
Riverview Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	172	175
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	2.2	2.3
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6	5-6
Robinson Street															
Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	56	58
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.6
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	3-4*	3-4*
Russell Street															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	60	64
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3	1.6
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	4-3	4-5
School Street															
Total Length Inundated (ft)	-	-	-	-	-	-	-	133	144	-	160	169	183	268	279
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	11.3	11.7	-	12.3	12.9	13.3	17.1	17.6
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	1.6	2.0	-	2.6	3.2	3.6	7.4	7.9
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	5-6	6-7	-	6-7	6-7	8-9	>12	>12

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	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Spring Street															
Total Length Inundated (ft)	-	-	-	-	-	51	-	128	144	-	161	167	183	265	269
Peak Water Surface Elevation (ft)	-	-	-	-	-	9.7	-	11.1	11.6	-	12.3	12.7	13.4	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	0.5	-	1.9	2.3	-	3.1	3.5	4.2	7.9	8.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	2-3	-	5-6	7-8	-	8-9	9-10	9-10	>12	>12
Spring View Lane															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	281	379
Peak Water Surface Elevation (ft)														17.0	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3	4.7
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6	9-10
Summer Street															
Total Length Inundated (ft)	-	109	125	-	154	164	78	177	184	123	191	197	204	260	264
Peak Water Surface Elevation (ft)	-	8.2	8.6	-	9.7	10.3	7.4	11.2	11.7	8.4	12.2	13.0	13.2	17.1	17.6
Max Depth of Inundation (ft)	-	1.9	2.3	-	3.4	4.0	1.1	4.9	5.4	2.1	5.9	6.7	6.9	10.8	11.3
Duration of Inundation (hrs)[3]	-	4-5	4-5	-	6-7	7-8	3-4	7-8	8-9	5-6	10-11	11-12	>12	>12	>12
Town Landing Road															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	161	182
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.8
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	3.9
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	5-6	7-8
Varney Mill Road															
Total Length Inundated (ft)	-	193	586	-	676	799	-	794	879	379	857	1,048	1,031	1,431	1,573
Section 1: Near Butler Head Road Intersection															
Peak Water Surface Elevation (ft)	-	8.3	9.4	-	9.8	11.4	-	11.3	12.7	8.6	12.3	14.3	13.4	17.1	18.6
Max Depth of Inundation (ft)	-	0.7	1.8	-	2.2	3.8	-	3.7	5.1	1.0	4.7	6.7	5.8	9.5	11.0
Duration of Inundation (hrs)[3]	-	1-2	4-5	-	4-5	8-9	-	6-7	>12	2-3	7-8	>12	9-10	>12	>12

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	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Varney Mill Road															
Total Length Inundated (ft)	-	193	586	-	676	799	-	794	879	379	857	1,048	1,031	1,431	1,573
Section 2: Near Blackwater Cove Road Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	14.1	13.4	17.1	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	1.3	0.6	4.3	5.6
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	3-4	2-3	7-8	>12
Vine Street															
Total Length Inundated (ft)	-	-	77	-	271	281	-	304	312	112	322	329	342	398	404
Peak Water Surface Elevation (ft)	-	-	7.8	-	9.8	10.3	-	11.3	11.7	8.0	12.3	12.9	13.3	17.1	17.6
Max Depth of Inundation (ft)	-	-	0.4	-	2.4	2.9	-	3.9	4.3	0.6	4.9	5.6	5.9	9.7	10.2
Duration of Inundation (hrs)[3]	-	-	1-2*	-	4-5*	4-5*	-	7-8*	7-8*	2-3*	7-8*	8-9*	9-10*	>12*	>12*
Walker Street															
Total Length Inundated (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	43	46
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.2	17.7
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	2.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	4-5	5-6
Washington Street															
Total Length Inundated (ft)	-	1,321	1,365	-	1,540	2,072	1,180	2,872	3,049	1,365	3,277	3,399	3,629	5,005	5,151
Section 1: Northern Washington Street near Thorne Head															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	11.3	12.2	-	12.3	13.5	13.4	17.1	18.0
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	0.4	1.3	-	1.4	2.7	2.6	6.3	7.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	2-3	4-5	-	3-4	5-6	5-6	8-9	>12
Section 2: Near Harward Street Intersection															
Peak Water Surface Elevation (ft)	-	8.3	8.9	-	9.8	10.6	7.6	11.3	12.1	8.6	12.3	13.4	13.4	17.1	17.9
Max Depth of Inundation (ft)	-	2.9	3.5	-	4.4	5.2	2.2	5.9	6.6	3.2	6.9	8.0	8.0	11.7	12.5
Duration of Inundation (hrs)[3]	-	5-6	6-7	-	6-7	7-8	5-6	8-9	11-12	5-6	9-10	>12	>12	>12	>12

Notes:

1. "Avg." refers to average daily tidal conditions and average daily riverine flows, "100-yr T" refers to 1% annual chance coastal storm flood scenarios, and "100-yr T & R" refe to combined 1% annual chance coastal storm and riverine event flood scenarios
2. Peak Water Surface Elevations reference NAVD88.
3. Flood durations correspond to the duration that the the area of the road experiencing the max flood depth is inundated over one tidal cycle that includes the peak water surface elevation (approximately a 12-hr period) and flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

	Present-Day			2050 (1.5 ft SLR) Commit to Manage			2050 (3.0 ft SLR) Prepare to Manage			2100 (4.0 ft SLR) Commit to Manage			2100 (8.8 ft SLR) Prepare to Manage		
	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Washington Street															
Total Length Inundated (ft)	-	1,321	1,365	-	1,540	2,072	1,180	2,872	3,049	1,365	3,277	3,399	3,629	5,005	5,151
Section 3: Between School Street and Centre Street															
Peak Water Surface Elevation (ft)	-	-	-	-	-	9.6	-	11.3	11.7	-	12.3	12.9	13.4	17.1	17.5
Max Depth of Inundation (ft)	-	-	-	-	-	1.5	-	3.2	3.6	-	4.2	4.8	5.3	9.0	9.4
Duration of Inundation (hrs)[3]	-	-	-	-	-	3-4*	-	5-6*	6-7*	-	6-7*	7-8*	8-9*	>12*	>12*
Section 4: Near Castine Avenue Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	9.1	-	11.1	11.6	-	12.3	12.7	13.4	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	0.9	-	2.9	3.4	-	4.1	4.5	5.2	8.9	9.2
Duration of Inundation (hrs)[3]	-	-	-	-	-	3-4*	-	6-7*	6-7*	-	6-7*	7-8*	8-9*	>12*	>12*
Section 5: Near Pine Street Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1	2.3
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	4-5*	5-6*
Section 6: Near Rose Street Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	17.1	17.3
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	1.4
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	-	-	-	-	-	3.5*	3.5*
Section 7: Near Hunt Street Intersection															
Peak Water Surface Elevation (ft)	-	8.3	8.4	-	9.8	10.0	7.6	11.3	11.4	8.6	12.3	12.5	13.4	17.1	17.3
Max Depth of Inundation (ft)	-	2.8	2.9	-	4.3	4.4	2.1	5.8	5.9	3.1	6.8	7.0	7.9	11.6	11.7
Duration of Inundation (hrs)[3]	-	5-6	5-6	-	7-8	7-8	4-5	8-9	8-9	5-6	8-9	9-10	>12	>12	>12

Notes:

1. "Avg." refers to average daily tidal conditions and average daily riverine flows, "100-yr T" refers to 1% annual chance coastal storm flood scenarios, and "100-yr T & R" refe to combined 1% annual chance coastal storm and riverine event flood scenarios
2. Peak Water Surface Elevations reference NAVD88.
3. Flood durations correspond to the duration that the the area of the road experiencing the max flood depth is inundated over one tidal cycle that includes the peak water surface elevation (approximately a 12-hr period) and flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

	Present-Day			2050 (1.5 ft SLR) Commit to Manage			2050 (3.0 ft SLR) Prepare to Manage			2100 (4.0 ft SLR) Commit to Manage			2100 (8.8 ft SLR) Prepare to Manage		
	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]	Avg.[1]	100-yr T[1]	100-yr T & R[1]
Road Name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Water Street															
Total Length Inundated (ft)	-	-	-	-	-	722	-	949	1,008	-	1,008	1,008	1,008	1,008	1,008
Peak Water Surface Elevation (ft)	-	-	-	-	-	9.4	-	11.3	11.7	-	12.3	12.9	13.4	17.1	17.6
Max Depth of Inundation (ft)	-	-	-	-	-	2.2	-	4.1	4.5	-	5.1	5.7	6.2	9.9	10.3
Duration of Inundation (hrs)[3]	-	-	-	-	-	2-3*	-	5-6*	6-7*	-	6-7*	7-8*	8-9*	>12*	>12*
Whiskeag Rd															
Total Length Inundated (ft)	-	-	46	-	177	259	-	277	574	-	439	762	758	1,222	1,336
Section 1: Near Ridge Road Intersection															
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	-	12.0	-	11.3	13.9	13.0	17.0	18.4
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	-	1.1	-	0.4	3.0	2.2	6.1	7.5
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	-	2-3	-	0-1	4-5	4-5	10-11	>12
Section 2: Near Whiskeag Creek															
Peak Water Surface Elevation (ft)	-	-	9.1	-	9.8	11.0	-	11.3	12.4	-	12.3	13.8	13.4	17.1	18.3
Max Depth of Inundation (ft)	-	-	0.7	-	1.4	2.6	-	2.9	4.0	-	3.9	5.4	5.0	8.7	9.9
Duration of Inundation (hrs)[3]	-	-	1-2	-	2-3	5-6	-	4-5	7-8	-	6-7	8-9	8-9	>12	>12
Williams Court															
Total Length Inundated (ft)	-	-	-	-	-	-	-	61	61	-	72	73	84	119	120
Peak Water Surface Elevation (ft)	-	-	-	-	-	-	-	11.3	11.3	-	12.3	12.4	13.4	17.1	17.2
Max Depth of Inundation (ft)	-	-	-	-	-	-	-	1.5	1.6	-	2.5	2.6	3.6	7.3	7.4
Duration of Inundation (hrs)[3]	-	-	-	-	-	-	-	4-5	4-5	-	5-6	5-6	7-8	11-12	11-12

Notes:

1. "Avg." refers to average daily tidal conditions and average daily riverine flows, "100-yr T" refers to 1% annual chance coastal storm flood scenarios, and "100-yr T & R" refe to combined 1% annual chance coastal storm and riverine event flood scenarios
2. Peak Water Surface Elevations reference NAVD88.
3. Flood durations correspond to the duration that the the area of the road experiencing the max flood depth is inundated over one tidal cycle that includes the peak water surface elevation (approximately a 12-hr period) and flood durations with an asterisk (*) may be less than shown due to the potential for stormwater drainage.

Appendix B

Remediation Model Results

	Present-Day			2050 (1.5 ft SLR) Commit to Manage			2050 (3.0 ft SLR) Prepare to Manage			2100 (4.0 ft SLR) Commit to Manage			2100 (8.8 ft SLR) Prepare to Manage		
	Avg.[1]	100-yr T[2]	100-yr T & R[3]	Avg.[1]	100-yr T[2]	100-yr T & R[3]	Avg.[1]	100-yr T[2]	100-yr T & R[3]	Avg.[1]	100-yr T[2]	100-yr T & R[3]	Avg.[1]	100-yr T[2]	100-yr T & R[3]
Remediation Site Name *remediation status*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Freight Shed Property *remedy in place: closed*	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kennebec Tavern and Marina *remedy in place: closed*	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dry Cleaning and Dyeing (Brackett's Market) *remediation stage*	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Old Shipyard *remedy in place: closed*	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Moses and Columbia Block *remedy in place: closed*	-	-	-	-	Yes	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Bath Iron Works *remedy in place: closed*	-	-	-	-	-	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
15 Vine Street *complaint investigated*	-	-	-	-	-	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Stinson Canning Co. *investigation stage*	-	-	-	-	-	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Grant Building *remediation stage*	-	-	-	-	-	-	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Frank Smith Cleaners *investigation stage*	-	-	-	-	-	-	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Coal Pocket *remediation stage*	-	-	-	-	-	-	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Prawer Block *investigation stage*	-	-	-	-	-	-	-	Yes	Yes	-	Yes	Yes	Yes	Yes	Yes
Steam Laundry *investigation stage*	-	-	-	-	-	-	-	-	-	-	-	-	Yes	Yes	Yes
South Yard (BIW) *remedy in place: closed*	-	-	-	-	-	-	-	-	-	-	-	-	-	Yes	Yes
Center St Laundry *complaint investigated*	-	-	-	-	-	-	-	-	-	-	-	-	-	Yes	Yes
798 Washington Street *remedy in place: closed*	-	-	-	-	-	-	-	-	-	-	-	-	-	Yes	Yes
Front Street Parking Lot *remediation stage*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Yes

Notes:

1. "Avg." refers to average daily tidal conditions and average daily riverine flows
2. "100-yr T" refers to 1% annual chance coastal storm flood scenarios
3. "100-yr T & R" refers to combined 1% annual chance coastal storm and riverine event flood scenarios
4. Remediation status based on ME DEP Remediation Site Database, acessed November 2022

Resilient Bath Monitoring Plan

Introduction

The City of Bath seeks to track metrics related to sustainability in a meaningful way in order to track progress toward the City's climate goals. This memo outlines recommendations for the City to track progress toward the completion of the goals, strategies, and actions included in the *Resilient Bath Climate Action & Resiliency Plan*. Two types of metrics may be tracked to evaluate progress for plan implementation, including:

- **Performance Metrics**: Measure progress toward goals
- **Implementation Status**: Measure successful completion of actions

In addition to metrics specifically related to the climate action plan, continued progress monitoring on GHG reductions can be done through periodic GHG inventory updates, however these should be paired with updates to underlying data where possible and a more comprehensive collection of indicator data to illustrate overall progress.

Monitoring progress for climate change adaptation will require understanding the outputs, indicators, and impacts for adaptation related actions in Bath. In the field of local climate adaptation planning and implementation there is still a need to develop robust and consistent climate adaptation indicators and metrics. However, while there may not be shared metrics guides the field at large, there is still a critical need for the City of Bath to be explicate about what metrics are being monitored and how these outcomes are being evaluated for public awareness and confidence in the implementation of this plan.

Performance Metrics

Performance metrics are essential tools for assessing and managing progress toward the *Resilient Bath* goals. In the context of our objectives, the evaluation process involves measuring advancements against long-term and interim targets, specifically targeting key milestones in 2030, 2040, and 2050. As such, at least one performance metric has been identified for each of the *Resilient Bath* goals.

Some of the outcomes of *Resilient Bath* have clear and objective end-states that define goal achievement, such as the elimination of fossil fuel use for building heating. Other performance metrics dealing with preparedness or social outcomes will likely continuously evolve in response to factors outside the control of the community. Similarly, the maximum amount of renewable energy capacity within city limits. These types of metrics are nonetheless useful to track as trends in them may inform

continuous improvement in *how* the City of Bath and its partners implement actions and practice adaptive management. In these cases, targets are expressed in terms of "increasing" or "decreasing" values for the metric to express the intent of the goal. It will be up to relevant City of Bath staff to interpret when trends indicate changes to the plan or its implementation are warranted.

The responsibility for tracking these metrics lies with the designated department assigned with collecting and reporting the data to the Bath Climate Action Committee and Sustainability Office. To maintain transparency and accountability, the results should be reported annually.

Goal EB 1: Buildings in Bath are energy efficient and minimize greenhouse gas emissions.

Metric	Unit	Narrative Support
Share of Residential Buildings Electrified	% of homes	May be used in the interim to track progress towards high-efficiency, electric buildings.
Share of Commercial Buildings Electrified	% of commercial building area	

Goal EB 2: Bath achieves enhanced renewable energy capacity and energy resilience.

Metric	Unit	Narrative Support
Installed Rooftop Solar Capacity	MW	Will enable the City to track progress toward increasing local solar capacity.
Households Enrolled in Maine Green Power Program	% of households	Will enable City to track renewable energy purchases to be able make claims for carbon neutrality.

Goal TM 1: Bath is a model for clean transportation options.

Metric	Unit	Narrative Support
Share of Light-Duty Vehicles Electrified	% of vehicles	Will enable the City to track progress toward residential and commercial vehicle electrification.
Share of Heavy-Duty Vehicles Electrified	% of vehicles	
Public EV Charging Ports	# of ports	Aligns with City's priorities to expand public charging network.

Goal TM 2: Bath community members have more options for sustainable and safe travel.

Metric	Unit	Narrative Support
Average Daily Vehicle Miles Traveled per Household	VMT / household	Aligns with City's priorities to reduce vehicle trips. Mobility uses this metric often.

Annual Bath CityBus and Bath Trolley Ridership	# of annual riders	Will enable the City to track public transit demand. Aligns with the City's priorities to reduce single occupancy vehicle trips and encourage multimodal transportation options.

Goal CO 1: The City leverages climate data and hazard mitigation best practices for infrastructure and neighborhood planning.

Metric	Unit	Narrative Support
Miles of roadway inundated with flooding during prepare to manage 2050 SLR scenario	2.8 current miles	Provides some level of understanding of the resiliency of City infrastructure.

Goal CO 2: The Bath community understands climate change and has tools and resources to stay safe during climate events.

Metric	Unit	Narrative Support
Heat-related ER Visits in Sagadahoc County	# of annual visits	Extreme heat events are having an increasing impact on human health and illustrating the trends can be an important communication tool for the urgency of GHG reductions as well as crafting and supporting targeted policy responses.

Goal CO 3: Housing in Bath is affordable and climate-ready.

Metric	Unit	Narrative Support
New Accessory Dwelling Units Developed	# of ADUs	Aligns with the City's priorities to enhance housing affordability.
Energy Cost Burden of Low-Income Households	% of income spent on energy costs	Will enable the City to assess community resiliency as increasing energy affordability is a high priority to reduce vulnerability.
Households with Central AC	% of households	Provides some level of understanding of access to cooling in the home; however, many households

		that rely on window units are not captured here.

Goal WW 1: The Bath community reduces its carbon footprint by minimizing waste; reducing the consumption of disposal goods, sharing, fixing, and upcycling materials; and recycling and composting.

Metric	Unit	Narrative Support
Residential Waste Diversion Rate	% of waste diverted from landfill	Aligns with City's priorities to achieve zero waste (or 90% diversion).
Share of Residential Food Waste Composted	% of food waste	Will enable the City to track residential composting practices.
Share of Households Enrolled in Garbage to Garden Composting Program	% of households	
Businesses Enrolled in Garbage to Garden Composting Program	% of businesses	Will enable the City to track commercial composting practices.

Goal WW 2: The City efficiently and sustainably manages wastewater, stormwater, and the combined sewage overflow (CSO) system.

Metric	Unit	Narrative Support
Combined Sewer Overflows	million gallons	Provides some level of understanding of overflow risks and will inform stormwater management.

Goal NR 1: Bath's existing and future natural resources are healthy and sustainable.

Metric	Unit	Narrative Support
Tree Canopy Coverage	% of land area	Aligns with City's priorities to increase the urban tree canopy by 15%.
Residents Living Within a 10-Minute Walk of a Park	% of residents	Provides some level of understanding of community access to green spaces.

City Owned Trees	# of trees	Will enable the City to track tree plantings and monitor the implementation of design standards for street trees.

Goal NR 2: Bath's coastal resources are resilient to climate change.

Metric	Unit	Narrative Support
Miles of Unstable Coastal Bluffs	# of miles	Will enable the City to track the protection and enhancement of coastal natural resources.

Goal NR 3: The City understands and promotes the potential of Bath's natural resources to sequester carbon from the atmosphere.

Metric	Unit	Narrative Support
Acres of Conservation Land	# of acres	Aligns with City's priorities to conserve land with high carbon sequestration potential.

Implementation Status

If the performance metrics are used to track progress toward goals, the implementation status are used to track progress toward implementation of actions, enabling Bath to demonstrate follow through on actions with regular reporting on the City's website or other means.

The high-level implementation steps that Bath should track across all actions, of which the action champions will report on, include the following:

- Not started
- In-progress
- Facing roadblock
- Complete
- Complete and using performance metrics to evaluate effectiveness

While some actions may stop at "Complete" (e.g., coordination with utilities), other actions may require continued tracking through performance metrics to evaluate the effectiveness of the policy or program (e.g., tracking high efficiency, all-electric households to measure effectiveness of the energy coaching program).

Monitoring Outcomes – GHG Inventory Improvements

Greenhouse gas inventories have a variety of purposes. Inventories serve to provide the basis for prioritizing the development of actions based on the relative contributions of sources in the community.

Inventory baselines provide the basis for target setting and periodic inventory updates provide the means for monitoring whether the City of Bath is on the trajectory needed to reach its reduction targets.

The unfortunate reality of community scale GHG inventories is that there are very few instances where all data about a community is known in the original baseline, and it may be multiple re-inventories until perfectly repeatable data has been established to illustrate measured progress from the baseline.

For the 2024 Resilient Bath Plan, several updates were made to previous inventories to make some calculation corrections as well as make clear which pieces of data are well positioned for progress monitoring and which data sources are still based on estimated inputs that will need to be refined over time.

Updates to the 2022 GHG Inventory:

Corrected electricity consumption:

- Data input into the ClearPath software was checked against notes and raw data that was attached to records in the tool.
- Initial review found that data inputs matched the values provided by Central Maine Power.
- Further review of results led to a determination that the quantity of energy represented by the records was unrealistically small and 2018 data was checked for reference. This review led to the realization that data reported by Central Maine Power was low by an order of magnitude, or a single decimal point.
- To correct for this, records for electricity use in the Residential, Commercial, and Industrial sectors were increased by 10x.
- Future engagement with Central Maine Power should include checks to ensure correct units. Where possible, it may be advantageous to also seek electricity use data at monthly intervals instead of annual totals.

Updated reference for non-utility energy:

Non-utility stationary energy such as fuel oil and propane are fundamentally limited in terms of ability to track usage. While building assessor records can help track the number and size of structures using these fuels for primary heat, actual use and improved performance that may come from building weatherization or changes in heating demand from the weather will not be captured. Trends here can be measured solely in terms how many buildings are using these fuels.

Placing a value on these fuels for inventory purposes and to gauge the relative impact of focusing decarbonization on buildings using different fuel types requires a reference for energy intensity of buildings using those fuels. Both the 2018 and 2022 inventories utilized the US EIA Residential Energy Consumption Survey and Commercial Building Energy Consumption Survey. These resources are included as default values in methods such as the US Community Protocol, however new data sources with better precision have emerged in recent years the ResStock[1] and ComStock[2] models from the National

[1] https://resstock.nrel.gov/
[2] https://comstock.nrel.gov/

Renewable Energy Laboratory provide modeled estimates of these intensities with greater geographic and building type precision.

Updating these data sources provides a better estimate of relative GHG reduction potential with the added benefit of aligning with the modeled energy saving values from ResStock and ComStock models. It is recommended that Bath monitor these models and other data products from all US national labs as potential continued improvements.

Natural gas in buildings:

An unfortunate complication for tracking natural gas usage in Bath is the presence of a single large customer using fuels in a productive capacity at Bath Iron Works with the inability to distinguish that usage from consumptive usage for the heating of buildings, domestic hot water, and cooking; all of which have viable options for decarbonization with today's technology. Thankfully this situation does not impact residential usage, but it does complicate getting a clear understanding of utility gas within non-residential structures in Bath. It is recommended that the city continue to engage with Maine Natural Gas to exclude Bath Iron Works from future reports on aggregate gas consumption in order to better track progress in this area.

Alternatively, some directed survey efforts focused on downtown businesses or other voluntary disclosure could fill gaps in knowledge. While improved information would be useful to know, the current situation should not be an impediment to action as individual building owners can still make proactive decisions to decarbonize their properties. It is worth noting that the situation in Bath is not unique and the need for modernizing utility privacy rules to advance climate action are recognized in other places, particularly within the State of California[3].

On-road transportation:

Emissions from on-road transportation in Bath's GHG inventories to date have been based on measures of total VMT occurring within the city limits derived from simple traffic counts on major roads. While this is an overall good and repeatable measure of traffic activity, it does not indicate much about the transportation demands of Bath residents and workforce. Alternative data sources such as those derived from cell phone and vehicle location data can provide a clearer picture of what Bath resident's individual contributions are; however, those alternatives are currently expensive. Over time options may continue to improve and possibly studies from the State of Maine or Mid-Coast Council of Governments could refine inventory estimates in this sector.

Evolving data availability is a factor that all communities working on climate action must work with. The City of Bath should not shy away from continued improvements in data collection and shifting to improved methodologies even if they lead to inconsistencies with the baselines from which targets were set. As field of local government climate action continues to evolve, it is likely that messaging and updating targets in the future may re-orient in terms of our distance from zero emissions rather than how far we've come from an uncertain starting point.

Updates to 2018

[3] Berkeley Law, et al. Data Access for a Decarbonized Grid. 2021. https://www.law.berkeley.edu/wp-content/uploads/2021/02/Data-Access-for-a-Decarbonized-Grid-February-2021.pdf

In addition to updates made to 2022, the process of comparing the two inventories prompted additional review of the 2018 baseline inventory as solid waste emissions had dropped significantly to 2022. Further exploration of input data revealed that the total tons of waste landfilled used to calculate GHGs included tons from road construction and other largely inert C&D debris. To correct the value of waste deposited was reduced to only include mixed municipal solid waste, reducing the tons from 10,073 tons to 4,562 tons. Both these values are listed in the Bath Landfill report attached to the ClearPath record.

Moving forward, as actions from the Resilient Bath Plan are implemented to eliminate organic material from the waste stream, the impact of this will show up somewhat in the reduced tons of waste deposited at the landfill. However, the full benefit of the savings would not be recognized in the calculation of subsequent inventories unless the share of organics in the waste characterization factor set are also updated to reflect that these materials are being diverted.

Simple calculations to re-allocate the waste characterization based on the tons removed could accomplish this adjustment as an estimate in lieu of a physical waste characterization study, however those should be performed periodically to understand what is truly remaining in the waste stream and how effective all diversion practices have been at eliminating sources of landfill methane.

Comprehensive Progress Monitoring

Relying on inventories alone to evaluate progress towards GHG reductions has limited ability to illustrate significant details into the drivers of change from one year to the next. As GHG inventories typically work data at annual timescales, it can be difficult to quantitatively recognize the influence of external factors working for or against target achievement. For example, changes to the carbon intensity of grid electricity may not always be progressively lower. Particularly hot or cold years may have a significant impact on building energy use that could mask achievements made or give a false impression of progress. Significant changes to the overall building stock can also skew apparent progress as will welcoming new residents and businesses into the community.

Overall, these types of factors should be considered and incorporated into any evaluation of trends and achievements and apparent progress should not be penalized when that occurs. To fully account for the driving factors behind changes in GHG performance, data that describes the community context at the time of the inventory can not only qualify the results, but also provide direction for adaptive management of the actions in the Resilient Bath plan.

While some of these datapoints are collected by default in an inventory, such as the grid electricity emissions factor, others may need to be deliberately collected in addition to the standard inventory inputs. Some examples include:

- Square feet of building area by building type and fuel type
- Vehicles registered and miles driven by vehicle type
- Total value of commercial activity
- Heating and cooling degree days

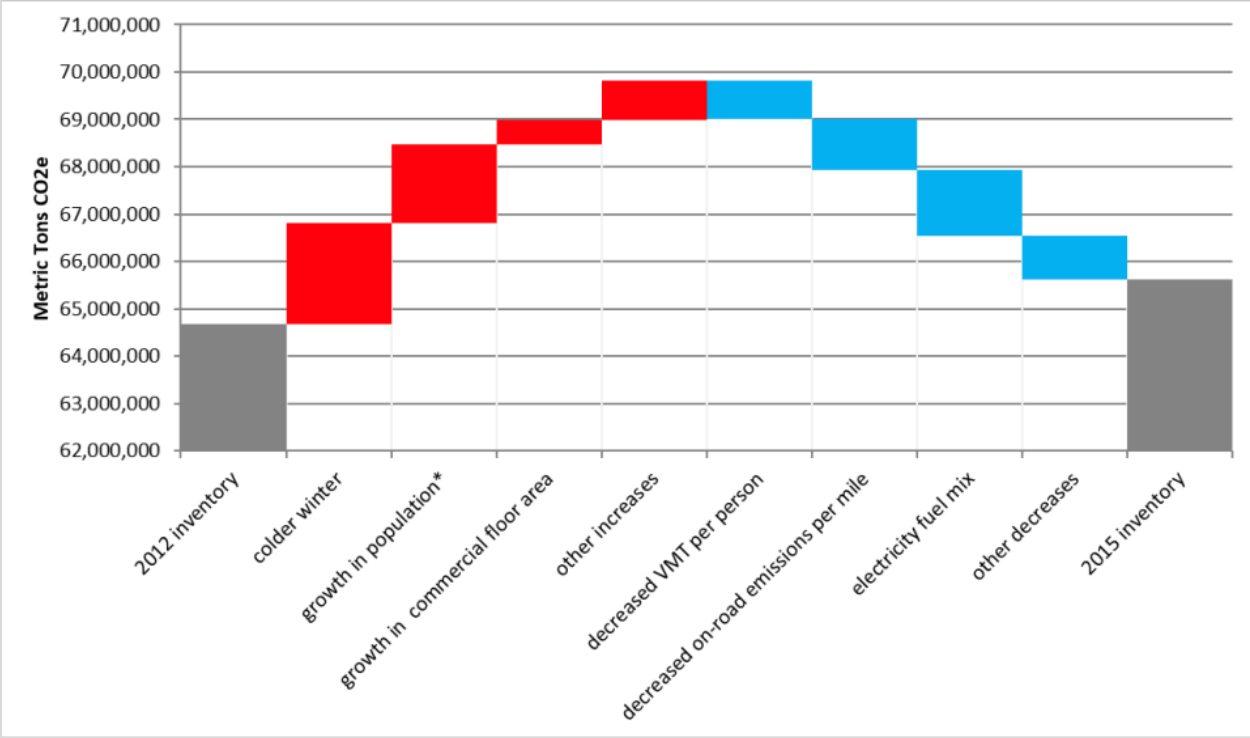
At a minimum, these types of metrics will support the City of Bath to perform simple “normalization” adjustments by expressing both absolute values in the GHG generating activities as well as in an indicator

format. Communicating per-capita or per-square foot, or other indicators can illustrate some level of progress when it is masked by growth or other external factors.

The use of indicators is one relatively low level of effort option for illustrating progress, but it has limitations for illustrating how changes across multiple variables impact. For example, illustrating the relative impact between changes to electricity usage as well as changes to the carbon intensity of that electricity. For this type of illustration, the Contribution Analysis Framework[4] from ICLEI-USA can be a powerful tool for communicating results and recalibrating level of effort applied to the actions in the Resilient Bath Plan.

One important aspect of the Contribution Analysis Framework is its ability to combine factors from both top-down and bottom-up perspectives. For example, it is possible to illustrate both the impact of cleaner grid electricity derived from high-level inventory inputs with measured or estimated impacts from implemented actions. As the City tracks the number of home electrification and or weatherization projects, all factors can be combined to illustrate comprehensive change. There are opportunities for integrating many of the Resilient Bath performance metrics into estimates of achieved reductions in this type of comprehensive framework.

Figure 1. Example Contribution Analysis Results (not Bath)



While there always remains some level of unallocated change “other” increases or decreases, this type of analysis is much more useful than simply knowing whether change is up or down. The Contribution Analysis Framework can be applied to individual sectors and does not require a full inventory to perform

[4] https://icleiusa.org/ghg-contribution-analysis/

either. It may be useful for the City of Bath to track annual building energy usage and apply the framework to just that sector alone. The scope of this type of analysis fits within a summer internship or other internal resources to accomplish, especially if Bath can also leverage training and other support from ICLEI-USA. The contribution analysis framework can be leveraged to look at individual sectors and any number of factors for which data is available. Overall, the technique could be the basis for a number of project suitable for summer internships, particularly during interim years when a full inventory is not required.

Monitoring Outcomes – Climate Adaptation

While there is not a consistently utilized framework for measuring adaptation at the sub-national, a consistent and transparent approach will enable the City of Bath to track progress overtime and adapt strategies and actions and new and better climate science becomes available. We recommend that for every adaptation action that the City begins to implement, your team identifies six core categories: *output*, output indicator, *outcome*, outcome indicator, *impact* and impact indicator. Examples of climate adaptation actions within this climate adaptation framework can be found here on the C40 Cities knowledge Hub.

RESILIENT BATH

WORKING TOGETHER FOR A SAFER, STRONGER FUTURE

When faced with challenges, our community remains strong: this is Bath. As a city that still builds ships on the same river as we did 200 years ago, **resilience has always been a part of our community**.

WITH THE RESILIENT BATH PLAN, WE WILL CHART OUR COURSE TOWARDS A SAFER, STRONGER FUTURE FOR EVERYONE.

The goals, strategies, and actions in our plan will be organized into **5 key focus areas:**

CLEAN ENERGY AND EFFICIENT BUILDINGS

VIBRANT NATURAL RESOURCES

SMART WASTE AND WATER MANAGEMENT

CONNECTED TRANSPORTATION AND MOBILITY

RESILIENT AND HEALTHY COMMUNITY

THE RESILIENT BATH TIMELINE

COMMUNITY ENGAGEMENT

DATA ANALYSIS
We will identify sources of climate pollution in Bath so that we can focus and prioritize our actions.

ACTION PLANNING
We will develop targeted actions with the guidance of community members and local experts to reduce climate pollution and build community resilience.

FINAL PLAN
With input and guidance from stakeholders, we will launch a final plan in fall 2024.

JANUARY 2024 — **OCTOBER 2024**

LEARN MORE AT cityofbathmaine.gov/ResilientBath

RESILIENT BATH

WORKING TOGETHER FOR A SAFER, STRONGER FUTURE

The impacts of climate change are nothing new to Bath residents; we have all experienced **more intense storms, increased flooding, and unprecedented seasonal temperature changes** in our community.

54% *Buildings*

24% *Industrial Energy*

19% *On-Road Transportation*

2% *Solid Waste*

1% *Water & Wastewater*

With the ***Resilient Bath Plan***, we have a collective opportunity to build resilience to these impacts while continuing to reduce our climate pollution and invest in clean energy.

Our climate is changing due to greenhouse gas (GHG) emissions, also called climate pollution, which trap heat in our atmosphere. These emissions are generated when we burn fossil fuels like oil and gas to power our homes, businesses, cars, and more. In Bath, 73% of climate pollution is generated by our buildings and vehicles.

The ***Resilient Bath Plan*** will lay out strategies to reduce GHG emissions and make our community safer in the face of extreme weather events and sea level rise. For example, Bath can take action to **electrify homes and vehicles**, **reduce waste**, **proactively manage stormwater and flooding events**, and much more.

It is up to all of us to ensure the success of the ***Resilient Bath Plan***.
Our city never backs down from a challenge – **let's move forward, together.**

GET INVOLVED

@BATHMAINE

TAKE OUR SURVEY
SCAN TO PARTICIPATE!

LEARN MORE AT cityofbathmaine.gov/ResilientBath

For Clerks Use Only

11/20/2024 | 2024-119

Meeting Date | Item No.

CITY COUNCIL ACTION

Requested Council Meeting Date: November 20 , 2024

Responsible Dept: City Manager

Requested Action: Resolution

Title

City Manager contract addendum

Summary

The item confirms the City Charter provision that the City Manager's term in indefinite, amending the original agreement, and adjusts the City Manager's salary, following annual performance evaluation.

Staff Comments

Action: Recommend for passage

City Manager

Introduced for: New Business

For Clerks Use Only

CITY OF BATH

Date:

City Manager contract addendum

ADDENDUM #1

THIS CONTRACT ADDENDUM is effective 20th day in November, 2024.

Between: The Municipal Officers of the City of Bath ("Council")
City Hall
55 Front Street
Bath, ME 04530

And: Marc S. Meyers ("Employee")
15 Seekins Drive
Bath, ME 04530

Collectively, the Council and the Employee are known as the Parties.

WHEREAS, the Parties entered into an Agreement made and entered into the 3rd day of November, 2021for the Employee to serve as City Manager of the City of Bath, as provided by Section 301 of the Charter of the City of Bath; and

WHEREAS, the Parties desire to amend the Agreement on the terms and conditions set forth in this Addendum; and

WHEREAS, this Agreement is the 1st addendum to the Agreement;

NOW, THEREFORE, BE IT RESOLVED, by the City Council of the City of Bath that the Parties agree to amend this Agreement and agree to keep, perform and fulfill the amendments, promises and conditions outlined below:

1) Confirm that the term of the Agreement is set for indefinite per Section 301 of the Charter of the City of Bath. The two additional three-year terms referenced in Section 2 will be removed.

2) The Council has conducted an annual performance evaluation of the Employee and the Employee's annual base salary was evaluated and adjusted in conjunction with, and upon completion of, the performance evaluation provisions of Section 7 of this Agreement. The Employee shall be paid an annual base salary of $132,208.00, effective November 22, 2025. All other conditions of Section 6 of the Agreement shall remain in effect.

For Clerks Use Only

11/20/2024 | 2024-120

Meeting Date | Item No.

CITY COUNCIL ACTION

Requested Council Meeting Date: November 20 , 2024

Responsible Dept: City Manager

Requested Action: Order

Title

Extending term of contract with Ubicquia

Summary

The City and Ubicquia, Inc., have reached an agreement to allow for attaching street radios for the provision of services related to telecommunications, public safety, public service, and/or public Wi-Fi access to City streetlight structures. This 10-year agreement will allow cell phone providers to strengthen coverage areas within the City by affixing equipment to the City's streetlights.

Per City Charter Section 1102, "No contract involving the payment of money out of the appropriations of more than one (1) year, (other than contracts in which rates are subject to approval of the Public Utilities Commission) shall be made for a period of more than five (5) years, nor shall any such contract be valid unless made or approved by ordinance. The five (5) year term limit on contracts involving payment of money out of appropriations of more than one (1) year may be waived by affirmative vote of the majority of the entire City Council (six (6) votes)."

Staff Comments

If the order does not pass, then the ordinance regarding this agreement will be tabled.

Action: Recommend for passage

City Manager

Introduced for: New Business

For Clerks Use Only

CITY OF BATH

Date:

Extending term of contract with Ubicquia

BE IT ORDERED by the City Council of the City of Bath in accordance with the section 1102 of the City Charter, that the City's contract with Ubiquia, Inc., relating to attaching certain equipment for the provision of services related to telecommunications, public safety, public service, and/or public Wi-Fi access to City streetlight structures will be allowed for a term up to ten (10) years with up to four (4) additional terms of five years each.

For Clerks Use Only

11/20/2024 | 2024-121

Meeting Date | Item No.

CITY COUNCIL ACTION

Requested Council Meeting Date: November 20 , 2024

Responsible Dept: City Manager

Requested Action: Ordinance

Title

Approving pole attachment aggrement with Ubicquia

Summary

The City and Ubicquia, Inc., have reached an agreement to allow for attaching street radios for the provision of services related to telecommunications, public safety, public service, and/or public Wi-Fi access to City streetlight structures. This 10-year agreement will allow cell phone providers to strengthen coverage areas within the City by affixing equipment to the City's streetlights.

The street radios will provide improvement in cellular service and provide a new revenue stream for the City. Per the agreement, Ubicquia serves as the single point of contact for any company interested in attaching to the City's streetlights. and coordinates all activities with wireless operators and/or public safety. The City has final say on where and whether or not an attachment is installed.

There is no out of pocket expenses for the City. The City will receive a fee for each attachment. The first year estimate of 25 street radios attached to streetlights, the monthly revenue to the City would be $750 ($30 X 25 street radios = $750), or $9,000/year. Ubicquia will also be responsible for any additional electricity use as a result of the street lights.

Staff Comments

This agreement does require a vote of the majority of council to waive the five-year term limit on contracts (City Charter Section 1102). If that vote does not pass, then the ordinance regarding this agreement will be tabled.

Action: Recommend for passage

City Manager

Introduced for: New Business

For Clerks Use Only

CITY OF BATH

Date:

Approving pole attachment aggrement with Ubicquia

WHEREAS, the City of Bath and Ubicquia, Inc, have reached an agreement relating to attaching certain equipment for the provision of services related to telecommunications, public safety, public service, and/or public Wi-Fi access to City streetlight structures.

WHEREAS, the proposed contract calls for a term of up to ten (10) years; and

WHEREAS, Section 1102 of the City Charter restricts the length of contracts that the City may enter into to five (5) years and the term limit may be waived by affirmative vote of the majority of the entire City Council.

WHEREAS the City Council, by order, has authorized the City's contract with Ubicquia, Inc., to be a term up to ten (10) years with up to four (4) additional terms of five years each;

NOW, THEREFORE, BE IT ORDAINED by the City Council of the City of Bath that the agreement by and between the City of Bath and Ubicquia, Inc., relating to attaching certain equipment for the provision of services related to telecommunications, public safety, public service, and/or public Wi-Fi access to City streetlight structures by and hereby is approved, and that the City Manager is authorized to execute the agreement on behalf of the City of Bath, in substantially the form as presented, subject to changes deemed necessary by the City Manager, and to execute any other documents that may be necessary, appropriate or convenient to the implementation of the agreement.

MASTER ATTACHMENT AGREEMENT

This Master Attachment Agreement (this "**Agreement**"), dated as of [--] (the "**Effective Date**"), is entered into by and between Ubicquia, Inc. ("**Licensee**"), a Delaware corporation, with offices located at 401 East Las Olas Blvd., Suite 800, Fort Lauderdale, FL 33301 and [--] ("**Licensor**"), a [--], with offices located at [--]. Licensee and Licensor are referred to herein as the "**Parties**," and each a "**Party**."

RECITALS

WHEREAS, Licensor owns and/or controls certain streetlight structures;

WHEREAS, Licensee desires to use such streetlight structures to attach certain equipment for the provision of services related to telecommunications, public safety, public service, and/or public Wi-Fi access;

WHEREAS, Licensor desires to permit Licensee to attach such equipment to the streetlight structures now existing or hereafter erected;

WHEREAS, because it is impractical to execute a separate agreement in each instance in which Licensee desires to attach such equipment to a streetlight structure owned or controlled by Licensor, the Parties intend that this Agreement shall be the all-inclusive master agreement regarding such attachments for the duration of this Agreement; and

WHEREAS, the Parties desire by this Agreement to set forth their understanding about such matters.

NOW THEREFORE, in consideration of the mutual covenants and agreements set forth hereinafter and for other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, Licensor and Licensee agree as follows:

AGREEMENT

1. DEFINITIONS.

1.1 "**Affiliates**" means, with respect to a Party, an entity that directly or indirectly controls, is controlled by or is under common control with such Party, wherein "control" shall mean the ownership of at least 50% of the shares and/or voting rights in an entity.

1.2 "**Attachment(s)**" means the equipment to be attached by Licensee (or its subcontractor) to the Streetlight Fixtures.

1.3 "**Confidential Information**" means a Party's confidential, proprietary or non-public information (or such non-public information of a third party that is in the possession of a Party), including without limitation, trade secret, discoveries, ideas, concepts, know-how, techniques, processes, procedures, designs, specifications, strategic information, proposals, requests for proposals, proposed products, drawings, blueprints, tracings, diagrams, models, samples, flow charts, data, computer programs, marketing plans, employee personal information, health or financial, information, authentication credentials, operations, infrastructure, networks, systems, facilities, products, rates, regulatory compliance, competitors and other technical, financial or business information, whether disclosed in writing, orally, or visually, in tangible or intangible form, including in electronic mail or by other electronic communication. All Confidential Information, whether disclosed orally or disclosed or accessed in written, electronic, or other form or media, and whether or not marked, designated, or otherwise identified as "confidential," in connection with this Agreement is confidential to the disclosing Party. Confidential Information does not include any information that: (a) is or becomes generally available to the public other than as a result of a Party's breach of this Agreement; (b) is obtained by the receiving Party on a non-confidential basis from a third party that was not legally or contractually restricted from disclosing such information; (c) the receiving Party establishes, by documentary evidence, such information was in its possession prior to disclosure by the disclosing Party; or (d) was or is independently developed by the receiving Party without using any of the disclosing Party's Confidential Information.

1.4 "**Force Majeure**" means an event or other circumstance that is beyond the Party's reasonable control, without the Party's fault or negligence, and which could not have been avoided by the Party's use of due care, which may include, without limitation: acts of God including hurricanes, tornadoes, wildfires, earthquakes, ice storms, and floods; acts of terrorism; civil unrest; interference by civil or military authority, including war and embargoes; fires; epidemics or pandemics; acts of any branches of government relating to declarations of emergencies; and labor strikes (other than labor strikes with the workforce of the delayed Party).

1.5 "**Request Form(s)**" means the request form provided by Licensee pursuant to the terms contained herein for Licensor's approval, setting forth the Attachments and Streetlight Fixtures which Licensee wishes to use. All Request Forms agreed between the Parties shall be governed by the terms and conditions of this Agreement and incorporated therein by this reference. A sample Request Form is attached as Exhibit A.

1.6 "**Streetlight Fixture(s)**" means the streetlight fixtures, including without limitation any chases, risers, trays, pipes, vaults, and hand holes, and any associated streetlights owned and/or controlled by Licensor. The Streetlight Fixture locations shall be stated in each Request Form, as such as been agreed upon by both Parties.

1.7 "**Streetlight Fixture Infrastructure**" means any and all form of existing power supply, conduit, pull boxes, electrical circuits, or other form of infrastructure fixtures or equipment for the delivery of power or communication services: (i) approved by the Licensor for use by the Licensee and (ii) reasonably related to the operation of a Streetlight Fixture or otherwise located in the public right of way or other location controlled or owned by the Licensor and reasonably capable of being used in connection with a Streetlight Fixture.

2. RIGHTS.

2.1 Grant of Rights. During the Term, Licensor hereby grants Licensee the right to construct, install and attach, or have installed and attached and operate, maintain, repair, replace, remove, reattach, reinstall, relocate and upgrade the Attachments to the Streetlight Fixtures and/or Streetlight Fixture Infrastructure identified in each accepted Request Form. The Parties agree that Licensor, in granting such right to Licensee, in no way purports to grant to Licensee an interest in any property, but only grants Licensee the right, subject to the provisions of this Agreement, to attach Attachments to the Streetlight Fixture and/or Streetlight Fixture Infrastructure. The rights granted in this Section 2.1 shall be non-exclusive and nothing herein shall be construed as affecting the rights or privileges previously conferred by Licensor or by law to other third parties.

2.2 Third Party Consent. To the extent that Licensor's rights to use and access a Streetlight Fixture emanate from an easement or from a license grant that Licensor determines does not permit the use of the Streetlight Fixture by Licensee as provided in this Agreement, Licensor shall so advise Licensee and shall provide Licensee with copies of the easement or other property document establishing Licensor's rights at any such Streetlight Fixture. Notwithstanding any other term or provision hereof, Licensor shall have the sole responsibility for negotiating and acquiring property rights necessary to permit the installation, maintenance, removal and operation of the Attachments on any such Streetlight Fixtures, along with any associated costs. Licensor should not approve the use of a Streetlight Fixture by Licensee unless and until it can demonstrate the successful acquisition of such rights. In performing any installation, alteration or repair of the Attachments under this Agreement, Licensee and/or its contractors shall comply with the terms and conditions of any easement or license grant applicable to the Streetlight Fixture on which such work is being performed and shall conform to the insurance requirements, if any, of the applicable owner.

2.3 Previously Conferred Rights. Licensor shall provide to Licensee a list of any previously granted rights to the Streetlight Fixtures, including the name and contact of the existing grantee, and shall provide written confirmation to Licensee that any equipment previously mounted to a Streetlight Fixture, or any rights previously granted will not prevent the affixing of the Attachments to the Streetlight Fixtures or affect Licensee's rights granted herein.

2.4 Exclusive Access. Licensor will not grant exclusive or priority access to any Streetlight Fixture or group of Streetlight Fixtures to a third-party and will not require existing Attachments to be

removed during the Term for any reason other than as permitted in this Agreement.

3. TERM. The initial term of this Agreement shall be for 10-year, commencing as of the Effective Date (the "**Initial Term**"). Upon expiration of the Initial Term, this Agreement will automatically renew on the same terms and conditions, for up to 4 additional 5-year terms, or until terminated by either Party hereto as set forth in this Agreement (the Initial Term, together with any such renewals, is herein referred to as the "**Term**").

4. FEES AND CHARGES.

4.1 Attachment Fee. Licensee agrees to pay a monthly fee set forth in the Request Form (the "**Fee**"). The Fee shall include any applicable electric use, and be invoiced monthly, starting from the date of installation of such Attachment, and shall be paid by Licensee within 90 days of receipt of invoice from Licensor.

4.2 Removed Attachments. Licensee shall not be entitled to any refund of any amount paid by Licensee for an Attachment that has been removed by Licensee in its sole discretion. Licensee shall be entitled to a pro-rata refund of any Fee paid in advance to Licensor if Licensor mandates removal of the Attachment.

4.3 Additional Costs. Licensee hereby acknowledges and agrees that any other costs associated with the installation of the Attachments, including without limitation, permit costs, installers' fee, traffic mitigation costs and any similar costs and expenses, shall be Licensee's sole obligation.

5. ATTACHMENTS & INSTALLATION.

5.1 Attachments. At no time during or after the Term will Licensor acquire any rights in and to the Attachments. The Attachments shall remain the sole responsibility of Licensee. Any material deviation to such description(s) (such as for example a change in weight or voltage) must be approved by Licensor in writing.

5.2 Third Party Owned Attachments. The Parties acknowledge that Attachments deployed by Licensee in the Streetlight Fixtures pursuant to this Agreement may be owned and/or remotely operated by a third-party ("**Third Party**") and installed and maintained by Licensee pursuant to existing agreements between Licensee and a Third Party. Such Attachment shall be treated as Licensee's Attachment for all purposes under this Agreement and any applicable Request Form. A Third Party's ownership and/or operation of such Attachment shall not constitute an assignment under this Agreement. Licensee shall remain solely responsible and liable for the performance of all obligations under this Agreement and applicable Request Form with respect to any Attachment owned and/or remotely operated by a Licensee's customer.

5.3 Limitations. Attachments will be limited to one per Streetlight Fixture and will be allowed only pursuant to the terms of the Request Form. The locations of the Attachments on the Streetlight Fixtures may be subject to engineering and safety analysis. Licensor shall have the right to refuse or remove any Attachment that adversely affects the structural or operational integrity of a Streetlight Fixture.

5.4 Locations. Licensee and Licensor shall collaborate to identify suitable Streetlight Fixtures for the Attachments. If the Parties determine that a modification or other adjustment is needed before one or more of the Streetlight Fixtures can be used by Licensee, then (i) Licensor shall obtain any and all permissions necessary (if any) to perform such modification or adjustment, and (ii) Licensee shall be responsible for the performance and cost associated with the modification or adjustment. The Parties will mutually agree on a scope of work prior to the commencement of any work as permitted under this Section 5.4. Every 6 months Licensor shall provide an updated list of Streetlight Fixtures to Licensee.

5.5 Use of Facilities. All Attachments shall be constructed, installed, and operated in accordance with generally applicable engineering requirements, and the specifications in the terms of the Request Form and this Agreement so as not to interfere with Licensor's present or future use of any Streetlight Fixture. In addition, all Attachments must be made on Streetlight Fixtures that are bucket truck accessible. At all times, Licensee shall maintain, operate, and construct/install all Attachments

in such manner as to ensure that Licensor has full and free access to all of its Streetlight Fixtures. Licensee shall not alter any Licensor's property except as specifically authorized.

5.6 Compliance with National Electrical Safety Code. All work shall be performed in accordance with applicable National Electrical Safety Code standards, including amendments thereto adopted at any time by any jurisdiction in which such work occurs. Licensee shall take all necessary precautions, by the installation of protective equipment or other means, to protect all persons and property of all kinds against injury or damage caused by or occurring by reason of the installation or existence of Attachments. Licensee shall follow industry-standard practices in the operation, maintenance, and inspection of its Attachments, and shall make all regular and special inspections as necessary to ensure compliance with this Section 5.6.

5.7 Compliance with Applicable Laws. The Parties shall comply with all applicable federal, state, and local laws, rules, and regulations in undertaking its obligations under this Agreement.

5.8 Operation and Maintenance of the Attachments. Licensee and/or its contractors must operate and maintain the Attachments to ensure proper functioning of the Attachments and limit intervention to the Streetlight Fixtures. Contractors must comply with any and all applicable provisions of this Agreement to the same extent such provisions would apply to Licensee.

5.9 Reports. Licensee will provide to Licensor regular updates on installation progress and maintenance schedule, including a listing of all Attachments installed on Licensor's Streetlight Fixtures with Streetlight Fixture number, address, or other identifier mutually agreed between the Parties.

5.10 Interference or Hazard. Whenever Licensor notifies Licensee in writing that, in Licensor's reasonable judgment, the Attachment(s) or the condition of Attachment(s) of Licensee on any Streetlight Fixture (s) (i) interfere(s) with the use of such Streetlight Fixture (s) or the operation of Licensor's facilities or equipment; (ii) constitute(s) a hazard to Licensor's personnel or any other persons authorized by Licensor to use such Streetlight Fixture; (iii) cause(s) a danger to the public; or (iv) materially fail(s) to comply with the terms of the Request Form, this Agreement, applicable law, codes or regulations, Licensee shall, within 10 business days, either (a) obtain Licensor's approval to leave the Attachment(s) as is or (b) remove, rearrange, repair or change the Attachment(s) as necessary. IN CASE OF A HAZARDOUS CONDITION OR OTHER EMERGENCY WHICH IN LICENSOR'S GOOD FAITH JUDGMENT REQUIRES IMMEDIATE ACTION, LICENSOR RESERVES THE RIGHT, WITHOUT PRIOR NOTICE AND WITH NO LIABILITY TO LICENSEE, TO REMOVE OR RELOCATE APPLICABLE ATTACHMENTS AS REQUIRED, PROVIDED THAT LICENSOR SHALL PROVIDE LICENSEE WITH WRITTEN NOTICE OF ANY SUCH ACTION AS SOON AS POSSIBLE THEREAFTER.

5.11 Unauthorized Attachments. Licensee agrees not to make any unauthorized or non-compliant Attachments to Streetlight Fixtures; provided, however, if an Attachment is made without permission, such Attachment shall be subject to the terms and conditions of this Agreement.

5.12 Reserved Rights; Maintenance and Operation of Poles. Licensor reserves to itself the right to maintain Streetlight Fixtures and other Licensor's property and to operate its business and maintain its property in such a manner as will best enable it to fulfill its own service requirements. Licensor shall maintain all Streetlight Fixtures in a safe and serviceable condition and shall replace, reinforce or repair should a Streetlight Fixture become defective.

5.13 Removal, Relocation of Pole; New Pole. Except in emergency or dangerous situations as stated in Section 5.10 above, Licensor may from time-to-time need to replace, relocate, remove, or abandon a Streetlight Fixture or group of Streetlight Fixtures and to cause the relocation or removal of any Attachment, consistent with normal operating, maintenance and development procedures and prudent utility practices. Licensor shall use its best efforts to provide an alternate location on Streetlight Fixtures for any of the Attachments required to be relocated or removed. Licensor shall provide written notice to Licensee at least 90 days prior to such removal and/or relocation specifying in such notice the time of such proposed replacement or relocation (except in case of emergency, according to Section 5.10 above). Licensor will bear all costs and expenses of any relocation of the Streetlight Fixture (s) and the Attachment(s) mounted thereupon.

5.14 Interference. It is expressly understood and agreed that the operation of an Attachment shall

not interfere with any other equipment of Licensor installed on the Streetlight Fixture prior to installation of the Attachment. Licensor shall not be responsible for any interference caused by other entities attaching equipment to a Streetlight Fixture on which one or more Attachments was previously installed, provided that Licensor requires such entities not to interfere with the operation of the earlier-installed Attachment(s) of Licensee.

5.15 Abandonment of Poles; Relocation of Attachments by Licensee. Licensee may at any time abandon the use of a Streetlight Fixture hereunder by giving written notice thereof to Licensor and removing therefrom all of its Attachments. Licensee may also request to relocate an Attachment to another Streetlight Fixture. Any request for relocation must be submitted for approval by Licensor in writing, which approval shall not to be unreasonably delayed, withheld or conditioned. To the extent Licensee abandons a Streetlight Fixture, Licensee shall not be entitled to any refund of any Fees paid to Licensor. To the extent Licensor rejects Licensee's request to relocate the Attachment to a new Streetlight Fixture, Licensor shall refund the pro-rata portion of the Fee prepaid by Licensee for such Attachment. Licensee shall bear all costs of removal and relocation of the Attachment.

6. LICENSEE'S PROTECTION AGAINST INTERFERENCE BY THIRD PARTIES. So long as Licensee is not in default hereunder, beyond the applicable notice and cure period, Licensor shall not grant a license to a third party for use of a Streetlight Fixture used by Licensee if such use would materially adversely interfere with Licensee's normal operation of its Attachment. Any such future license granted to a third party that permits the installation of equipment to a Streetlight Fixture licensed to and occupied by Licensee shall be conditioned upon such potential (third party) licensee not causing measurable interference with Licensee's signal or materially impairing Licensee's ability to utilize the Streetlight Fixture.

7. REQUEST. Upon receipt of a Request Form from Licensee, Licensor will approve or deny the authorization to proceed within 20 days of its receipt. Licensor shall have the sole right to determine the availability of space on or in any such Streetlight Fixture for use by Licensee and shall be under no obligation to grant permission for its use by Licensee, provided that such permission shall not be unreasonably withheld, conditioned or delayed. Licensor may also provide alternative Streetlight Fixture locations or a revised Request Form for Licensee's review and approval. Once a Request Form is approved by Licensor, Licensee shall have the right to use such Streetlight Fixture in accordance with the terms of this Agreement.

8. INSURANCE. During the term of this Agreement, Licensee shall maintain and shall cause its contractor(s) to procure and to maintain in full force and effect, at the Licensee (or contractor's) sole expense, insurance policies of the types and amounts listed in Exhibit A. Prior to installation of any Attachment, Licensee (and each of its contractor, if any) shall furnish Licensor with certificates of insurance. Each such certificate shall accurately reflect the insurance in place and shall be in a form reasonably satisfactory to Licensor. Failure by Licensor to request such certificate of insurance shall not be deemed a waiver of Licensee's obligation under this Section 8.

9. REPRESENTATION AND WARRANTIES.

9.1 Mutual Representations and Warranties. Each of the Parties represents and warrants to the other, acknowledging that the other Party is relying upon such representations and warranties in connection with its entering into this Agreement, as follows: (a) the Party has all requisite power and authority to execute and deliver this Agreement and has all necessary power and authority, and the skills, rights, and financial resources necessary to perform its obligations as set out herein; (b) the entry into this Agreement will not result in the violation of any of the terms and provisions of any agreement, written or oral, to which the Party may be a party; (c) there are no actions, suits, obligations, agreements, or proceedings, existing, pending or to its knowledge threatened, which prevent the Party from fulfilling its obligations under this Agreement or will have a material adverse effect on its ability to fulfill its obligations under this Agreement, and (d) the execution and delivery of this Agreement has been duly authorized by all necessary action on the part of the Party and this

Agreement, when duly executed and delivered by such Party, will constitute a legal and binding obligation of the Party, enforceable in accordance with its terms.

9.2 By Licensor. Licensor further represents and warrants that it has the right and has obtained and will maintain throughout the Term all rights and permissions necessary to grant to Licensee the rights and access granted hereunder.

10. INDEMNITY & LIMITATION OF LIABILITY.

10.1 Licensor's Indemnification. Subject to the terms and conditions of this Agreement, including those set forth in Section 10.3 and Section 10.4, Licensor shall indemnify, defend and hold harmless Licensee, its Affiliates, officers, directors, employees, contractors, or agents (collectively, "**Licensee Indemnified Parties**") against any and all losses, damages, liabilities, deficiencies, claims, actions, judgments, settlements, interest, awards, penalties, fines, costs, or expenses of whatever kind, including reasonable attorneys' fees, fees and the costs of enforcing any right to indemnification under this Agreement and the cost of pursuing any insurance providers (collectively, "**Losses**") incurred by any one or more Licensee Indemnified Parties relating to, arising out of or resulting from any third-party claim alleging (a) a breach of any representation or warranty by Licensor, (b) any grossly negligent or more culpable act or omission of Licensor, its subcontractors or its personnel (including any intentional, reckless or willful misconduct) in connection with the performance of this Agreement; or (c) any failure by Licensor, its subcontractors or its personnel to comply with any applicable laws.

10.2 Licensee Indemnification. Subject to the terms and conditions of this Agreement, including those set forth in Section 10.3 and Section 10.4, Licensee agrees to indemnify and defend Licensor, its affiliates, officers, directors, employees, contractors, or agents (collectively, "**Licensor Indemnified Parties**") against all Losses incurred by one or more Licensor Indemnified Parties, arising directly from any third-party claim alleging bodily injuries, death, damage to property, trespass or other personal injury or physical property damage cause of action due to the installation, operation, maintenance, repair, modification, removal or presence of attachments on the poles, whether such installation was performed by Licensee or its contractors. Licensee agrees to require its contractors and subcontractors to indemnify Licensor to the fullest extent permitted by law consistent with the foregoing indemnity.

10.3 Procedure. The Party seeking indemnification (the "**Indemnified Party**") will: (i) unless prohibited by applicable law or court order, inform the Party providing the indemnification ("**Indemnifying Party**") as promptly as reasonably practical of any claim for which the Indemnified Party is seeking indemnification; (ii) provide the Indemnifying Party with reasonable assistance in the defense of the claim; (iii) have the right, but not the obligation, to participate in the defense of the claim at its own expense and through counsel of its choice; and (iv) if the Indemnifying Party refuses to defend the Indemnified Party for any indemnifiable claim, control the defense or settlement of such claim and retain all rights to seek recovery from the Indemnifying Party.

10.4 Limitation of Obligations. Notwithstanding anything to the contrary in this Agreement, an Indemnifying Party is not obligated to indemnify or defend (if applicable) an Indemnified Party against any claim if such claim or corresponding Losses arise out of or result from, in whole or in part, the Indemnified Party's: (a) gross negligence or more culpable act or omission (including intentional, reckless, or willful misconduct); (b) any bad faith failure by the Indemnified Party to materially comply with any of its obligations set forth in this Agreement; or (c) use of the Attachments or the Streetlight Fixtures in any manner not authorized under this Agreement or that does not materially conform with any usage instructions, the terms of the Request Form, or specifications expressly set forth in this Agreement, or provided in writing by or for a Party.

10.5 NO LIABILITY FOR CONSEQUENTIAL OR INDIRECT DAMAGES. EXCEPT FOR LIABILITY FOR A BREACH OF SECTION 13 BELOW, IN NO EVENT SHALL EITHER PARTY OR THEIR REPRESENTATIVES BE LIABLE FOR CONSEQUENTIAL, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, PUNITIVE OR ENHANCED DAMAGES, LOST PROFITS OR REVENUES OR DIMINUTION IN VALUE, ARISING OUT OF OR RELATING TO ANY BREACH OF THIS AGREEMENT, REGARDLESS OF (A) WHETHER SUCH DAMAGES WERE FORESEEABLE, (B)

WHETHER OR NOT THE OTHER PARTY WAS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES AND (C) THE LEGAL OR EQUITABLE THEORY (CONTRACT, TORT OR OTHERWISE) UPON WHICH THE CLAIM IS BASED, AND NOTWITHSTANDING THE FAILURE OF ANY AGREED OR OTHER REMEDY OF ITS ESSENTIAL PURPOSE.

10.6 MAXIMUM LIABILITY FOR DAMAGES. EXCEPT FOR LIABILITY FOR A BREACH OF SECTION 13 BELOW, OR INDEMNIFICATION OBLIGATIONS UNDER SECTIONS 10.1 AND 10.2, IN NO EVENT SHALL EACH PARTY'S AGGREGATE LIABILITY ARISING OUT OF OR RELATED TO THIS AGREEMENT, WHETHER ARISING OUT OF OR RELATED TO BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, EXCEED USD $200,000 OR THE AGGREGATE AMOUNT PAID BY LICENSEE PURSUANT TO THIS AGREEMENT IN THE 12 MONTH PERIOD PRECEDING THE EVENT GIVING RISE TO THE CLAIM, WHICHEVER IS GREATER. ALL LIABILITY UNDER THIS AGREEMENT IS CUMULATIVE AND NOT PER INCIDENT.

11. FORCE MAJEURE. Timely performance by both Parties is essential to this Agreement. However, neither Party is liable for reasonable delays in performing its obligations under this Agreement to the extent the delay is caused by a Force Majeure event. A Party will be excused from performance under this Agreement for any period and to the extent that is prevented from performing its obligations, in whole or in part, as a result of delays caused by an event of Force Majeure. The Party relying upon the Force Majeure event must (i) provide to the other Party prompt written notice describing the Force Majeure condition, and (ii) take all reasonable steps to avoid or remove such causes of nonperformance and immediately continue performance whenever and to the extent such causes are removed; provided however, that specific written notice need not be given where the relied-upon event of Force Majeure is or has been widely publicized, such as in the case of, for example, pandemic, epidemic, global parts and material shortages, supply chain and/or transportation delays, war, an act of terrorism, and so forth.

12. TERMINATION.

12.1 Mutual Right to Terminate. Either Party may terminate this Agreement without liability to the other if (i) the Party's performance hereunder would be illegal under applicable law or regulation or under any order or ruling issued by any federal, state or local agency having regulatory jurisdiction over the Streetlight Fixtures or the Attachments; (ii) the other Party fails to comply with any of the material provisions of this Agreement or defaults in any of its obligations under this Agreement and fails to correct such default or noncompliance within 30 days after receiving written notice from the non-breaching Party; or (iii) after 60 days of a Force Majeure event which has made performance impossible or economically impractical.

12.2 Termination for Insolvency. Either Party may terminate this Agreement upon written notice to the other, if the other Party (i) becomes insolvent or is generally unable to pay, or fails to pay, its debts as they become due, (ii) files or has filed against it a petition for bankruptcy, which has not been dismissed within 90 days of such filing, (iii) makes or seeks to make a general assignment for the benefit of its creditors, or (iv) applies for or has appointed a receiver, trustee, custodian or similar agent appointed by order of any court of competent jurisdiction to take charge of or sell any material portion of its property or business.

12.3 Removal of the Attachment. Unless Licensee terminates this Agreement for cause, upon termination or expiration of this Agreement, Licensee shall (i) remove all the Attachments from the Streetlight Fixtures at its own expense within 180 days; and (ii) after such removal, ensure the Streetlight Fixtures are in the same condition as they were when the Attachments were installed except for ordinary wear and tear, or damage not caused by the Attachments.

13. CONFIDENTIAL INFORMATION.

13.1 Standard of Care. The receiving Party shall maintain the disclosing Party's Confidential Information with the same degree of care it uses to maintain its own Confidential Information, and, in all events, it shall maintain the disclosing Party's Confidential Information with no less than

commercially reasonable care. Upon the disclosing Party's request, the receiving Party shall promptly return all documents and other materials received from the disclosing Party. The disclosing Party shall be entitled to seek injunctive relief for any violation of this Section 13.

13.2 Retention. Notwithstanding anything herein to the contrary, the receiving Party may retain Confidential Information as may be required by (a) law, (b) professional requirements or (c) internal document retention policies.

13.3 Limitations of Use. The receiving Party may use the disclosing Party's Confidential Information solely in relation to the performance or in connection with the purposes of this Agreement and will not disclose the disclosing Party's Confidential Information except as authorized by the disclosing Party in writing or as otherwise permitted under this Agreement. Confidential Information may be disclosed by the receiving Party to its representatives who have a need to know and who are subject to a confidentiality agreement that contains terms and conditions at least as restrictive as those set forth in this Section 13. Further, the receiving Party will not be restricted from disclosing the disclosing Party's Confidential Information as required pursuant to law, regulation or judicial or governmental order, provided that any such disclosure will be limited to the extent of the legal requirement and the receiving Party will promptly notify the disclosing Party and cooperate with the disclosing Party, at the disclosing Party's expense, so that the disclosing Party may intervene and object to such disclosure or seek a protective order or other appropriate protection for its Confidential Information.

13.4 No Disclosure to Competitors. Notwithstanding any provision of this Agreement to the contrary, neither Party may disclose any Confidential Information of the other Party to any known competitor of the other Party without receiving prior written permission of the other Party.

13.5 Survival. The terms set forth in this Section 13 will survive the expiration or termination of this Agreement for a period of 3 years.

14. GENERAL.

14.1 Notices. All notices, consents, claims, demands, waivers, and other communications under this Agreement must be in writing and addressed to the other Party at its address set out below (or to such other address that a Party may designate from time to time in accordance with this Section 14.1). Unless otherwise agreed herein, all notices must be delivered by personal delivery, nationally recognized overnight courier, or certified or registered mail (in each case, return receipt requested, postage prepaid) with a copy provided to the Party's email address set forth below. Except as otherwise provided in this Agreement, a notice is effective only (a) on receipt by the receiving Party; and (b) if the Party giving the notice has complied with the requirements of this Section 14.1:

Notices to Licensor:

_____
_____
_____
Attn: _____
e-mail:_____

Notices to Licensee:

Ubicquia, Inc.
401 East Las Olas Blvd., Suite 800
Fort Lauderdale, FL 33301
Attn; Legal Department
Email: legal@ubicquia.com

14.2 Assignment. Neither Party may assign this Agreement to any entity without prior written notification and consent of the other, except (i) to an Affiliate that does not compete with the other Party or (ii) pursuant to a merger, acquisition, reorganization, restructuring, or sale of a substantial portion of the assets of the Party's business, as applicable, to which the assignment relates. Upon assignment, as such may be permitted under this Section 14.2, the assigning Party shall be relieved

of all future performance, liabilities, and obligations under this Agreement arising after the date of such assignment. This Agreement shall be binding upon and inure to the benefit of the Parties, their successors and permitted assigns.

14.3 No Third-Party Beneficiaries. This Agreement benefits solely the Parties and their respective successors and permitted assigns and nothing in this Agreement, express or implied, confers on any third party any legal or equitable right, benefit, or remedy of any nature whatsoever under or by reason of this Agreement.

14.4 Relationship of Parties and Independent Contractor Status. Neither Party shall be deemed to be a partner, agent, or joint venturer with or of the other by reason of this Agreement. Licensor and Licensee shall perform their duties under this Agreement as independent contractors and at their own risk. Neither Party shall at any time hold itself out as being a partner, co-venturer or agent of the other.

14.5 Publicity. Each Party shall obtain the written consent of the other Party, not to be unreasonably delayed, withheld or conditioned before making any public announcement or press release relating to this Agreement or the Parties' relationship.

14.6 Survival. Expiration or termination of this Agreement for any reason shall not release either Party from any liability or obligation set forth in this Agreement which (i) the Parties have expressly agreed will survive any such expiration or termination, or (ii) remains to be performed or by its nature would be intended to be applicable following such expiration or termination. Notwithstanding the foregoing, the provisions of Sections 1, 8, 9, 11.4, 12, and 13 shall survive termination of this Agreement.

14.7 Severability. Should any part of this Agreement be deemed invalid, illegal or unenforceable, such part shall be removed from this Agreement and the Agreement shall otherwise remain in full force and effect and shall be applied by the Parties in such manner as most nearly accomplishes the expressed purposes of the Parties in executing this Agreement.

14.8 Dispute Resolution. Except under circumstances requiring injunctive relief, any dispute, controversy, or claim arising out of or relating to the Agreement, the Parties' performance under it, or its breach (a "**Dispute**") shall be dealt with in accordance with the negotiation procedure set forth in this Section 14.8 before resorting to litigation. If any Dispute is not resolved promptly in the ordinary course of business, the Parties shall attempt to resolve such Dispute by face-to-face negotiations with each other before resorting to mediation, arbitration, or litigation. These face-to-face negotiations shall be initiated within 5 business days from receipt of written notice from one Party to the other and shall be conducted by a duly appointed representative of each Party with authority to settle the Dispute. The Parties hereby agree to negotiate in good faith a resolution to the Dispute within 30 days. If after 30 days, the Parties have not resolved or settled the Dispute, either Party may submit the Dispute to litigation pursuant to Section 14.9 below.

14.9 Governing Law; Venue. This Agreement and all related documents, including all attachments thereof, and all matters arising out of or relating to this Agreement, whether sounding in contract, tort, or statute are governed by, and construed in accordance with, the laws of the State of Florida, United States of America, without giving effect to the conflict of laws principles or rules thereof to the extent such principles or rules would require or permit the application of the laws of any jurisdiction other than those of the State of Florida. Each Party irrevocably and unconditionally agrees that it will not commence any action, litigation, or proceeding of any kind whatsoever against the other Party in any way arising from or relating to this Agreement, including all Request Forms, as well as all exhibits, schedules, attachments, and appendices attached to this Agreement, and all contemplated transactions, in any forum other than the U.S. District Court for the Southern District of Florida or, if such court does not have subject matter jurisdiction, the courts of the State of Florida sitting in Broward County, Florida. Each Party agrees that a final judgment in any such action, litigation, or proceeding, unless timely appealed, is conclusive and may be enforced in other jurisdictions by suit on the judgment or in any other manner provided by law.

14.10 Waiver of Jury Trial. EACH PARTY IRREVOCABLY AND UNCONDITIONALLY WAIVES ANY RIGHT IT MAY HAVE TO A TRIAL BY JURY IN RESPECT OF ANY LEGAL ACTION ARISING OUT OF OR RELATING TO THIS AGREEMENT, INCLUDING ANY REQUEST FORMS,

STATEMENTS OF WORK, EXHIBITS, SCHEDULES, ATTACHMENTS, OR APPENDICES ATTACHED TO THIS AGREEMENT, OR THE TRANSACTIONS CONTEMPLATED HEREBY.

14.11 Amendments. This Agreement may not be modified, amended, or discharged, and no provision hereof may be waived, except by an instrument in writing and duly executed by an authorized signatory for the Party against whom enforcement of the amendment, modification, discharge, or waiver is sought.

14.12 Entire Agreement. This Agreement, including and together with any related exhibits, schedules, attachments, and documents incorporated herein, constitutes the entire agreement between the Parties with respect to the subject matter hereof and it supersedes all prior oral or written agreements, commitments, or understandings with respect to the subject matter hereof.

14.13 Counterparts. This Agreement may be executed in counterparts, each of which is deemed an original, but all of which together are deemed to be one and the same agreement. A wet or electronically signed copy of this Agreement delivered by facsimile, email, or other means of electronic transmission is deemed to have the same legal effect as delivery of an original signed copy of this Agreement.

IN WITNESS WHEREOF, the undersigned have executed this Agreement on the date next to their signatures.

[--]

By: _____

Name: _____

Title: _____

Date: _____

UBICQUIA, INC.

By:

Name: David Wong

Title: VP, Site Acquisition & Deployment

Date:_____

EXHIBIT A
REQUEST FORM

This Request Form, as referenced in that certain Master Attachment Agreement, between Licensor and Licensee dated _____ , 20 _ ("Agreement"), which is incorporated by reference as if fully set out here. Licensee submits a Request Form pursuant to the Agreement for Licensor review and approval subject to all of the terms and conditions of the Agreement. In the event of a contradiction or inconsistency between the terms of the Agreement and this Request Form, the terms of this Request Form shall govern. Capitalized terms used in this Request Form shall have the same meaning ascribed to them in the Agreement unless otherwise indicated herein.

Date of Application:	
Total # of Pages (including this one):	
Site Name/Project #:	
Approved by (name and signature):	
Date of the Approval:	

ATTACHMENT TO EXISTING STRUCTURE

Structure #	GPS Coordinates		Street/Cross Street	Highest Point	Streetlight Fixture Type	Attachment Weight	Output Power Level	[--]	[--]
	LAT	LONG							
Notes:									

EXHIBIT B

BACKUP DOCUMENTATION ATTACHED

List of equipment to be attached, full construction drawings of the proposed installation detailing method of attachment, location of power and fiber runs into and up each Streetlight Fixture, cut sheets, and actual product specifications.

All necessary land use permits (planning, building, encroachment) from the respective jurisdiction(s).

Wet stamped report by a licensed engineer demonstrating; 1) Streetlight Fixture can safely support the weight and wind loading of the Attachment; and 2) total number of watts per installation on each Streetlight Fixture and cumulative total number of watts including other systems placed within 100 feet of each Streetlight Fixture are within acceptable safety limits for human exposure.

EXHIBIT C

FEES

One-time Application Fee: $100/ Streetlight

Attachment Fee: $360.00/per year per Streetlight Fixture
Includes; $30/month Attachment Fee
Total; $30/month for 12 Months = $360/year.

EXHIBIT D

CONTACT INFORMATION

Licensor:

Name: _____
Address: _____
Phone #: _____
E-mail Address _____

Licensee:

Name: _____
Address: _____
Phone #: _____
E-mail Address _____

MAINTENANCE AND OUTAGE

1. Maintenance:

   (a) Licensor shall make reasonable efforts to complete scheduled and routine maintenance that will have a disruptive impact on the continuity or performance of the Attachment between 12:00am and 6:00am local time. Licensor shall provide Licensee with 5 days' prior notice of any schedule or routine maintenance that could have a disruptive impact on the continuity or performance of the Attachment.

   (b) If a schedule maintenance activity is canceled or delayed, Licensor shall inform Licensee so the maintenance activity may be rescheduled.

   (c) If unscheduled maintenance must occur, Licensor shall use commercially reasonable efforts to Licensee with at least 2 hours' notice prior to any emergency repairs that may affect the Attachment.

2. Outage

   Licensor shall make reasonable efforts to work with Licensee, in the event of a service outage to assist in restoration of power or any damages that causes a service interruption, impacting continuity of the Attachment and requires a third party to assist in such repair.

There are 360M streetlights,
500M distribution transformers,
and 1B utility poles worldwide.

We make them intelligent.

ubicquia | RTE ENERGY SOLUTIONS

Turning Streetlights Into 5G Sites

ubicquia

Company Background

225 People and Growing…

- Based in Fort Lauderdale Florida
- 120-person product development and engineering team from Motorola. Cisco & GE
- Deployed in 900+ Cities and Utilities and adding ONE NEW city/utility per day

Award Winning Carrier and Utility Grade Products used by…

- Cities: San Jose, San Diego, Los Angeles, Ontario, Fremont
- Utilities: Florida Power and Light, Southern Co., National Grid, Oncor, PGE
- Mobile Operators: AT&T, Rogers, USCC, LLA, America Movil

Partnerships and Investors

- Acuity: Industry's First "Control Ready" Luminaire with Ubicquia technology inside
- Prolec GE: Industry's First "Smart Transformer" with Ubicquia technology inside
- Motorola: Industry's First "Streetlight Camera" based on Ubicquia's UbiHub platform
- Ericsson: Industry's First "Streetlight Small Cell" based on Ubicquia's UbiMetro platform
- Lead Investors: Hamilton Lane, Clear Sky and NextEra

Data driven Platforms for Critical Infrastructure

Smart City

Energy Savings & Public Safety

Smart Lighting Control
20%-40% Energy Savings

Air Quality Monitor
Air/Noise Pollution, Fires

Streetlight Public Safety Hub
Traffic, Surveillance, LPR

Smart Grid

Grid Resiliency & Asset Mgmt

Transformer Monitor
Improve Grid Resiliency

Utility Pole Monitor
Critical Infrastructure R/T Data

Connectivity

Accelerate 5G & FWA

Streetlight Small Cell
Mobile Operator 5G

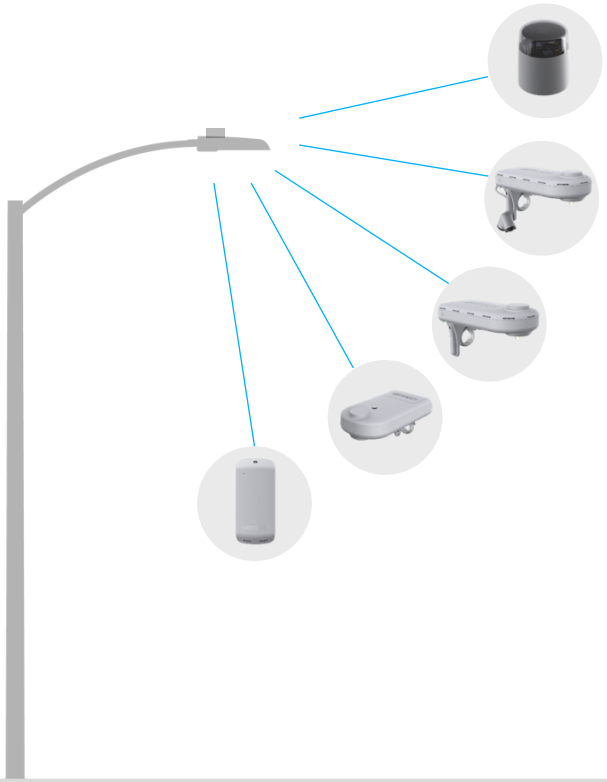
Streetlight Small Cell
Mobile Operator FWA

ubicquia

Existing Infrastructure is Underutilized.

We Provide a Simple, Scalable, and Innovative Way to Make Infrastructure Intelligent

We use existing streetlights to:

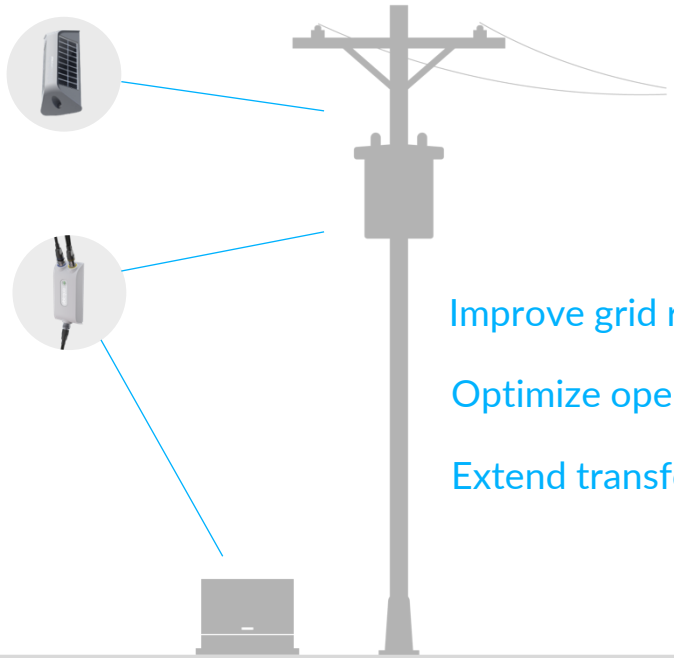


Improve environment

Increase public safety

Bridge the digital divide

We use existing transformers to:



Improve grid reliability

Optimize operations

Extend transformer life

ubicquia

Why Ubicquia and Ericsson Street Radio

Industry's First Streetlight Small Cell

Compatible with 65M Streetlights in US

Installs in minutes, activates in days

Integrated Certified Meter, IoT functions

Reduce Small Cell deployment costs by 85%

Eliminates $120k cost for integrated pole replacement (e.g. LA)

Established Customers

800+ Cities & Utilities under 10+ year contracts

15 of the Top 30 Cities by Population

IOUs, COOPs and Municipal Utilities

Streetlights

Master Attachment Agreements

Standardized deployments on millions of sites

Lowest TCO / Shortest Time To Market

Ericsson

100% Compatible with Ericsson Radio System

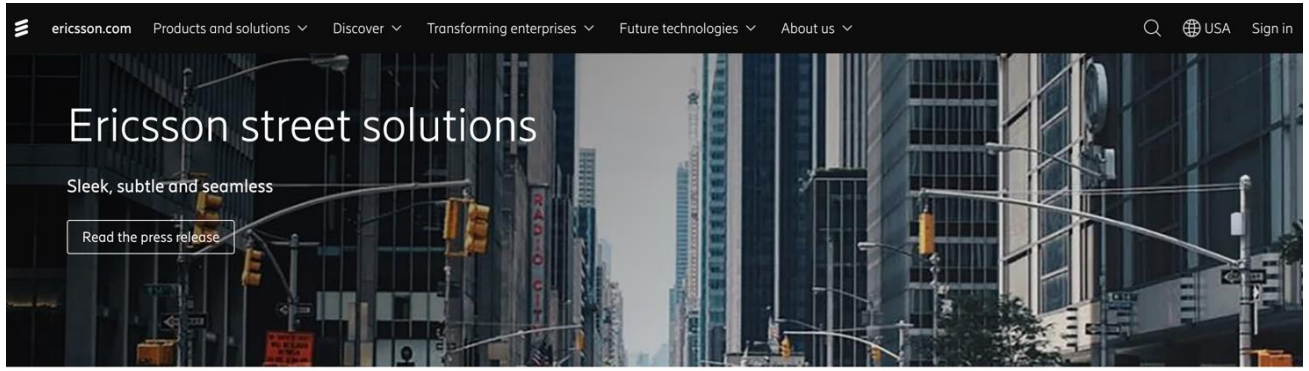
Feature parity across network layers

Global Operator Support: Product and Business

ubicquia

Ericsson OEM Partnership

Solving Small Cell Deployment Challenges



HOME › SMALL CELLS › OUTDOOR SMALL CELLS

Accelerate 5G capacity and 5G experience in hotspot locations

Today, it's all about 5G experience and a ubiquitous coverage, especially in urban areas and hotspots. But often, connectivity can suffer in these environments, and it can be difficult to expand the network in the streets due to footprint, permits or appropriate infrastructure.

Small cells | Networks | 5G RAN | #Macro

From streetlight to 5G site in 15 minutes

Learn how Ericsson and Ubicquia partnered to pioneer a new radio solution that utilizes existing streetlights and adds as much as 5 times better download speeds. All in as little as 15 minutes site installation time.

Click to watch the video.

Accelerating 5G Deployments

Solving Small Cell Deployment Challenges

Conventional Small Cells

Aesthetics
- Bulky Equipment and Cables visible
- Eye-sore to public

Permitting Process
- 12 – 24 months
- 25% of sites are approved.

Power
- Requires Separate Utility Meter –long lead times.
- Circuit upgrades, redesigns or replacements
- Requires new pole penetration for wiring.
- Ground disturbance for new fuses, grounding rod

Time to Deploy
- 6 – 12 months
- Fiber construction, power, footings, pole, etc
- Multiple traffic disruptions
- Permitting 90 days/pole replacements

Total Cost of Ownership
- High and Complex
- Components: Poles, cables, antenna, utility meter, etc.

Pole Owner
- Resource impact not commensurate to FCC Safe Harbor Rate

Power/fiber handhole

Streetlight Small Cells

Aesthetics
- Virtually invisible installation
- No unsightly attachments
- Monetizes existing structure

Permitting Process
- Weeks
- Utilizes existing Streetlight Infrastructure

Power
- Utilizes NEMA socket power

Time to Deploy
- Attachment: 15 minutes
- Fiber construction. No ground fuses, no grounding rods, no pole replacements, no foundation replacements
- Bulk deployments

Total Cost of Ownership
- Low and simple
- Components: Street Radio & fiber

Pole Owner
- Significantly reduced level of effort, and impact on personnel

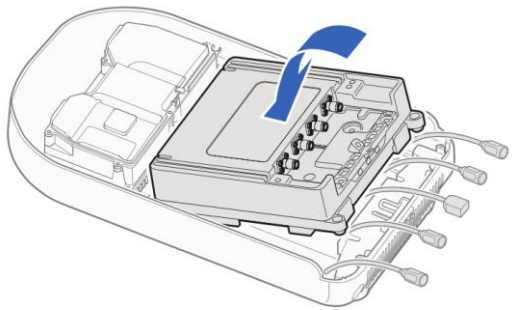
Power/fiber handhole

ubicquia

Ericsson Street Radio 4402 / 4408

A Complete Menu

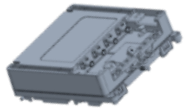
The Ubicquia part



2 platforms

+

The Ericsson part



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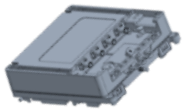


8+ Radios

=

The Street Radio

Solution

ubicquia

Street Radio Overview

1st Streetlight Compatible Small Cell

Design

- Smallest Form Factor in the market /Virtually unseen from street level
- Fully integrated powerful 4x5W Ericsson 4402 and 4408 radio
- Compatible with 360M streetlights globally
- 110V-480V auto-sense integrated power supply
- 90 W Average/125W Max power consumption
- Integrated antenna designed for streetlight deployment

Small, compact form factor fitting a wide range of luminaires

Weight: 16 lbs, 7.25 kg

Streetlight Compatibility

- No new power wire needed: Plugs directly into Streetlight photocell socket
- Integrated GPS for ”Location Awareness”
- Qualifies for Non-Metered service
- Grounding bracket attaches to street arm

Low Impact to Street Light & Circuit

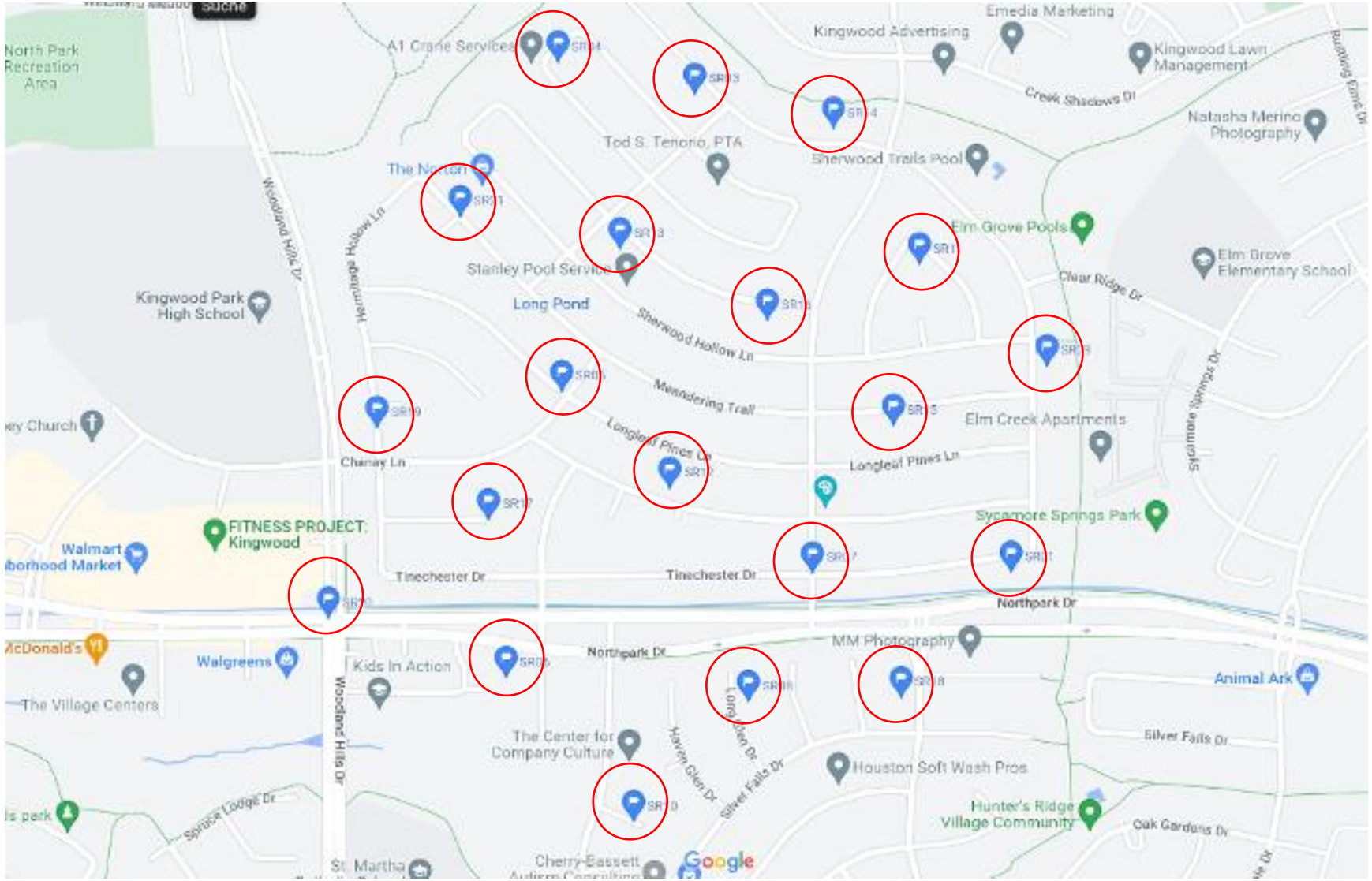
- Pole arm penetration is avoidable
- Avoids intrusive substructure activity such as pole replacements, foundation replacements, and new ground wells
- Negligible structural or circuit capacity impact
  - Average 90-Watt Power Consumption vs: 1100 Watts (Traditional Small Cell) exponentially reduces likelihood of voltage drops
  - Poles where SP fixtures have been replaced with LED, 40lb burden relieved, and voltage restored to circuit
- Ubicquia photocells that share a circuit with the Street Radio can give the City full visibility to the health the circuit’s voltage 24x7

ubicquia

Ubicquia Sites Deployed

ubicquia

Deployments with Density



ubicquia

Summary/Next Steps

Summary:

How does the Street Radio solution benefit the town or city?

- Monetization of existing streetlight infrastructure
- Utilizes existing NEMA socket on existing streetlights
- Improve BROADBAND service to residents
- Nearly invisible alternative to the “eyesore” of traditional cell towers
- $0 cost to the town and no town resources needed
- Ubicquia does all the work and coordination with wireless operators
- Simple and non-disruptive installation

Next Steps:

1. Negotiate and secure a Streetlight Fixture Attachment Agreement
2. Locations of streetlight fixtures owned by the Municipality
3. Ubicquia engage the wireless service providers and public safety departments
4. Ubicquia work with the Municipality on the submittal and approval of selected streetlights

ubicquia

UbiCell

Intelligent Streetlight Control Platform

Deployed in 900+ Cities and Utilities

Philadelphia: $1.3M per. Month in Energy Savings & O&M reduction

Value Proposition

Installs in Seconds

Drives 20% - 40% in Energy Savings

Tilt, Vibration, Power Metering, Power Quality

Compatible with 360M Streetlights WW

Marquee Customers

Duke Energy Florida (151 Cities)

National Grid

Memphis, Light Gas & Water

Pedernales (Largest Utility Coop)

Philadelphia

Los Angeles

San Jose

Las Vegas

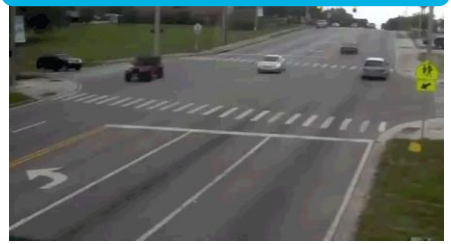
ubicquia

UbiHub

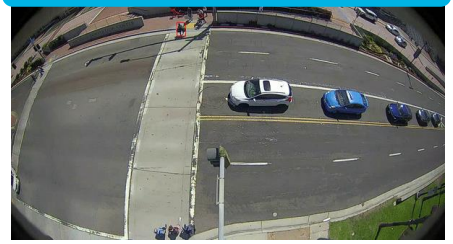
Streetlight Hub for Public Safety, LPR and Edge Detection

VS

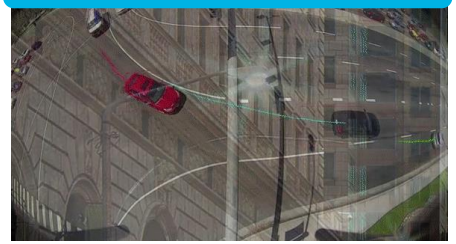
Public Safety & LPR



Pedestrian Safety



Traffic



Bicycle Planning

Cameras and LPR installed in days vs months and at 30% the cost.

WRAL INVESTIGATES

License plate reading cameras help Raleigh police make 41 arrests in 6 months

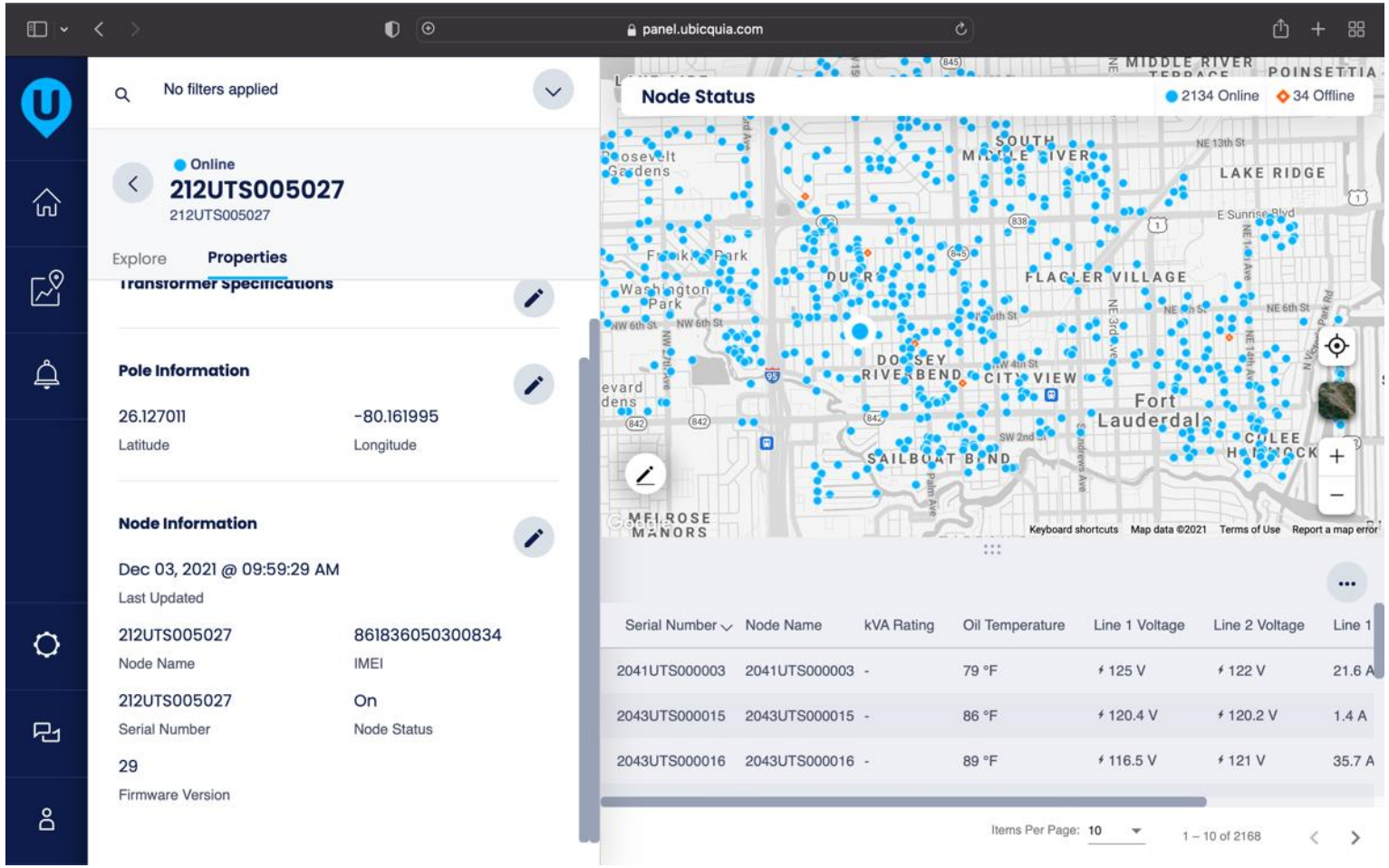
Twenty-five cameras that scan license plates looking for criminal suspects have been positioned on roads throughout Raleigh, from crime hotspots to entertainment districts.

Posted 8:30 a.m. Feb 3 - Updated 9:10 p.m. Feb 6

ubicquia

UbiVu Proactive Management Platform

Used by more than 700 Cities and Utilities



Market Positioning

Single Platform Across ALL products

Asset Management, Control, Reporting

Analytics driven by Industrial AI

AWS Gov Cloud Certified

ISO 27001 Certified

Marquee Customers

Miami Dade County (31 Cities)

City of San Jose, CA

City of Ontario, CA

City of Oaxaca, MX

Camp LeJeune Marine Base

Duke Energy, FL (151 Cities)

Florida Power & Light


ubicquia
Thank You
TRUCK ROUTE
LOCAL
10 Av

For Clerks Use Only

11/20/2024 | 2024-122

Meeting Date | Item No.

CITY COUNCIL ACTION

Requested Council Meeting Date: November 20 , 2024

Responsible Dept: Planning

Requested Action: Ordinance

Title

150 Congress Avenue Contract Zoning

Summary

Staff are requesting City Council review, and if agreeable, approve the proposed contract zone at 150 Conrgess Avenue (Map 24, Lot 1).

Please refer to the memo to City Manager Meyers dated November 14, 2024.

Staff Comments

Staff recommend approving the contract zone as the proposed development is consistent with the goals of the 2023 Comprehensive Plan. The Planning Board Public Hearing on the proposed Contract Zone had no members of the public speaking against it.

Action: Recommend for passage

City Manager

Introduced for: New Business

For Clerks Use Only

CITY OF BATH

Date:

150 Congress Avenue Contract Zoning

See attached

DRAFT ORDINANCE

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF BATH THAT THE LAND USE CODE OF THE CITY OF BATH ADOPTED JULY 19, 2000, AND SUBSEQUENTLY AMENDED, BE HEREBY FURTHER AMENDED AS FOLLOWS:

Amend Article 16, by adding Section 16.34, as follows:

SECTION 16.34 150 Congress Avenue CONTRACT ZONE

A. District Designation

The property designated for contract rezoning is located at 150 Congress Avenue, identified as Lot 1, on City of Bath Tax Map 24 dated April 1, 2021.

B. Findings

The City Council makes the following findings:

1. The property is located in the Mixed Commercial and Residential (C-2) District.

2. Contract Rezoning is allowed in the Mixed Commercial and Residential (C-2) District.

3. The project consists of a proposal to demolish an existing building and to develop three 3-story buildings which will contain up to 84 workforce housing apartments.

4. Contract rezoning is allowed on the parcel per section 8.10 (D) of the Land Use Code.

5. Without the creation of a contract zone, the minimum lot area per dwelling unit is 6,000 SF.

6. The applicant proposes to develop the project at 5,717 SF/unit as depicted on the Zoning Summary Plan C-3.2, which shows additional land to be placed in conservation on Map 24, Lot 1-1, as part of a master zoning plan also incorporating the parcels at Map 29, Lot 14 and Map 29, lot 13.

7. Without Contract rezoning the maximum height would be 40 feet.

8. The applicant proposes the maximum height be increased to 48 feet.

9. The rezoning of the parcel is consistent with the 2023 Comprehensive Plan and there are no other applicable City plans.

10. The project is consistent with the mandatory conditions set forth in Land Use Code Section 8.20 paragraph D. 1.

11. The applicant submits the following discretionary enhancements to the City:

    a. Creates up to 84 new, sustainable rental housing units.
    b. The project will set aside 10.52 acres on a neighboring parcel as permanent conservation land with Kennebec Estuary Land Trust. The applicant proposes to make this designation as part of the master plan zoning for the overall 17.24 acres, which encompasses 80 Congress Avenue (Map 29, lot 14), 100 Congress Avenue (Map 29, Lot 13) 150 Congress Avenue (Map 24, lot 1) and the back land (Map 24, Lot 1-1) as depicted on the Zoning Summary Plan C-3.2.
    c. Facilitates City of Bath Comprehensive Plan goals as follows:
        i. POPULATION 1. Support incremental population growth by drawing new people to Bath and supporting existing residents, with a diverse mix of ages, income levels, race, and backgrounds.
        ii. HOUSING 1. Encourage and promote adequate housing to support the community and region's economic development – anyone who works in Bath should have an affordable option to live in Bath.
        iii. HOUSING 2. Ensure land use controls encourage the development of quality affordable housing, including rental housing.
        iv. HOUSING 4. Work with proactive partners in the private, non-profit, quasi-government and public sectors to pursue housing goals.
        v. ECONOMY 4. Support local property redevelopment and revitalization, specifically 4e Property owners will be impacted by flooding and climate change. Provide support for solutions that mitigate the negative impacts of climate change on businesses, developers and property owners.
        vi. TRANSPORTATION 3. To promote public health, protect natural and cultural resources, and enhance livability by managing land use in ways that maximize the efficiency of the transportation system and minimize increases in vehicle miles traveled.
        vii. TRANSPORTATION 4. To meet the diverse transportation needs of residents (including children, older adults and disabled) and through travelers by providing a safe, efficient, and adequate transportation network for all types of users (motor vehicles, pedestrians, bicyclists). Specifically:
            1. 4c. Continue to promote safe walking and biking to schools through coordination with the RSU; Police; Public Works; Sustainability and Environment Bicycle and Pedestrian Committee Ongoing Local initiatives
            2. 4e. Continue to work with KELT and other hikers, bike riders, community health advocates, historic preservationists, and motorized trail users as appropriate, to develop, maintain, and promote a local and regional trail system, including the A2K regional trail proposal.

12. The Planning Board did not require any additional discretionary enhancements.

C. Zoning Provision Affected

This contract zoning amendment is intended to relax the minimum lot area per dwelling unit, and height requirements pursuant to Section 8.08 of the Land Use Code, by allowing the construction of the structures and other site improvements depicted on the Site Plan approved with conditions, by the Bath Planning Board on ___November 5, 2024_____.

This contract zone is intended to modify the following space and bulk standards of the Mixed Commercial and Residential (C-2):

1. Minimum Lot area per dwelling unit (reduce the requirement from 6,000 SF to 5,717 SF as depicted on the approved site plan).

2. Maximum height (increase from 40 feet to 48 feet)

D. Conditions of Approval

This Contract Rezoning Ordinance requires full and complete compliance with all conditions of approval, which are part of the Site Plan and Subdivision approval, granted to Bath Housing Development Corporation, by the Bath Planning Board on __November 5, 2024_____, including the following conditions:

Standard Conditions:

1. Approval is dependent upon and limited to the proposals and plans contained in the application materials and supporting documents and oral presentations submitted and affirmed by the applicant, and conditions, of any, imposed by the Planning Board, and any variation from such plans, proposals, and supporting documents and representations are subject to review and approval in accordance with the Land Use Ordinance.
2. All work shall be completed in accordance with Best Management Practices for Soil Erosion and Sediment Control. Erosion and Sedimentation management measures must be implemented during every phase of construction. The among of exposed soil throughout construction must be minimized. Any exposed ground area must be temporarily or permanently stabilized within one week from the time it was actively worked by use of riprap, sod, seed, mulch, or other measures.

***

BATH
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OFFICE of PLANNING & DEVELOPMENT

Jennifer Curtis
Director of City Planning
jcurtis@cityofbath.com

MEMO

To: Marc Meyers, City Manager

From: Jenn Curtis, Director of Planning

Date: November 14, 2024

Re: Developers Collaborative Predevelopment LLC Application for Contract Rezoning at Map 24, Lot 1 (150 Congress Ave).

Requested Action:

Staff are requesting City Council review, and if agreeable, approve the proposed contract zone at Map 24, Lot 1.

Overview:

Description existing/proposed: This project is phase 2 of a master plan ("Zoning Summary Plan C-3.1") that encompasses Tax Map 24, Lots 1 and 1-1, and Map 29 Lots 13 and 14. The applicant proposes to demolish the former church located at 150 Congress Avenue and construct three 3-story buildings containing 84 units in total. The applicant is working in conjunction with Bath Iron Works and the Navy to provide housing that would meet the needs of their employees in Bath. The applicant proposes a contract zone that has been approved by Planning Board and now needs Council approval. The project received Site Plan, Subdivision, and Contract Zone approval from the Planning Board on November 5, 2024.

The state statutory requirements for rezoning at 30-A M.R.S.A. Section 4352(8) are:

A. Be consistent with the growth management program adopted under this chapter;

Staff note that the C2 District is in an identified growth area, so the proposal is in accordance with the growth management program.

B. Establish rezoned areas that are consistent with the existing and permitted uses within the original zones; and

Staff note that the applicant is proposing a use that is consistent with existing and permitted uses within the original zone.

C. Only include conditions and restrictions that relate to the physical development or operation of the property.

There are no restrictions proposed as part of the contract zone.

Bath Land Use Code 8.20:

8.20 F,1., limits the scope of review by the City Council to the conditions contained in D. (below)

D,1 Mandatory Conditions: *(Staff findings, approved by the Planning Board, in italics below)*

1. Mandatory Conditions All rezoning under this Section must:

(a) be consistent with the Comprehensive Plan of the City of Bath and any other supporting documents pertinent to the Plan.

Staff note that the proposal is consistent with the Actions recommended by the 2023 City of Bath Comprehensive Plan (Plan). The proposed project is meeting all five housing policies listed in the Implementation Matrix of the Plan.

(b) includes only conditions and/or restrictions that relate to the physical development or operation of the property

The applicant is proposing a decrease to the minimum lot area per dwelling unit and an increase to maximum building height.

D,2 2. Discretionary Conditions

The applicant proposes the following discretionary conditions:

1. *Minimum Lot Area per dwelling unit to be reduced from 6,000 sf to 5,717 sf as depicted on the Zoning Summary Plan C-3.1, which shows additional land to be placed in conservation on Map 24, Lot 1-1 as part of a master zoning plan also incorporating the parcels at Map 29, Lot 13 and Map 24, Lot 1.*
2. *Maximum Height to be increased from 40 feet to 48 feet.*

8.20, E. Planning Board Recommendation to the City Council and Findings of Fact *(Staff findings, approved by the Planning Board, in italics below)*

Staff note that in accordance with 8.20,E, when recommending contract rezoning approval to the City Council, the Planning Board must make findings of fact consistent with Site Plan and Subdivision Approval criteria of this Code, and that the following criteria are met:

1. The approval is consistent with the mandatory conditions set forth in Paragraph D 1 herein above.

Finding: The applicant is proposing a project that is compliant with the comprehensive plan, and the applicant is proposing to adhere to the discretionary conditions.

2. The applicant is willing to meet certain community objectives contained in the Comprehensive Plan due to additional flexibility being allowed, the applicant has employed innovative design, or that there exists an unusual nature, condition, or location relative to the property being considered for rezoning.

Finding: The applicant outlines the consistency of their proposed plans with City of Bath Comprehensive Plan goals under their Contract Zone Agreement Draft that include:

a. *Creates up to 84 new, sustainable, rental housing units.*
b. *Set aside 10.52 acres on a neighboring parcel as permanent open space conservation land with Kennebec Estuary Land Trust as part of zoning summary plan C-3.1.*
c. *Contributes to multiple comprehensive plan goals, documented by the applicant as follows:*

i. POPULATION 1. Support incremental population growth by drawing new people to Bath and supporting existing residents, with a diverse mix of ages, income levels, race, and backgrounds.
ii. HOUSING 1. Encourage and promote adequate housing to support the community and region's economic development – anyone who works in Bath should have an affordable option to live in Bath.
iii. HOUSING 2. Ensure land use controls encourage the development of quality affordable housing, including rental housing.
iv. HOUSING 4. Work with proactive partners in the private, non-profit, quasi-government and public sectors to pursue housing goals.
vi. ECONOMY 4. Support local property redevelopment and revitalization, specifically 4e Property owners will be impacted by flooding and climate change. Provide support for solutions that mitigate the negative impacts of climate change on businesses, developers and property owners.
vii. TRANSPORTATION 3. To promote public health, protect natural and cultural resources, and enhance livability by managing land use in ways that maximize the efficiency of the transportation system and minimize increases in vehicle miles traveled.
viii. TRANSPORTATION 4. To meet the diverse transportation needs of residents (including children, older adults and disabled) and through travelers by providing a safe, efficient, and adequate transportation network for all types of users (motor vehicles, pedestrians, bicyclists). Specifically:
1. 4c. Continue to promote safe walking and biking to schools through coordination with the RSU; Police; Public Works; Sustainability and Environment Bicycle and Pedestrian Committee Ongoing Local initiatives
2. 4e. Continue to work with KELT and other hikers, bike riders, community health advocates, historic preservationists, and motorized trail

users as appropriate, to develop, maintain, and promote a local and regional trail system, including the A2K regional trail proposal.

3. In addition to compatibility with the neighborhood, the building must be consistent in terms of colors, materials, and other design items with the Gateway or Downtown goals of the City, if applicable.

Finding: There are no applicable Gateway or Downtown goals that apply to this project.

Relevant Bath Land Use Code

Article 8: Contract Zoning
F. City Council Approval of Contract Rezoning

1. The scope of the review by the City Council in granting contract rezoning is limited to the Conditions contained in D, herein above, and only if these conditions are not otherwise required for Historic District Approval, Site Plan Approval, or Subdivision Approval.

Staff recommendation:

Staff recommend approving the contract zone as the proposed development is consistent with the goals of the 2023 Comprehensive Plan. The Planning Board Public Hearing on the proposed Contract Zone had no members of the public speaking against it.

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OFFICE of PLANNING & DEVELOPMENT

Jennifer Curtis
Director of City Planning
jcurtis@cityofbath.com

November 12, 2024

Dear Applicant,

I'm pleased to notify you that your SITE PLAN and SUBDIVISION application to develop three 3-story buildings containing 84 housing units at 150 Congress Ave, (Map 24 Lot 1) was unanimously **APPROVED with conditions** by the City of Bath Planning Board at their regular meeting on November 5, 2024.

The Planning Board voted on these approvals and also voted on the related contract rezoning proposal as follows:

MR. HOPKINSON, SECONDED BY MR. GERSH, MOVED TO APPROVE THE SITE PLAN, SUBDIVISON, AND CONTRACT REZONING APPLICATION FOR THE 3 STORY BUILDINGS WHICH CONTAIN 84 RENTAL UNITS AT 150 CONGRESS AVENUE TO BE APPROVED WITH THE FINDINGS OF FACT CONCLUSIONS AND CONDITIONS AS DOCUMENTED IN THE STAFF MEMO DATED NOVEMBER 5, 2024, AND WITH THE FOLLOWING ADDITIONAL CONDITIONS:

- THAT THE APPLICANT WORK WITH THE CITY TO REQUEST THE DOT TO REDUCE THE SPEED LIMIT TO THE NORTH SUFFICIENT TO SATISFY CITY'S SIGHT DISTANCE REQUIREMENT.
- THAT THE PERMIT BY RULE APPLICATION BE SUBMITTED TO THE CITY PLANNER AT THE SAME TIME IT IS SUBMITTED TO THE DEP AND A FOLLOW-UP CONFIRMATION OF NO OBJECTION.
- THAT A FINAL RECORDED COPY OF THE CONSERVATION EASEMENT BE SUBMITTED TO THE CITY PLANNER.
- THAT THE FINAL ACCESS POINT TO THE CONSERVATION EASEMENT ALONG THE NORTHERLY BOUNDARY BE CONFIRMED TO THE CITY PLANNER.
- THAT A FINAL AREA AND LOCATION FOR BIKE RACKS BE SUBMITTED TO THE CITY PLANNER.
- THAT AN AGREEMENT WITH BATH HOUSING CONCERNING ACCESS FROM THE SOUTHERLY PROJECT TO THE CONSERVATION AREA AND FOR THE APPLICANT OVER BATH HOUSING'S CENTRAL CORRIDOR BE SUBMITTED TO THE CITY PLANNER.
- THAT THE APPLICANT RECEIVE AN EXTENSION OF SIX MONTHS ON THE TIME FOR INITIATING CONSTRUCTION.

PLANNING BOARD UNANIMOUSLY APPROVED.

Approval contingency/Void: As documented in the conditions at the end of this document, the contract rezoning will need to be subsequently approved by the City Council for the Site Plan and Subdivision approvals to be valid. As stated in §12.07 of the Bath Land Use Code, Site Plan Approval is void 6 months from the date of the Review Authority approval if a building permit for the project has not been issued by the Code Enforcement Officer. If the Site Plan Approval is contingent upon a rezoning by the City Council, the 6-month period [before the approval becomes void] begins 21 days following final City Council Approval of such rezoning. Once the contract rezoning is approved, you will need to work with the Code Enforcement Officer to obtain a building permit.

Appeals: An aggrieved party may appeal any decision of the Planning Board to Sagadahoc County Superior Court within 30 days of the date the Board issues a written decision.
Site Plan and Subdivision waivers approved:

Review history: An application requesting Pre-Application Workshop, was received in the Planning Office on Tuesday, July 2nd. The pre-application workshop was held at the Planning Board meeting on August 6, 2024. The applicant submitted a Sketch Plan Application on August 6, 2024. A pre-application meeting was held with the City Department Heads on August 20th. On October 1st the applicant came before the Planning Board for Pre-Application and Sketch Plan Review. The Contract Zone application was found to have merit by the City Council on October 16, 2024. Staff found the application complete with regard to the submission item checklist as of October 24, 2024. A public hearing was held for the Contract Rezoning and Site Plan and Developmental Subdivision application at the November 5, 2024, Planning Board meeting. The Planning Board found the application complete. The application was approved with the following findings of fact, conclusions, and conditions.

I look forward to working with you on the conditions of approval.

Signed,

Jennifer Curtis
Director of Planning

Findings of Fact, Conclusions, and Conditions

Overview:

Description existing/proposed: This project is phase 2 of a master plan ("Zoning Summary Plan C-3.1") that encompasses Tax Map 24, Lots 1 and 1-1, and Map 29 Lots 13 and 14. The applicant is being represented by Stephen Bushey, PE, of Gorrill Palmer. The site is currently occupied by a former church building and surface parking. The applicant proposes to demolish the former church located at 150 Congress Avenue and construct three 3-story buildings containing 84 units in total. The applicant is working in conjunction with Bath Iron Works and the Navy to provide housing that would meet the needs of their employees in Bath. The applicant intends to use sustainable building materials and construction methods. Materials could include wood and reclaimed wood, recycled plastics, recycled steel, Clay, etc.

30-A M.R.S.A. Section 4352(8) and Article 8: §8.20 Contract Rezoning

The state statutory requirements for rezoning at 30-A M.R.S.A. Section 4352(8) are:

A. Be consistent with the growth management program adopted under this chapter;

Staff note that the C2 is in an identified growth area, so the proposal is in accordance with the growth management program.

B. Establish rezoned areas that are consistent with the existing and permitted uses within the original zones; and

Staff note that the applicant is proposing a use that is consistent with existing and permitted uses within the original zone.

C. Only include conditions and restrictions that relate to the physical development or operation of the property.

The applicant is not proposing any restrictions.

Bath Land Use Code 8.20:

D,1 Mandatory Conditions:

1. Mandatory Conditions All rezoning under this Section must:

(a) be consistent with the Comprehensive Plan of the City of Bath and any other supporting documents pertinent to the Plan.

Staff note that the proposal is consistent with the Actions recommended by the 2023 City of Bath Comprehensive Plan (Plan). The proposed project is meeting all five housing policies listed in the Implementation Matrix of the Plan.

(b) includes only conditions and/or restrictions that relate to the physical development or operation of the property

The applicant is proposing conditions related to minimum lot area per dwelling unit and maximum building height.

D,2 2. Discretionary Conditions

The applicant proposes the following discretionary conditions:

1. Minimum Lot Area per dwelling unit to be reduced from 6,000 sf to 5,717 sf as depicted on the Zoning Summary Plan C-3.1, which shows additional land to be placed in conservation on Map 24, Lot 1-1 as part of a master zoning plan also incorporating the parcels at Map 29, Lot 13 and Map 24, Lot 1.
2. Maximum Height to be increased from 40 feet to 48 feet.

8.20, E. Planning Board Recommendation to the City Council and Findings of Fact

Staff note that in accordance with 8.20,E, when recommending contract rezoning approval to the City Council, the Planning Board must make findings of fact consistent with Site Plan and Subdivision Approval criteria of this Code, and that the following criteria are met:

1. The approval is consistent with the mandatory conditions set forth in Paragraph D 1 herein above.

Finding: The applicant is proposing a project that is compliant with the comprehensive plan, and the applicant is proposing to adhere to the discretionary conditions.

2. The applicant is willing to meet certain community objectives contained in the Comprehensive Plan due to additional flexibility being allowed, the applicant has employed innovative design, or that there exists an unusual nature, condition, or location relative to the property being considered for rezoning.

Finding: The applicant outlines the consistency of their proposed plans with City of Bath Comprehensive Plan goals under their Contract Zone Agreement Draft that include:

a. Creates up to 84 new, sustainable, rental housing units.
b. Set aside 10.52 acres on a neighboring parcel as permanent open space conservation land with Kennebec Estuary Land Trust as part of zoning summary plan C-3.1.
c. Contributes to multiple comprehensive plan goals, documented by the applicant as follows:

i. POPULATION 1. Support incremental population growth by drawing new people to Bath and supporting existing residents, with a diverse mix of ages, income levels, race, and backgrounds.
ii. HOUSING 1. Encourage and promote adequate housing to support the community and region's economic development – anyone who

works in Bath should have an affordable option to live in Bath.
iii. HOUSING 2. Ensure land use controls encourage the development of quality affordable housing, including rental housing.
iv. HOUSING 4. Work with proactive partners in the private, non-profit, quasi-government and public sectors to pursue housing goals.
vi. ECONOMY 4. Support local property redevelopment and revitalization, specifically 4e Property owners will be impacted by flooding and climate change. Provide support for solutions that mitigate the negative impacts of climate change on businesses, developers and property owners.
vii. TRANSPORTATION 3. To promote public health, protect natural and cultural resources, and enhance livability by managing land use in ways that maximize the efficiency of the transportation system and minimize increases in vehicle miles traveled.
viii. TRANSPORTATION 4. To meet the diverse transportation needs of residents (including children, older adults and disabled) and through travelers by providing a safe, efficient, and adequate transportation network for all types of users (motor vehicles, pedestrians, bicyclists).
Specifically:
1. 4c. Continue to promote safe walking and biking to schools through coordination with the RSU; Police; Public Works; Sustainability and Environment Bicycle and Pedestrian Committee Ongoing Local initiatives
2. 4e. Continue to work with KELT and other hikers, bike riders, community health advocates, historic preservationists, and
    a. motorized trail users as appropriate, to develop, maintain, and

3. In addition to compatibility with the neighborhood, the building must be consistent in terms of colors, materials, and other design items with the Gateway or Downtown goals of the City, if applicable.

Finding: There are no applicable Gateway or Downtown goals that apply to this project.

Contract rezoning request:

The applicant is proposing a contract rezoning for the site to accommodate lot coverage, and lower minimum density requirements.

Contract Rezoning is allowed by State statute under 30-A M.R.S.A. Section 4352(8) and is delegated to certain zones within the City of Bath as a provision of §8.20. The Mixed Commercial & Residential District (C2) is included in the areas where contract rezoning is allowed.

Applicant RTI: The applicant provided a copy of the purchase and sale agreement referenced in the application.

District conformance: The parcel is in the C2 – Mixed Commercial & Residential District. This district allows multi-family buildings. The applicant has applied for Contract Rezoning in accordance with the Zoning Summary Plan for the project area. The contract rezoning is for both the density and building height to achieve the desired number of units. The Zoning Summary Plan allocates up to 198 units for the project area. The Planning Board has previously approved a project in the area with up to 48 units. The applicant is proposing 84 units for this project, which would cumulatively result in 132 units.

Jurisdiction: Code Enforcement Officer Adam Jones determined the project was of a scope and scale that required Planning Board review and approval.

Waivers approved by the Planning Board:

- 10.03 F. Access Drive Construction -
  - The applicant has requested a waiver of the requirement for a 30-foot minimum radii as the proposed design calls for a tapered/flared condition on the entrance due to the existing 8' wide sidewalk crossing.
- *10.* 06, A Parking and Loading – Off-street parking, Number of Spaces Required
  - The applicant has requested a waiver to provide 130 spaces for the proposed 84 units of housing, or 1.5 per unit.
    - *Staff note this waiver was not required, as the applicant was able to provide an adequate minimum number of spaces due to the reduction allowed by the EV Charging Infrastructure standards. See FOF below.*
- The applicant requests a waiver of the requirement to show trees 18 inches or more at the base. The plan objective is to minimize any cutting of the large trees around the site perimeter unless they are already dead.

Article 10: General Performance Standards

PART A PUBLIC FACILITY AND SAFETY PROTECTION
SECTION 10.02 ACCESS CONTROL AND TRAFFIC IMPACTS

The applicant is proposing to use a modified driveway access overlapping the existing one and moving it to the extent practicable to accommodate the desired site distance, to access the site from Congress Ave and is not considering alternative locations because of subsurface conditions and topography. Edgett Street residents also expressed concern about the use of that street during the previous site walk thus supporting the driveway access from Congress Avenue.

Access to parking is proposed to be internal only.

The applicant provided a traffic assessment from Diane Morabito of Sewall in Attachment H. The assessment includes the following information:
• There will be one 24' wide access driveway off Congress Ave. This will be a new driveway that replaces an existing driveway into the site.
• All proposed parking will be off a new entrance drive and there is no parking directly off Congress Ave.
• The proposed 84-unit project will not trigger a Maine Department of Transportation Traffic Movement Permit as the development will yield less than 100 trips in the AM or PM peak hour.
• The trip volumes in/out of the proposed parking lot do not warrant a need for separate turning lanes into the site based on the existing volumes.

On page 6, the assessment states that, "One of the most important safety factors to consider for a project with limited trip generation is sight distance from the access drive. This sight distance is measured ten feet back from the edge of travel way at a driver's eye height of 3.5 feet to an object height of 4.25 feet. The existing site drive is located at a speed zone change, where the speed limit changes from 25 mph to 35 mph. The Town standard for 35 mph is 350' while the MaineDOT requirement is 305'.

Gorrill Palmer conducted a field review and measured sight distances from the site drive on Congress Avenue. Sight distance to the left was found to exceed 400', meeting the higher city standard for the 35-mph speed zone. Sight distance to the right is 330', meeting the MaineDOT requirement for 35 mph roadways but not the city standard.

Sewall recommends that the city request MaineDOT to shift the 35-mph zone further north to encompass the site drive in the 25-mph zone since the City has had concerns with safety at the nearby intersection of Centre Street. If the lesser 25 mph speed zone is not relocated the access should still provide safe access since it meets the MaineDOT sight distance standard.

It is important to note that Sewall has not conducted a site visit to verify the sight distances reported by Gorrill Palmer. It is also important that no landscaping or signage be located in the driveway sight triangles that will limit or restrict sight distance in the future. The report recommends requesting DOT move the location of the speed limit change to accommodate the project.

No connections are proposed to adjoining lots.

The access drive is located more than 100 feet from the point of tangency of the nearest signalized or unsignalized intersection. The Ordinance requires a minimum distance of 50 feet.

The applicant states that based on the driveway alignment as shown on the site plans, the sight distance to the north is 330 feet and over 400 feet to the south. This meets the Maine DOT

standard of 305 feet for a posted speed of 35 mph but is slightly below the local standard of 10 feet for each mile per hour speed limit or 350 feet.

The report by Diane Morabito, P.E., PTOE of Sewall recommends that the City request Maine DOT to shift the 35-mph zone further north of the project site. The proposed change would encompass the project site in the 25 speed zone. The report also states that without the change, their opinion was that the current speed limits "should still provide safe access since it meets the Maine DOT sight distance standard." *The Board may wish to advise the City to request Maine DOT change the location of the 35 mph zone, and/or grant the applicant a waiver 0f 10.02,K.*

Police Chief Andrew Booth commented that "May want to consider a turn lane on Congress" and "Concerns with speed limit – currently 35 mph – would like to see 30 or 25 if DOT allows" and "Significant concerns with future projected growth and increase of traffic on Congress – especially when school lets out."

The applicant responded that "The Police comments include a suggestion for a turning lane from Congress Ave into the development driveway. The existing northbound side of Congress Ave includes an approximately 10' wide travel lane and an approximately 10' wide paved shoulder. We believe this will adequately provide for right turning movements into the site driveway.", and "We appreciate the Chief's support for a speed reduction on Congress and we will pursue the necessary steps with the Maine DOT to make this happen."

SECTION 10.03 ACCESS DRIVE CONSTRUCTION

The applicant states that, "We have provided a progress plan to the Fire dept for their review. The site plan contains a 50' diameter paved area at the end of the parking lot suitable for Fire apparatus to turn around. We are also providing a shared use pathway between the buildings that will function as a combined pedestrian route and vehicular route for occasional use by tenants and emergency apparatus."

Following up on Planning Board comments that they prefer the space between buildings be limited to pedestrian use, the applicant conferred with the Fire Department and received approval of a change to the plan that would instead provide 20' wide access lanes at the north and south ends of the space between buildings A and B as shown on the updated site layout plan (10.28.24 plan)

See waiver request.

G. Additional Requirements in the Shoreland Zone

None of the proposed development is located in the shoreland zone.

SECTION 10.04 CORNER CLEARANCES

N/A – not a corner lot.

SECTION 10.05 MULTIPLE PRINCIPAL BUILDINGS ON A LOT

The applicant states that they are amenable to a condition of approval that the lot may not be divided in the future unless the space and bulk regulations of the zone are met. At this time the applicant has no intent on dividing the parcel further despite there being three principal buildings on the lot. (See COA #4)

SECTION 10.06 PARKING AND LOADING

A. Off-street Parking, Number of Spaces Required

The applicant states that, "The code requires 1.75 spaces per dwelling unit for multi-family housing which equates to 147 spaces. The applicant is proposing 130 new spaces for 84 units onsite which is a ratio of 1.54 spaces per unit. There are a total of 72 studio/one-bedroom units and only 12 two-bedroom units, (a total of 96 beds) thus we believe that 130 parking spaces will be sufficient

The proposed parking lot will be paved and contain the following dimensions:

- o Parking spaces – 121 parking spaces at 9' x 18' size including six ADA spaces and nine parking spaces at 9'x20' with EV charging, including two ADA spaces.
- o There is a total of eight ADA spaces including 6 van -accessible.
- o The site plan shows 6 EV Installed spaces and 24 EV-capable spaces for a total of 30. The code requires 6 EV installed and 24 EV-Capable spaces.
- o The main drive will be 24' wide.
- o Provisions for bicycles and Electric bikes will be provided both for outside bike rack storage and electric bike charging."

Staff note that per 10.06,F,3,(b) Where a parking minimum is required, EV-Capable spaces shall count as 1.5 and EV-Installed spaces shall count as 2.0 spaces as defined in Section 10.06.A. Where the applicant is proposing 6 EV installed spaces (6 x 2.0 = 12) and 24 EV capable spaces (24 x 1.5 = 36), the applicant is allowed a reduction of the difference ((12-6) = 6) + ((36 -24) = 12) = 18 of the minimum parking space requirement. Where the code requires 147 spaces at 10.06, A to which the applicant is allowed a reduction of 18 per 10.06,F,3,(b); the applicant is thereby required to provide 129 spaces (147 – 18 = 129). Where the applicant is proposing 130 spaces, they will be exceeding the requirements of the ordinance.

B. Parking Lot Construction and Layout

The applicant is proposing two-way double-loaded parking. The proposed road width is 24' and the proposed parking spots are a minimum of 18' for a total of 60' width curb to curb.

The applicant states that:

The proposed impervious area for the site will be 81,378 SF and the existing impervious area is 64,049 SF. The project will be installing new drainage collection and conveyance pipes to replace the existing. The increase in impervious area is small, nonetheless, several storage systems will be installed to capture and store pavement and roof runoff thus reducing post development runoff rate of release to less than pre-development rates. The site drainage currently ties into the municipal drainage system in Congress Ave and Centre Street and this will continue as part of the project.

Public Works Director, Lee Leiner, P.E., commented "It is unknown if the parking lot slopes are 1% minimum." The applicant should clarify.

In a response to comments dated October 24, 2024, the applicant stated that they note the site grading provides for all parking lots to be graded at no less than 1% and no more than 6%. All ADA spaced will be graded at no more than 2%.

C. Parking Lot Landscaping

The landscaping for the project is shown on plan L-1.0.

The applicant states that the Landscape plan L-1.0 identifies several hundred trees and shrubs to be planted for screening and visual softening of the site from abutting properties and adjacent streets. The site layout places the buildings behind existing mature trees on Congress Ave and therefore the buffering will remain relatively dense, creating privacy for tenants etc.

Staff reviewed Plan L 1-00 and note that it includes eight parking lot islands that will contain large deciduous trees. It also shows a combination of retained vegetated buffers and new plantings that will screen or soften the view from Congress Ave.

The plan also depicts shrubs and trees to the south and southeast, to provide filter-screening from adjacent residential properties.

City Arborist Jack Hernandez reviewed the plan and commented in an email on October 30, 2024 and stated that everything looked in order and he had no objections to the plan.

Off-street Loading Standards

Not applicable due to this being a residential use.

Additional Requirements in the Shoreland Zone.

Not applicable due to the project being located outside Shoreland Zone.

Electric Vehicle Charging Infrastructure

o The site plan shows 6 EV Installed spaces and 24 EV-capable spaces for a total of 30. The code requires 6 EV installed and 24 EV-Capable spaces.

Staff note that the proposal satisfies the required number of 6 EV-installed spaces. The applicant is also proposing 24 EV-capable spaces. The applicant is proposing a total of 30 capable OR installed spaces.

SECTION 10.07 PEDESTRIAN CIRCULATION

The applicant states that: The site plan contains numerous sidewalks for connectivity of the site, parking lots, and buildings to the surrounding street system and to future pedestrian routes envisioned within the commonly owned property to the north. These sidewalks area highlighted in [page 9 of the application]. The layout includes a north-south shared access between Buildings A & B that will ultimately connect thru to the existing Anchorage and proposed Anchorage South sites. This will also be connected to the multi-use pathway along Congress Ave. Finally, pedestrian connectivity to the Whiskeag Trail will be provided within the 10 acre+ open space to the east.

SECTION 10.08 SETBACKS FROM FUTURE STREETS

No future streets are planned for this area, therefore this section is not applicable.

PART B ENVIRONMENTAL AND HEALTH PROTECTION

SECTION 10.14 EROSION AND SEDIMENTATION CONTROL

The applicant states that they and their contractor will abide by all the applicable erosion controls outlined in this section. Drawing C-4.0, Grading, Drainage and Erosion Control Plan, contains pertinent information on the required controls to be in place during the course of construction, including, but not limited to:
o Sediment barriers around the site perimeter
o Sediment barriers at all existing and proposed drainage inlets including catch basins and pipe inlets.
o A temporary crushed stone stabilized construction entrance will be in place and maintained throughout the duration of construction.
o Any slopes steeper than 3H:1V will be stabilized after seeding with erosion control blanket.
o Centre Street and Congress Ave will be maintained free and clean of mud/debris on daily basis.
o Dust will be controlled by use of water or calcium chloride.

In comments dated October 10, 2024, Public Works Director Lee Leiner, P.E. indicated that the information presented on the erosion control plan and notes is not detailed enough to address sections E.1 and E.2:

> E1. Where mulch is used, it must be applied at a rate of 1 bale per 500 square feet and must be maintained until a catch vegetation is established.

E2. Anchoring the mulch with netting, peg and twine, or another suitable method may be required to maintain the mulch cover.

The notes have been added to the Grading Plan, C-4.0.

SECTION 10.15 HAZARDOUS OR DANGEROUS WASTES AND MATERIALS

NA- use is residential

SECTION 10.16 REFUSE DISPOSAL

The applicant states that the site plan shows multiple solid waste enclosures each for the placement of two 5 or 6 CY waste containers that will be serviced by a contracted local waste hauler on a weekly or more frequent basis. The enclosures will consist of wood, PVC or slatted chain link fence and several plantings will be provided at the rear for screening outside of the enclosure.

In comments dated October 10, 2024, Public Works Director Lee Leiner, P.E. noted that there is no information presented on the availability of recycling for residents.

In a response to comments dated October 24, 2024, the applicant stated that "The owner routinely provides for the separation of recyclable and regular waste by providing separate containers for each. For this site they are providing three enclosure areas that will each have waste and recycling cannisters and/or totes for residents to use. The owner contracts with a local waste hauler for the routine management and disposal services".

In a statement to the Planning Director on October 29, 2024, the applicant's agent commented: The applicant is committed to providing both waste and recycling containers onsite and will use a qualified waste handling vendor to collect and property process both waste and recycling.

In response to comments dated October 24, 2024, the applicant stated that demolition debris will be removed from the site and disposed of at a licensed demolition debris processing facility. Wood debris may be processed for woodchips, biofuel or related recycling.

SECTION 10.17 SEWAGE DISPOSAL

The applicant states that the existing site currently contains a private gravity sewer service line connecting to the sewer in Edgett Street. The existing line appears to be in acceptable functional condition, however it will be video inspected prior to the start of work to assure it is in operable condition for the development. A new onsite gravity pipe collection system will connect the three buildings to tie into this existing line. The sewer volume increase is calculated to be 10,650 gpd which will be subject to the $18.15/gal impact fee assessment. This amounts to $193,297.50 See COA #12

SECTION 10.18 STORMWATER MANAGEMENT

The applicant states:

• The existing site contains 64,049 SF of impervious area within a work limit of 121,805 SF. The proposed development will result in a total of 81,378 SF for an increase of 17,329 SF. Besides local approvals, the project will require a Maine Department of Environmental Protection Stormwater Management Permit-by-Rule Notification for soils disturbance greater than 1 acre. This PBR will be filed at least 14 days prior to the commencement of activity.

• The proposed development includes new onsite drainage in the form of multiple catch basins and new storm drainpipe to capture and convey stormwater runoff within the site and to tie into new onsite storage areas. The storage areas will discharge to several points of interest while controlled to maintain peak discharge to at or below predevelopment levels. See the attached Stormwater management report in Attachment I.

• All catch basins will be fitted with 3' deep sumps and hooded outlets to capture floatables and sediment, thus providing a water quality treatment benefit.

In an email dated July 1, 2024, Public Works Director Lee Leiner, P.E. had the following limited questions: Section 10.18

• *What are the impacts on the adjacent property of outfalls 1 and 3?*

In a response to comments dated 10-24-24 the applicant responded:

"Outfalls 1 and 3 are both undisturbed areas of vegetation that are considered suitable for the proposed pipe discharges since water flowing from these spots will make its way to other existing stormwater conveyance paths and into closed systems on the Bath Housing property that tie into the drainage system in Centre Street. The design includes onsite storage of stormwater runoff to assure that post development conditions mimic the existing predevelopment conditions."

• *In the application PDF file, catch basin sumps are specified as 3-feet deep on page 10 and 2-feet deep on page 168. Which is the correct depth?*

In a response to comments dated 10-24-24 the applicant responded,

"The catch basin sumps will be 3 feet for improved storage of sediment." The note is now shown on Detail B on Sheet C-6.2.

SECTION 10.19 WATER QUALITY PROTECTION

The applicant stated that:

• The proposed development is residential in nature and is not expected to store, discharge, or permit the discharge of any liquid, gaseous, or solids materials to harm or pollute surface or

groundwater.
• There will be no storage of fuel or chemicals larger than in typical household quantities.
• The land use is not expected to involve any deposit on or into the ground or discharge to waters of the State any pollutant causing water quality impairment.

SECTION 10.20 ADEQUATE WATER SUPPLY

The applicant stated that:

• The project will be served by a new 6" water supply line out to Edgett Street where it will tie into an existing 8" public water supply main.
• The proposed buildings will each have a new 2" domestic water supply line and a 6" fire service line into the building off the existing 8" water supply main in Edgett Street. An ability to provide service confirmation request has been made to the Bath Water District.
Each building will have a sprinkler system and the design team will coordinate with the fire department for the locations of Knox Boxes and annunciator panels for each building, as building permits are completed.

The Bath Water District commented on October 11, 2024 that all of their concerns had been addressed.

PART C NEIGHBORHOOD PROTECTION

SECTION 10.26 ACCESS TO BACK LOTS

This parcel does not meet the definition of a back lot, therefore this section is not applicable.

SECTION 10.27 EXTERIOR LIGHTING

The applicant states that:

Swaney Lighting has prepared a Site Lighting plan that accompanies this submission. The lighting plan includes 22 area lights at a mounting height of 14 feet and 23 building mounted lighting fixtures over the entrances. The area lights will be an LED Microstrike fixture by Beacon as shown on [page 11 of the application] and the wall fixtures are the Geopak LED fixture by Beacon. Information on the sight lighting is contained in Attachment E. Lighting intensity at the property lines will not exceed 0.2 foot candles. The lighting systems will contain controls to turn off the lighting from 11 pm to 6 am.

SECTION 10.28 HISTORIC AND ARCHEOLOGICAL RESOURCES

The applicant states that they issued a request to the Maine Historic Preservation Commission regarding the potential for historic or archeological resources at the site and they have replied that there will be no historic properties affected by the proposed undertaking, as defined by

Section 106 of the National Historic Preservation Act. The applicant submitted a copy of the letter, which was stamped as signed by the MHPC on August 28, 2024.

SECTION 10.29 LANDSCAPING AND SCREENING

The applicant has provided a landscaping plan (L L0-01, and L 1-00) that includes location, types of plants, minimum sizes, planting notes, maintenance notes, and spacing notes.

Staff note that the entire site will be screened from Congress Ave by retention of a mature stand of trees. The width of the vegetated screen on the plan C-3.0 ranges from approximately 20-30'.

Filter screening is provided to the south and southwest. The mix of on-site landscaping includes a mix of trees, shrubs, grasses and perennials. There are 99 deciduous trees, and 10 coniferous trees proposed.

The landscape plan depicts three lawn areas, two picnic tables, and a bench. Walkway areas connect the parking areas, through the lawn and landscaped areas, to the building entrances and exits, and to Congress Ave and the adjacent Anchorage property to the south.

City Arborist Jack Hernandez reviewed the plan and commented in an email on October 30, 2024 and stated that everything looked in order and he had no objections to the plan.

SECTION 10.30 NOISE

Not applicable due to this is a proposed residential development.

SECTION 10.31 SETBACK REDUCTION PLAN

Not applicable

SECTION 10.32 EXCEPTION TO SPACE AND BULK REGULATIONS

B. Height Exception

To be addressed via Contract Rezoning.

C. Setback Exception

Not applicable.

D. Yard Area Exceptions

Not applicable.

SECTION 10.33 VIEWSHED PROTECTION PLAN

Not applicable.

Section 10.34 R1 Setback Plan

Not applicable.

CONCLUSIONS (based on Bath LUC Article 12 Site Plan Review)

Based on the above findings and conditions below, the Planning Board finds that the proposed project will meet the requirements of the Land Use Code at Article 12, Site Plan Review.

ARTICLE 13 Subdivisions

Section 13.13 PERFORMANCE STANDARDS

B. Pollution

See 10.14 and 10.18 above.

C. Sufficient Water.

See 10.20 above.

D. Soil Erosion.

See 10.14 above.

E. Traffic Conditions.

See 10.02 above.

F. Sewage Disposal.

See 10.17 above.

G. Solid Waste

See 10.16 above

H. Impact on Natural Beauty, Aesthetics, Historic Sites, Wildlife Habitat, Rare Natural Areas or Public Access to the Shoreline.

See FOF under 10.28 above.
The subdivision as proposed, will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites, significant wildlife habitat identified by the Department of Inland Fisheries and Wildlife or the City, rare and irreplaceable natural areas, or any public rights for access to the shoreline.

I. Conformance with Ordinances and Plans.

The applicant is applying for a contract zone to meet Minimum Lot Area per dwelling unit, and Maximum height allowed for structures. As noted in the Contract Zoning application, the applicant is meeting multiple policy goals of the 2023 Comprehensive Plan.

The Future Land Use Plan portion of the 2023 Comprehensive Plan at page 16 identifies the site in the Commercial Corridors, and states that Bath's Commercial Corridors subarea stretches along the roads of Route 1 from Bath's boundary to High Street, State Road, and Congress Avenue north to Morse High School. Public input reflects a desire to use these already-developed areas more intensely, improve safety for all road users, and to create a more welcoming entry to the City that encourages people to stop here, not just pass through. High density residential use is desired here.

Staff note that the mix of high density residential dwellings, significant landscaping, pedestrian amenities, and public open space conservation are elements that align directly with the future land use plan for this portion of the growth area.

J. Financial and Technical Capacity.

The applicant submitted a letter from NBT Bank dated September 27, 2024 indicating they are supportive of financing the project proposed by Developers Collaborative, pending formal approval.

The applicant has retained qualified contractors and consultants to prepare the development plans, and does not have a history of construction violations.

K. Impact on Water Quality or Shoreline

The applicant is not proposing any part of the project to be situated within 250' of any wetland or river.

L. Impact on Groundwater Quality or Quantity

Staff notes the subdivision will be on public water and sewer systems. See findings under Section 10.19 above.

M. Floodplain Management.

Not applicable. The project is not located in a special flood hazard area.

N. Identification of Freshwater Wetlands

The applicant provided an NRCS medium intensity soil survey information identifying the site soils as very rocky soils, with no wetland soils identified. Staff independently verified no wetlands located on or abutting the site using US Fish & Wildlife Service GIS information. Wetlands were not identified by the applicant or observed on site during the site walk.

O. Stormwater Management.

See 10.18 above.

P. Spaghetti-lots Prohibited

Not applicable.

Q. Impact on Adjoining Municipalities
Not applicable.

CONCLUSIONS (based on Bath LUC Article 12 Site Plan Review)

Based on the above findings and below conditions, the Planning Board finds that the proposed project will meet the requirements of the Land Use Code at Article 12, Site Plan Review.

CONCLUSIONS (based on M.R.S.A. 30-A, §4404 Subdivision Review)

***Note that underlined portions in the conclusions below indicate decisions**

1. The proposed subdivision will/will not result in undue water or air pollution.

2. The proposed subdivision has/does not have sufficient water available for the reasonably foreseeable needs of the site plan.

3. The proposed subdivision will/will not cause an unreasonable burden on an existing water supply.

4. The proposed subdivision will/will not cause unreasonable soil erosion or a reduction in the land's capacity to hold water so that a dangerous or unhealthy condition results.

5. The proposed subdivision will/will not cause unreasonable highway or public road congestion or unsafe conditions with respect to the use of the highways or public roads existing or proposed.

6. The proposed subdivision will/will not provide for adequate sewage waste disposal.

7. The proposed subdivision will/will not cause an unreasonable burden on the municipality's ability to dispose of solid waste.

8. The proposed subdivision will/will not have an undue adverse effect on the scenic or natural beauty of the area, aesthetics, historic sites, significant wildlife habitat identified by the Department of Inland Fisheries and Wildlife or the municipality, or rare and irreplaceable natural areas or any public rights for physical or visual access to the shoreline.

9. The proposed subdivision conforms/does not conform with a duly adopted site plan regulation or ordinance, comprehensive plan, development plan, or land use plan.

10. The developer has/does not have adequate financial and technical capacity to meet the standards of this section.

11. The proposed subdivision is/is not situated entirely or partially within the watershed of any pond or lake or within 250 feet of any wetland, great pond or river as defined in Title 38, Chapter 3, subchapter I, article 2-B M.R.S.A.

12. The proposed subdivision will/will not alone or in conjunction with existing activities, adversely affect the quality or quantity of ground water.

13. The proposed subdivision is/is not situated entirely or partially within a floodplain.

14. All freshwater wetlands within the proposed subdivision have/have not been identified on the plan.

15. Any river, stream, or brook within or abutting the subdivision has/has not been identified on any maps submitted as part of the application.

16. The proposed subdivision will/will not provide for adequate storm water management.

17. (N/A) If any lots in the proposed subdivision have shore frontage on a river, stream, brook, or great pond as these features are defined in Title 38, section 480-B, none of the lots created within the subdivision have/do not have a lot depth to shore frontage ratio greater than 5 to 1.

18. The long-term cumulative effects of the proposed subdivision will/will not unreasonably increase a great pond's phosphorus concentration during the construction phase and life of the proposed subdivision.

19. (N/A) For any proposed subdivision that crosses municipal boundaries, the proposed subdivision will/will not cause unreasonable traffic congestion or unsafe conditions with respect to the use of existing public ways in an adjoining municipality in which part of the subdivision is located.

20. Timber on the parcel being subdivided has/has not been harvested in violation of rules adopted pursuant to Title 12, section 8869, subsection 14.

Conditions of Approval:

Standard Conditions:

1. Approval is dependent upon and limited to the proposals and plans contained in the application materials, and supporting documents and oral representations submitted and affirmed by the applicant, and conditions, if any, imposed by the Planning Board, and any variation from such plans, proposals, and supporting documents and representations are subject to review and approval in accordance with the Land Use Ordinance.
2. All work shall be completed in accordance with Best Management Practices for Soil Erosion and Sediment Control. Erosion and sedimentation management measures must be implemented during every phase of construction. The amount of exposed soil throughout construction must be minimized. Any exposed ground area must be temporarily or permanently stabilized within one week from the time it was actively

worked by use of riprap, sod, seed, mulch, or other measures.

Additional Conditions (Site Plan):

3. The required discretionary conditions of the proposed contract zone must be approved and adopted into the Land Use Code.
4. The lot may not be divided in the future unless the space and bulk regulations of the district in which the lot is located are met (required by 10.05).
5. THAT THE APPLICANT WORK WITH THE CITY TO REQUEST THE DOT TO REDUCE THE SPEED LIMIT TO THE NORTH SUFFICIENT TO SATISFY CITY'S SIGHT DISTANCE REQUIREMENT.
6. THAT THE PERMIT BY RULE APPLICATION BE SUBMITTED TO THE CITY PLANNER AT THE SAME TIME IT IS SUBMITTED TO THE DEP AND A FOLLOW-UP CONFIRMATION OF NO OBJECTION.
7. THAT A FINAL RECORDED COPY OF THE CONSERVATION EASEMENT BE SUBMITTED TO THE CITY PLANNER.
8. THAT THE FINAL ACCESS POINT TO THE CONSERVATION EASEMENT ALONG THE NORTHERLY BOUNDARY BE CONFIRMED TO THE CITY PLANNER.
9. THAT A FINAL AREA AND LOCATION FOR BIKE RACKS BE SUBMITTED TO THE CITY PLANNER.
10. THAT AN AGREEMENT WITH BATH HOUSING CONCERNING ACCESS FROM THE SOUTHERLY PROJECT TO THE CONSERVATION AREA AND FOR THE APPLICANT OVER BATH HOUSING'S CENTRAL CORRIDOR BE SUBMITTED TO THE CITY PLANNER.
11. THAT THE APPLICANT RECEIVE AN EXTENSION OF SIX MONTHS ON THE TIME FOR INITIATING CONSTRUCTION.

Additional Conditions (Subdivision):

12. Prior to issuance of a building permit, the applicant shall pay the required sewer impact fee.
13. Prior to building permit issuance, the applicant shall submit a performance guarantee, in accordance with City of Bath Land Use Code 13.16, A, 1 or 2.