CITY OF SACO
Climate Adaptation & Action Plan

August 2024

TABLE OF CONTENTS

03 **Preface**

04 Acknowledgements

05 Letter from the Mayor

06 Executive Summary

10 **Introduction and Background**

11 What is a Climate Adaptation and Action Plan?

12 Our Climate Adaptation and Action Planning Timeline

14 Saco's Visions, Goals, & Targets

16 Community Engagement

18 Planning for Equitable Climate Action

20 **Climate Change in Saco**

21 Climate Change Impacts in Southern Maine: A Regional Summary

30 City of Saco Climate Change Vulnerability Assessment

98 City of Saco Baseline Emissions Summary and 2030 Forecast

113 **Climate Actions**

115 Health, Safety, and Well-Being

118 Buildings and Energy

121 Natural Environment

124 Transportation and Infrastructure

127 Leadership and Support

130 **Conclusion**

131 What's Next

132 Looking Ahead

133 **Appendices**

134 A: Glossary of Terms

136 B: References

137 C: Survey Summary Memo

143 D: Complete Strategy Matrix

151 E: Community Comments on CAAP

PREFACE

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- John P. Bohenko, City Administrator
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- **Southern Maine Planning and Development Commission** for assiting the City of Saco with developing the Climate Adaptation and Action Plan.

This plan was funded in part by a Community Action Grant from the State of Maine's Community Resilience Partnership.

Letter from the Mayor

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June 12, 2024

The City of Saco is pleased to present this Climate Adaptation & Action Plan. A culmination of years of climate, energy and sustainability work, this plan presents a path forward for the next ten years of Saco's climate future. The goals, strategies, and initiatives coordinate well with our recently approved 2022-2034 Comprehensive Plan. Together, these documents outline Saco's sustainable future and highlight our vision: Saco – a community for a lifetime.

In 2020, middle school students approached the city to review a Resolution Endorsing the Declaration of a Climate Emergency and Emergency Mobilization Effort to Restore a Safe Climate. After working with the Energy & Sustainability Committee, Conservation Commission, and City Council, the resolution was adopted. This resolution outlined several steps, one of which was to embark on a climate action plan. In effort to fund and move this initiative forward, the City enrolled in the Governor's Office of Policy and Innovation Community Resilience Partnership program. Through this program, Saco was awarded a Community Action Grant to complete its first climate action plan.

This plan has been spearheaded by our Energy & Sustainability Committee, which coordinated with city staff, consultants from Southern Maine Planning & Development Commission (SMPDC), the Conservation Commission, and other committees, boards, and commissions along the way. Public feedback was particularly important for this initiative, so the city hosted a survey effort with more than 670 responses, retained a dedicated webpage, shared information in newsletters, and presented updates at various public meetings. From these engagements, we listened, learned, and adapted goals and strategies that specifically spoke to the comments we received. We have coordinated this plan to address concerns from the local, state, and regional levels, fitting Saco within a regional context to better prepare our community for future grant-funding opportunities.

While we know that Saco alone cannot solve the climate crisis, this plan empowers us to continue regional collaboration that can make a positive climate impact for southern Maine. This plan was prepared while our neighboring coastal communities prepared their climate plans, making ours a piece of a regional puzzle that provides a long and healthy roadmap for our shared climate future.

Sincerely,

Jodi MacPhail
Mayor

Executive Summary

The Need for Action

As climate change causes disruptions around the globe, we are feeling the effects right here in Maine. The statewide annual temperature has increased by 3.2°F since 1895 and annual rain and snowfall have increased by more than 6 inches, bringing extreme heat and more intense storms. These changes not only disrupt our natural environment, but also have detrimental impacts on infrastructure and public health.

Saco is already experiencing the effects of climate change in our community. Recent extreme storms and flooding have destroyed homes and infrastructure, threatening the safety of our community members and requiring expensive emergency repairs. The time has come to take action. Saco is among five municipalities in York County, Maine that have recently developed local climate action plans. By taking action on climate change, Saco is joining cities in Maine and around the world in creating a resilient future.

> "It is imperative to emphasize that our efforts in the Climate Adaptation and Action Plan should not be solely about taking action to prevent the effects of global warming; it is equally about addressing the damage it has already caused..."
>
> *– Climate Adaptation and Action Plan Survey*

Our Vision

The City of Saco is a vibrant community that takes pride in its historical downtown and mill district, its beautiful beaches and open spaces, and its world-class education system. Saco is determined to create a future in which our connections with each other and our natural systems are stronger than ever, our environment is resilient, and the well-being of our community members is prioritized. Saco's climate initiatives are critical to its long-term sustainability as a community where people want to live, work, and play now and into the future.

Saco's Climate Adaptation and Action Plan (CAAP) will serve as a roadmap for our climate ready future, including:

1. **Where we are now:** our city's climate change vulnerabilities (how we're impacted) and current greenhouse gas emissions (how we're contributing).
2. **Where we are headed:** goals, targets, and actions to reduce our greenhouse gas emissions and adapt to the impacts of climate change.

Where We are Now: Vulnerabilities and Emissions

Impacts including extreme heat, flooding, storm surge, and sea level rise are among Saco's greatest climate vulnerabilities. The City's downtown area is especially vulnerable to hotter temperatures because it is an area with a large amount of impervious surfaces (like buildings and pavement) that reflect heat. Saco's downtown also has higher social vulnerability than the rest of the City, and impacts like extreme heat can exacerbate these existing vulnerabilities. Saco's coastal areas, especially Camp Ellis, Ferry Beach, and Kinney Shores, as well as low-lying areas along the Saco River, including the Water Resource Recovery Facility, are most vulnerable to the increasing impacts of flooding, storm surge, and sea level rise.

Saco's largest source of greenhouse gas emissions is on-road transportation, including emissions from passenger and commercial vehicles and public transit. The second largest source is residential buildings, including emissions from electricity and energy used for home heating, followed by commercial/industrial buildings and solid waste disposal.

Understanding Saco's current greenhouse gas emissions and vulnerabilities to climate change impacts allows us to understand where and how to take action to achieve our goals.

Where We are Headed: Goals, Targets, and Actions

Our plan outlines 14 comprehensive actions across five categories that we will take to reduce our greenhouse gas emissions and adapt to the impacts of climate change.

1. Health, Safety, and Well-Being

Goal: Share the impacts of climate change with community members, neighborhoods, and future developers to empower more resilient decisions throughout the community. Ensure community members, neighborhoods, and future development are resilient to the impacts of climate change through the use of education, outreach, and proactive policies.

Actions:

1a. Conduct education and outreach about climate change, including the impacts to public health, climate-related events, and actions community members can take to address climate change.

1b. Incorporate climate resilience measures in land use policies and regulations and direct new development away from areas that have high exposure to climate hazards (e.g., sea level rise, erosion, and inland flooding) and toward appropriate areas of town with public services (e.g., utilities, transportation, and essential services).

1c. Conduct neighborhood-specific assessments, similar to Camp Ellis Architectural Study, to evaluate climate impacts and vulnerabilities to neighborhoods/areas of the city and develop locally-tailored strategies for enhancing the resilience and sustainability of those neighborhoods.

2. Buildings and Energy

Goal: Foster energy efficient and climate resilient commercial, residential, and public buildings.

Actions:

2a. Create an incentive and educational program to improve energy efficiency, electrification or renewable energy sources, of residential and commercial buildings (including solar generation) and continue to improve efficiency, electrification, and renewable energy for public buildings.

2b. Incentivize for resilient building design.

More Information

To learn more about the CAAP actions, see the "Climate Actions" Section of this plan.

Where We are Headed: Goals, Targets, and Actions

3. Natural Environment

Goal: Protect Saco's natural environment and working lands to enhance resiliency and help combat cascading effects of climate change helping natural areas to be resilient to climate change and to help sequester carbon.

Actions:

3a. Preserve and protect natural areas and local farms.

3b. Maintain tree canopy cover.

3c. Promote and enable restoration and/or enhancement of natural areas and nature-based solutions.

4. Transportation and Land Use

Goal: Reduce transportation emissions by supporting active mobility, public transit, and electric and hybrid vehicle use as alternatives to gas-powered single-occupancy vehicles.

Actions:

4a. Improve walkability and bikeability of city's roadways and alternative pathways.

4b. Improve education about public transit services to expand use.

4c. Support the expansion of EVs and associated infrastructure.

5. Leadership and Capacity

Goal: Lead by example on climate change by providing capacity, education, and resources to municipal staff, elected officials, boards, committees, and the business community.

Actions:

5a. Dedicate more staff hours to future long-term planning initiatives aligned with the Climate Adaptation and Action Plan and the Comprehensive Plan.

5b. Provide climate training for municipal boards, committees, and commissions.

5c. Foster a climate-resilient local economy and tourism industry.

INTRODUCTION AND BACKGROUND

What is a Climate Adaptation and Action Plan?

A Climate Adaptation and Action Plan (CAAP) is a strategic plan that lays out policies and programs for reducing a community's greenhouse gas (GHG) emissions and adapting to the impacts of climate change. CAAPs include an inventory of the municipality's current GHG emissions and existing vulnerabilities, goals for emissions reductions and climate adaptation, and actions to achieve those goals.

This CAAP will serve as a roadmap to ensure Saco's climate ready future.

Emissions reductions – Actions that help reduce the total amount of GHGs in the earth's atmosphere. These actions put the brakes on the speed at which climate change is happening.

Climate adaptation – Actions taken to strengthen a community's ability to adjust to climate change and thrive in spite of its impacts. Adaptation softens the blow of climate change.

> **The failure to act against the effects of climate change carries a great risk for Maine, as doing nothing will cause costly damage to Maine's buildings & infrastructure, vulnerable ecosystems, iconic species, & public health.**
>
> – *Maine Won't Wait, the State of Maine's 2020C Climate Action Plan*

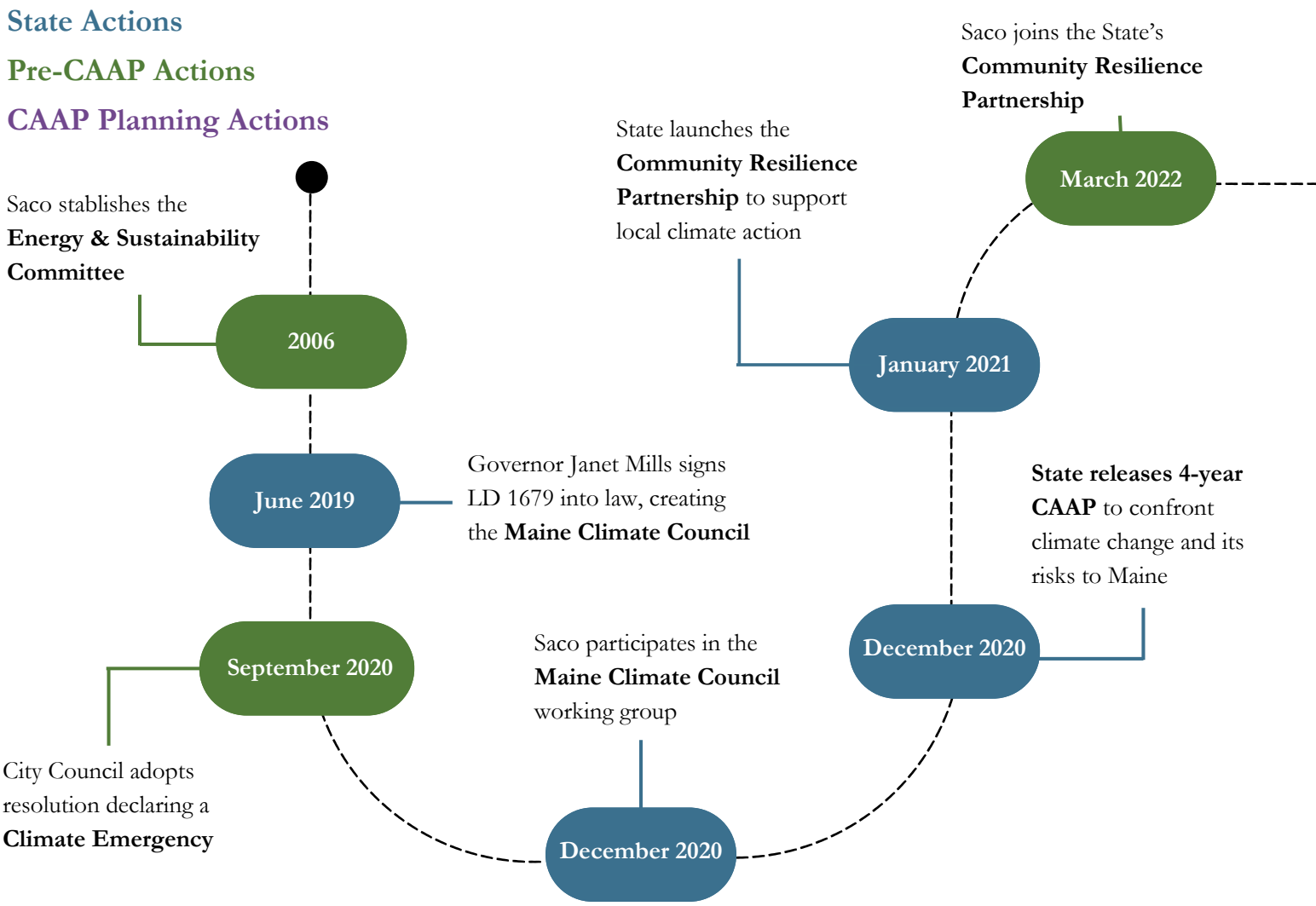
Our Climate Adaptation and Action Planning Timeline

Since 2006, the Saco Energy & Sustainability Committee has worked to reduce the municipality's energy usage, promote education around energy reduction initiatives, and empower the city to consider more sustainable options. This collaborative work has saved thousands of dollars, spurred capital projects such as the recent LED street light conversion, and fostered critical sustainability improvements.

In 2020, a group of Saco Middle School students collaborated with the Conservation Commission and the Energy & Sustainability Committee on a climate emergency declaration. The declaration was presented to the City Council, and on September 21st, 2020, the City Council passed the resolution.

In response to this resolution, Saco pursued grant funding to support long-range climate planning initiatives. Saco, along with nine other southern Maine communities, participated in *Climate Ready Coast - Southern Maine,* a grant funded project to develop a regional coastal vulnerability assessment and plan in the Spring of 2021. During that time, Saco's Energy & Sustainability Committee worked with the City Council to join the Community Resilience Partnership administered through the Governor's Office of Policy Innovation and the Future. Saco also joined ICLEI, the International Council for Local Environmental Initiatives, which is a global network for sustainability.

In 2022, Saco was awarded a $50,000 Community Action Grant through the Community Resilience Partnership program to develop the CAAP.



Our Climate Adaptation and Action Planning Timeline

February 2023

GHG Emissions Inventory and Forecast

March 2023

Climate Change Vulnerability Assessment

April 2023

Start of **CAAP public engagement**

Fall 2023

Direct outreach to committees, commissions & community orgs.

Fall 2023

Public survey about CAAP priorities

Winter 2023

Development of **CAAP actions**

March 2024

Public Information Session to present draft CAAP actions and get public feedback

August 2024

CAAP public comment period

Fall 2024

City Council adopts CAAP ***(anticipated)***

Next Up: Implementation!

Saco's Visions, Goals, & Targets

Our Vision

The City of Saco is a vibrant community that takes pride in its historical downtown and mill district, its beautiful beaches and open spaces, and its world-class education system. Saco is determined to create a future in which our connections with each other and our natural systems are stronger than ever, our environment is resilient, and the well-being of our community members is prioritized. Saco's climate initiatives are critical to its long-term sustainability as a community where people want to live, work, and play now and into the future.

Health, Safety, and Well-Being

Goal: Share the impacts of climate change with community members, neighborhoods, and future developers to empower more resilient decisions throughout the community. Ensure community members, neighborhoods, and future development are resilient to the impacts of climate change through the use of education, outreach, and proactive policies.

10-year Target: 100,000 engagements.

Buildings and Energy

Goal: Foster energy efficient and climate resilient commercial, residential, and public buildings.

10-year Target: 5000 Energy efficiency building permit applications.

Natural Environment

Goal: Protect Saco's natural environment and working lands to enhance resiliency and help combat cascading effects of climate change helping natural areas to be resilient to climate change and to help sequester carbon.

10-year Target: 10% Increase in acreage of protected lands.

Transportation and Land Use

Goal: Reduce transportation emissions by supporting active mobility, public transit, and electric and hybrid vehicle use as alternatives to gas-powered single-occupancy vehicles.

10-year Target: 10% drop in-town vehicle miles traveled by solely gasoline powered vehicles.

Leadership and Capacity

Goal: Lead by example on climate change by providing capacity, education, and resources to municipal staff, elected officials, boards, committees, and the business community.

10-year Target: 10,000 Staff & Volunteer Hours.

Community Engagement

Community engagement was critical to the development of this CAAP. We employed various engagement tools to inform the community about the CAAP process and seek input from City staff, official municipal boards and committees, and the public. The Saco Energy and Sustainability Committee (ESC) spearheaded engagement efforts including in-person and virtual meetings, a community survey, newsletter articles, webpage on City website, outreach at community events, and social media posts. This input informed the actions in this plan and will direct Saco's climate efforts for years to come.

Municipal Boards, Committees, and Commissions Engaged

- Conservation Commission
- Planning Board
- Shoreline Commission
- Coastal Waters Commission
- Saco Schools
- Economic Development Commission

Other Community Groups and Agencies Engaged

- Saco Main Street
- SOS Saco Bay
- Biddeford, Saco, Old Orchard Beach Transit (BSOOB)
- Age Friendly Saco

Spring 2023

- Energy & Sustainability Committee begins regular meetings with Conservation Commission and Planning Board

Summer 2023

- Public Survey receives nearly 200 responses in first week after launch

Fall 2023

- Energy & Sustainability Committee reports CAAP progress at City Council and Planning Board Meetings
- Public Survey closes with over 670 responses
- Outreach to Shoreline Commission, Conservation Commission, Coastal Waters Commission, SOS Saco Bay, BSOOB Transit, Saco Main Street, Saco Schools
- Outreach in Saco Parks and Recreation Newsletter
- Outreach in community newsletter and social media posts

Winter 2023-24

- City Council meeting
- Public Information Session at City Hall

CAAP development's public engagement chapter closes, but the implementation dialogue continues!

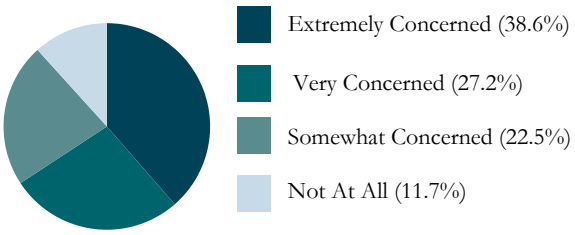
What We Heard

Climate Concerns

We listened to the climate concerns shared by our community members.

1. **Preserve, protect, and restore natural areas.**
2. **Put land use measures in place for sustainable development.**
3. **Provide social support to residents during extreme weather events.**

How concerned are you that climate change will directly impact your life in the next ten years?



Data source: Saco Climate Survey, 2023

Climate Action Feedback

We heard your ideas for actions Saco can take to tackle climate change.

- **Preserve open space.**
- **Align building codes with our CAAP goals.**
- **Prevent or reduce development on existing green space.**
- **Incentivize energy reduction.**
- **Educate our Saco students and the public via municipal and regional outreach.**
- **Collect public input on the plan and actions.**
- **Maintain open lines of communication with the public.**
- **Combine individual calls to action with municipal policy.**
- **Prepare the City, especially the coastal areas, for the flooding and erosion that we know is on the way.**
- **Partner with our neighbors where possible.**
- **Our plan is equally about addressing the damage climate change has already caused, particularly to our cherished coastline and beaches.**
- **Add green space and trees to Downtown.**

Planning for Equitable Climate Action

Social equity means all community members can participate, prosper, and reach their full potential. Climate change and social equity are closely intertwined. **Climate change affects some members and groups of our community differently,** some more severely than others. Equally, climate action has many benefits, and in some cases, negative impacts, that can be distributed unevenly and unfairly to different groups.

Saco's climate actions must address social equity every step of the way. We've embedded equity in the design and implementation of our CAAP to ensure that actions respond to social inequities and the needs of those who are most vulnerable.

- Public engagement efforts such as the survey and multiple public meetings starting in September, 2022, were designed to reach as much of the community as possible. The survey itself had 672 responses. Respondents were glad to have the ability to participate in this survey and to have an opportunity to provide input to the city as they work on their CAAP.

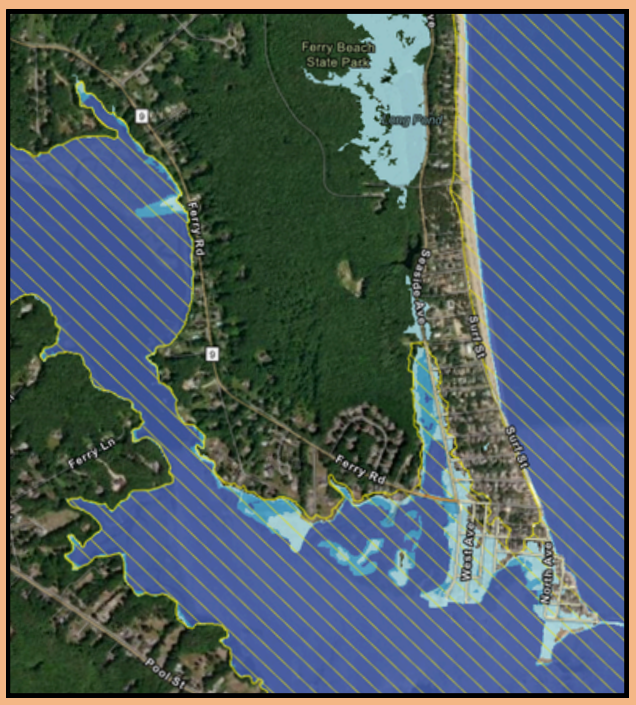
- Equity was one of three guiding criteria for the action evaluation process. In considering each potential action, we asked, "*Are the costs, benefits of this action distributed fairly? Does this action minimize harm to the most vulnerable groups?*"

As we look toward implementing our CAAP, we will need to be flexible, adaptive, and reflexive to ensure the biggest benefit and least harm to our vulnerable community members.

Saco's Equity Considerations

Over Saco's long history, the city has seen many changes. Once a settlement for the indigenous Abenaki tribe that thrived along the Saco River, the area was named for the Abenaki word "Saco," meaning "flowing out" or "outlet" and for the word "Sawacotuck" meaning "mouth of the tidal stream." European visitors have been attracted to the area by its natural resources and harbor since the early 17th century. Permanent settlers arrived in 1631. Saco was incorporated as a town in 1775. From mill town to a community hub on the southern Maine coast, Saco has grown into a thriving small city of more than 20,000 residents.

But the city's growth is not without challenges. Saco, along with the rest of Maine, is **experiencing a housing affordability crisis. The Downtown area has the highest social vulnerability compared to the rest of the community,** driven by the prevalence of people/households with lower annual incomes, without a vehicle, limited internet access, and other compounding factors. In addition to the need for affordable housing, roughly **$158.5 million in assessed property value is located in areas expected to be impacted by flooding.** This includes more than 3 miles of roadway, which impacts access to and travel within coastal areas of Saco. Coastal areas of Saco, especially neighborhoods, roads, and infrastructure in **Camp Ellis, Ferry Beach, and Kinney Shores, as well as low-lying areas along the Saco River, including the Water Resource Recovery Facility, are extremely vulnerable to the increasing impacts of flooding, storm surge, and sea level rise.** Some of the areas most exposed to flooding also have a relatively high percentage of structures built before modern building codes, making them more sensitive to flood hazards.



Flood map of Saco's Camp Ellis neighborhood. Data source: Climate Ready Coast - Southern Maine

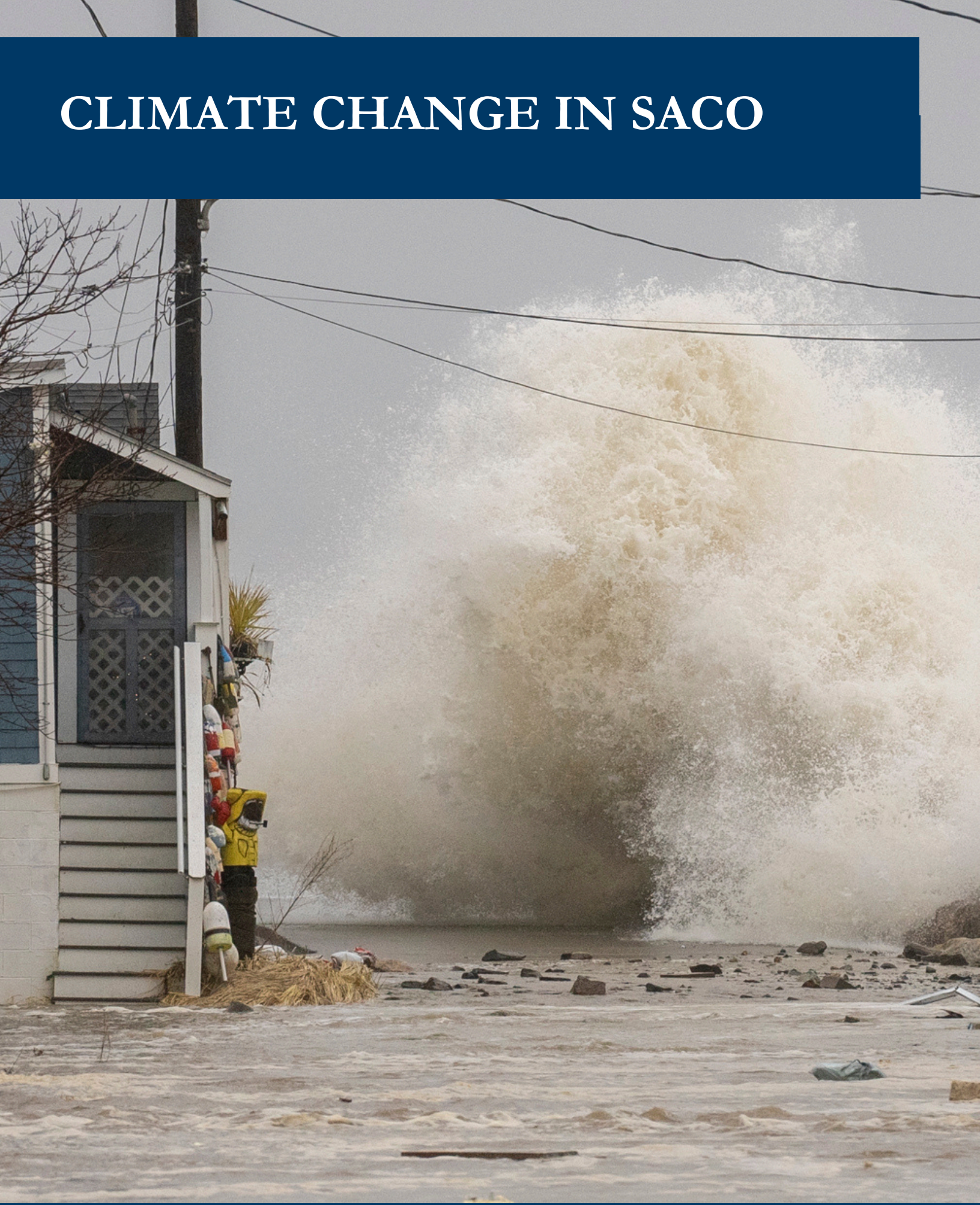
Saco's Climate Adaptation and Action Plan reflects the City's commitment to Environmental Justice. Environmental Justice aims to provide **equal access to the decision-making process for all people regardless of race, color, national origin, or income regarding the development, implementation, and enforcement of environmental laws, regulations, and policies.** Many disenfranchised groups in the United States live with increased environmental and health hazards. The goal of Environmental Justice is to rectify this situation so everyone can live, learn, and work in a healthy community.

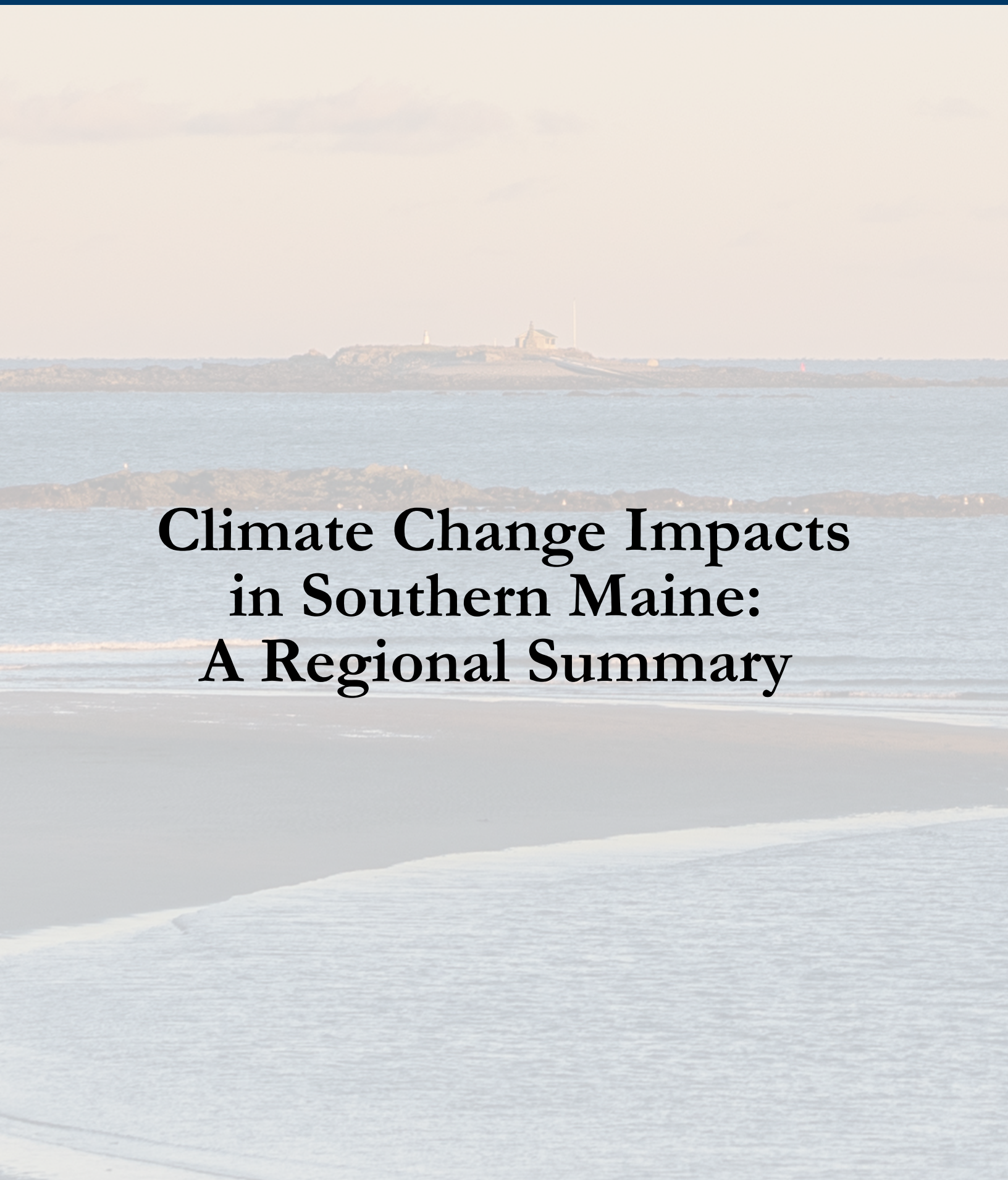
In 2022, President Joe Biden signed Executive Order 14008 and launched the Justice40 initiative. **The goal of this initiative is to reallocate forty percent of certain Federal Investments to disadvantaged communities overburdened with legacy pollution and environmental hazards.** Justice40 funds can be utilized to pursue projects related to climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and clean water and wastewater infrastructure.

To access opportunities through Justice40, a community must have a census track considered to be disadvantaged by the Council on Environmental Quality (CEQ). The census track must meet the social vulnerability threshold and at least one environmental, climate, or other hazard threshold to qualify for this designation. No census tracks in the City of Saco are considered disadvantaged by the CEQ, but **the Environmental Protection Agency (EPA) identified several areas of the City as disadvantaged using the Inflation Reduction Act criteria.** Additionally, Saco's sister city, Biddeford, has a CEQ disadvantaged census track. Both Saco and Biddeford should consider Environmental Justice tools and resources to increase resiliency between their neighboring communities.

The EPA's Environmental Justice Screening and Mapping Tool also shows how certain sections of the City are more or less vulnerable to environmental and health hazards such as exposure to lead paint, proximity to superfund sites, and cancer diagnosis. **The need for Environmental Justice is prevalent in all communities including Saco, which is why Equity was used as a guiding principle in the formation of Saco's Climate Action and Adaptation Plan.**

CLIMATE CHANGE IN SACO





Climate Change Impacts in Southern Maine: A Regional Summary

Climate Change Impacts in Southern Maine - Regional Summary

Key Takeaways

This report summarizes the anticipated climate change impacts on southern Maine communities. It is intended to help local communities develop their Climate Action Plans and inform the public about the possible effects of climate change in the region. **Through local actions and solutions, we will build stronger communities and protect all Maine community members from climate change impacts.**

Overall, southern Maine is undergoing changes driven by rising temperatures, altering precipitation patterns, rising sea levels, and shifting ecosystems. Communities are experiencing these climate change impacts across the region, which will have far-reaching effects on the people, places, and culture of southern Maine.

Southern Maine's **natural environment** - the ecosystems, plants, and animals that make this region special - are already being stressed by climate change.

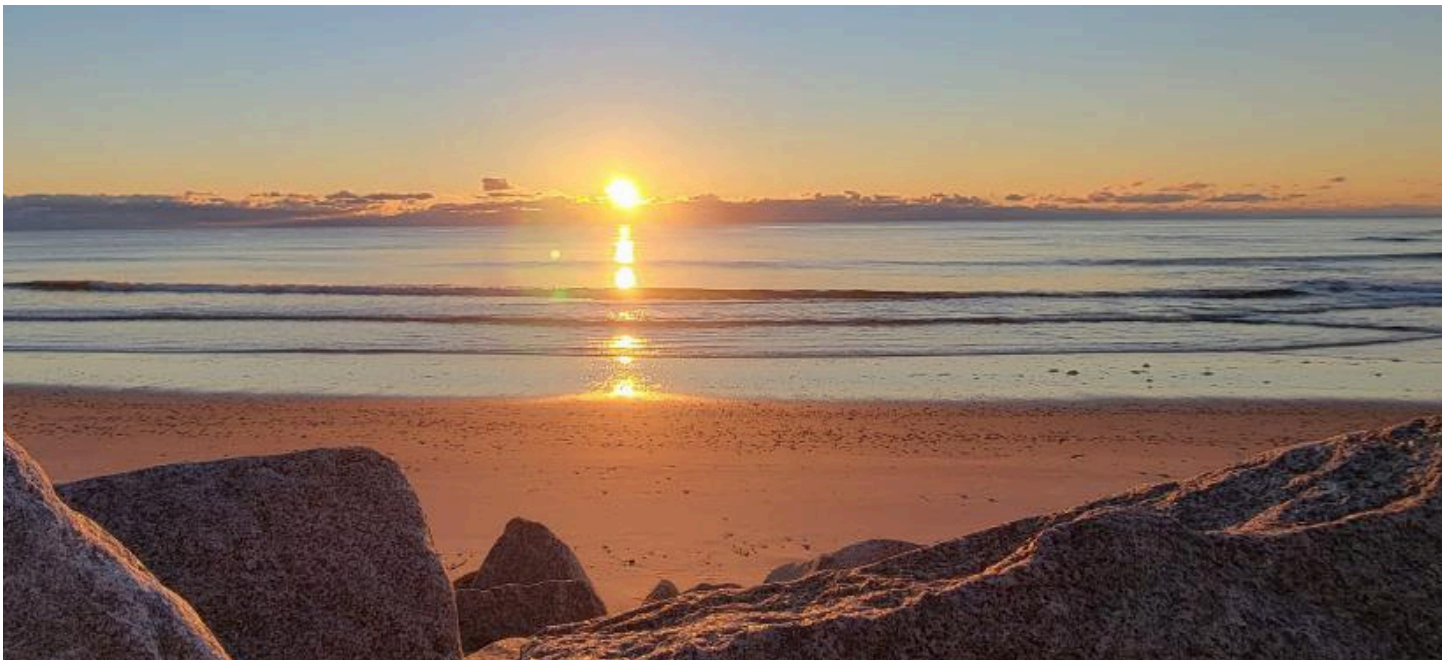
Southern Maine's roads, bridges, and **critical infrastructure** are at greater risk of damage due to sea level rise and increasing storm severity and frequency.

Large sectors of southern Maine's **economy** including tourism, fishing, recreation, and agriculture will need to adjust to climate change impacts.

The essential **public services** that southern Maine municipalities provide will be greatly strained by climate change impacts.

Climate change is altering the availability of **recreation activities** traditional to southern Maine.

Climate change impacts are negatively affecting the **health** of southern Maine community members.



Southern Maine's Changing Climate

We face major threats to the future of our communities and the places we love. But we have it within our power to take action on local solutions that will make a difference. Increasing temperatures, changing precipitation, sea level rise, and shifting ecosystems are driving changes across southern Maine.

Increasing Temperatures

Due to the Greenhouse Effect, **average air temperatures around the world are increasing over time. Maine's statewide annual temperature has increased by 3.2 °F (≈1.8 °C) since 1895.**

(Maine Climate Council, Scientific Assessment of Climate Change and its Effects in Maine)

Impacts of increasing air temperatures:

- **Increased frequency of extreme temperature days (over 90°F)**: Extreme heat days are expected to be 2 - 4 times more frequent in Maine by 2050, increasing the likelihood of heatwaves.
- **Increased average air temperatures**: Resulting in more frost-free days, shifting ecosystems, and increases in average water temperatures in lakes and rivers.
- **Shorter and warmer winters**: Warming has shortened Maine's winters and lengthened the summers by two weeks on average over the last century. This has led to reduced snowpack, changing snowmelt patterns, and earlier river and lake ice-out dates.
- **Increased risk of algal blooms**: Recurring blooms of harmful blue-green algae in freshwater are expected to become frequent as temperatures warm, potentially impacting human, animal, and ecosystem health.

Freshwater blue green algae bloom. *Photo source: Lake Stewards of Maine.*

What is the Greenhouse Effect?

The release of greenhouse gases (GHGs) into the atmosphere creates a layer of gas that acts like a blanket, trapping heat released from the surface of the Earth.

Changing Precipitation

In Maine precipitation has become both heavier and more frequent; **Maine's annual precipitation (rain and snowfall) has increased more than 6 inches since 1895, and extreme precipitation events (1+ inches over 24 hours) are becoming more frequent.**

(Maine Climate Council, Scientific Assessment of Climate Change and its Effects in Maine)

Impacts of changing precipitation:

- **Less precipitation is falling as snow due to increased temperatures**. This results in changes in seasonal water-flow patterns.
- **Extreme weather events are becoming more likely**: More frequent nor'easters, coastal storms, and hurricanes can cause flooding and damage to infrastructure and buildings.
- **More extensive flooding in coastal areas**: Stormwater runoff from intense rainfall events combined with storm surge and future sea level rise will lead to more extensive flooding in coastal areas. That threat is further exacerbated by development pressure in southern Maine that is increasing the number of roads, buildings, and parking lots that limit the natural infiltration of water into the soil.

What Causes Increased Precipitation?

Increased temperatures cause the evaporation of surface waters to intensify. This leads to more water in the atmosphere, resulting in unpredictable and intensified precipitation events.

Changing Drought

Despite increasing annual precipitation across the state, **York County has experienced three severe droughts in the last five years, which lasted between two to eight months**.

(Maine Climate Council, Scientific Assessment of Climate Change and its Effects in Maine)

Impacts of changing drought:

- **Decreased resilience of drinking water sources:** Reduced water supply and degraded quality can affect public and private drinking water sources, agricultural operations, and ecosystem health.
- **Increased risk of wildfires:** Wildfire frequency, particularly in the spring, is increasing in Maine due to drought, decreased snowpack, and windier conditions.

What Causes Droughts?

Warmer air temperatures and changing precipitation patterns have caused water tables to fall during the summer months and increased the severity of droughts.

In April 2020, high winds and dry conditions led to more than a dozen wildfires in Maine. A wildfire in Biddeford burned about 20 acres of forest.

Sea Level Rise

Globally, the mean sea level has risen about 8 to 9 inches since 1880, with roughly one third of that occurring in just the last two and a half decades. In the Gulf of Maine, sea level rise has mirrored the global trend. Data from the Portland tide gauge show that local sea level has increased 7.5 inches since 1912, when the gauge first began collecting data. Nearly half of the documented sea level rise that has occurred over the past century in Maine has occurred since 1993, representing a rapid increase in the rate of change.

By 2050, Maine will likely experience between 1.1 - 1.8 feet of sea level rise, and between 3.0 -4.6 feet of sea level rise by 2100, with higher amounts possible. *(Maine Climate Council, Scientific Assessment of Climate Change and its Effects in Maine)*

Impacts of sea level rise:

- **Increase in average sea level**: The increase in the normal tidal extent of the sea level will decrease the width of dry beach and will inundate both natural and built environments.
- **Increase in the likelihood of nuisance flooding during high tide**: southern Maine has seen 4 times as many nuisance flooding events over the last decade compared with the average of the past 100 years. One foot of sea level rise will increase the frequency of nuisance flooding in southern Maine by 15-fold.
- **Saltwater Intrusion**: As average sea level rises, coastal waters seep further inland and underground, pushing groundwater levels up and shifting the interface of fresh groundwater and saltwater. Saltwater can intrude into groundwater, contaminating drinking water resources, cause flooding from higher coastal water tables, result in premature septic system failure, mobilize hazardous waste, and damage subsurface infrastructure and pavement from underground.
- **Increased severity of coastal flooding and storm surge**: With a higher normal high tide, storm surge from coastal storms will extend further into natural and built environments, causing flooding and damage to roads, homes, and bridges. Intense wave action and surge can bring with it dangerous debris like rocks, sand, and seaweed. While future sea level rise will occur gradually over time, extreme storm events can cause damaging flooding episodically in the short-term.
- **Loss of coastal habitat**: As sea level rises, coastal beaches, dunes, salt marshes, and bluffs are likely to experience increased erosion and land loss. Landward migration of coastal habitats like salt marshes can occur, but only if the habitat is healthy, can keep pace with the rate of sea level rise, and is unobstructed by landward barriers.

What Causes Sea Level Rise?

Warming temperatures cause rapid melting of glaciers as well as the expansion of water molecules in the oceans. Both effects are increasing the total volume of water in the earth's oceans. This causes the average sea level to increase over time, with water encroaching on beaches and coastal communities.

Changing Terrestrial and Marine Ecosystems

Of the State's **378 most at-risk fish and wildlife species, nearly one-third are predicted to be negatively affected by climate-change related threats**, including habitat shifts and alterations, droughts, temperature extremes, and storms and flooding. *(Maine Climate Council, Scientific Assessment of Climate Change and its Effects in Maine)*

Impacts of changing ecosystems:

- **Ocean Acidification**: As the concentration of carbon dioxide increases in the atmosphere, carbon dioxide is absorbed into the ocean. This changes the chemistry of ocean waters, increasing the overall acidity of the water. Acidification is exacerbated by river discharge which carries excess nutrients from stormwater runoff. Increased ocean acidity limits marine life that produce calcium carbonate to build shells, such as oysters, scallops, clams, mussels, and sea urchins.
- **Ocean Warming**: The Gulf of Maine is warming faster than 99% of the world's oceans. This warming has harmful effects on the Gulf of Maine's subarctic ecosystem, including iconic North Atlantic species such as cod, whales, and puffins, as well as species like plankton that serve as the base of the food web.
- **Decreased biodiversity**: Maine is an ecological transition area, meaning both the temperate climate of southern New England and colder boreal forests of Canada overlap. The many compounding impacts of climate change have changed this environment over time, and a smaller number of species will be able to survive and thrive as many go extinct or migrate elsewhere.
- **Increased Potential for Invasive Species**: Invasive species, such as the Emerald ash borer, Asiatic bittersweet, and European green crab, are those that have a competitive advantage in our environment. In many cases, they are adapted for higher temperatures or wetter environments, making them better at surviving in a changing Maine climate. Invasive species can overgrow and outpace native Maine plants and wildlife, making it extremely difficult for native species to survive.

What Impacts Ecosystems?

Warming temperatures, changing precipitation, and a general shifting climate stress Maine's natural ecosystems and resources. These can have detrimental effects on Maine wildlife and people.

An invasive green crab. *Photo Credit: USFWS 2019.*

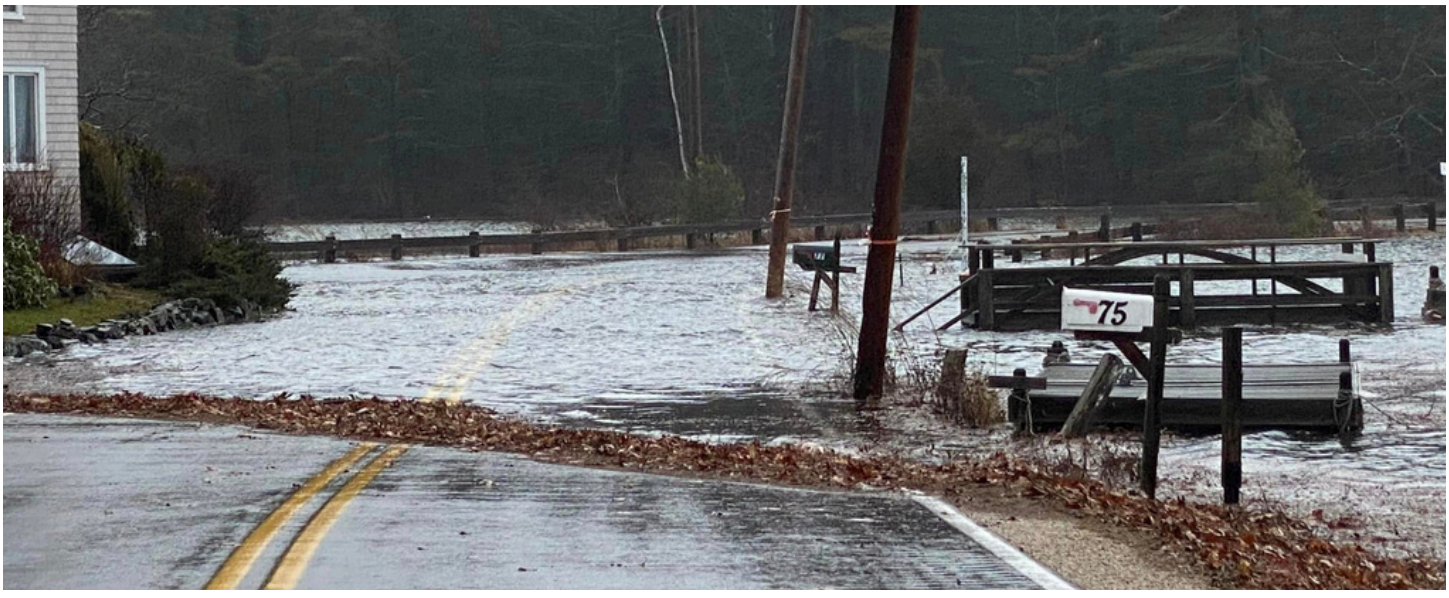
What Climate Change Means for Southern Maine

Climate change and its impacts will affect all the people, places, and culture of southern Maine.

Infrastructure

Southern Maine's roads, bridges, and critical infrastructure are at greater risk of damage due to increasing storm severity and frequency.

- **Sea level rise, storm surge, and extreme precipitation put coastal infrastructure at very high risk.**
  - Several coastal southern Maine towns' critical drinking and wastewater treatment facilities are in areas of high flood risk. Repairing and replacing these facilities will cost millions of dollars.
- **Southern Maine's electricity infrastructure is particularly vulnerable to increases in storm frequency and intensity**.
  - Maine has some of the worst power outages in the country. From 2015-2019, the state had the highest average annual frequency of power outages per customer of any state (3.9 outages per customer per year). These power outages jeopardize essential public safety services.
- **Inland infrastructure is at risk from extreme weather events, and particularly extreme precipitation**.
  - When a large amount of rain falls in a short amount of time, small watersheds can flood suddenly, damaging culverts, roads and bridges. Hundreds of statewide culverts are not designed for expected future precipitation. In 2021, an intense downpour washed out a large portion of an embankment along the Saco River in Biddeford, with repair costs estimated over $2 Million.
- **Drought and decreases in summertime precipitation are negatively impacting drinking water supply for both private wells and public water systems**.
  - In the summer of 2022, drought led to water restrictions in some southern Maine communities. In addition to increased concerns about water supply, drought can lead to decreased water quality and greater health risks due to algal blooms and trace mineral concentrations.



Flooding in Kittery, ME. *Photo Credit: Cross Currents Communications*

Economy

Large sectors of southern Maine's economy including tourism, fishing, recreation, and agriculture will need to adjust to climate change impacts.

- **With 1.6 feet of sea level rise projected by 2050, Maine can expect $17.5 billion in coastal damage and 21,000 coastal jobs lost.**
  - Additionally, this could result in 1.1 million fewer visitors in the southern Maine beach region and a $136 million loss in tourism spending annually.
- **Southern Maine outdoor recreation industries account for 12% of all outdoor recreation value produced in the state.**
  - Fast-warming future temperatures, especially in winter, and declines in regional snowpack and ice cover will negatively impact winter recreation industries and the industries that support them. Alternatively, longer summer and shoulder seasons will be an opportunity for expanding summer recreation activities like boating and RVing.
- **Maine's farms will experience benefits from warming temperatures such as longer growing seasons and lower heating costs, but also costs such as heat stress to workers, crops and livestock and higher cooling costs.**
  - Increased frosts/freezes and unpredictable precipitation are expected to grow. Plant hardiness zones will shift northward with future warming, making Maine's climate more suitable for some kinds of crops (e.g. corn and soybeans) and potentially more challenging for others (e.g. wheat, Christmas trees, and wild blueberries).
- **Ocean warming and acidification are already affecting coastal fisheries including shrimp, clams, oysters, scallops, and groundfish**.
  - Lobsters, Maine's largest and most valuable fishery, are becoming more susceptible to shell disease and predatory fish, and are beginning to migrate north and farther offshore to colder waters.

Recreation

Climate change is altering the availability of recreation activities traditional to southern Maine.

- **Winter recreation opportunities are changing as less snowpack and more winter rain caused by warmer winter temperatures are making snowmobiling, skiing and ice fishing seasons shorter and more challenging**. River and lake ice is also thinner, making ice fishing and other activities more dangerous.
- **Earlier thaws and warmer waters lower important fish species' survival**, decreasing population health and impacting fishing opportunities.
- **Some natural and recreational services enjoyed at coastal beaches and waterways will disappear as sea level rise erodes beaches and damages sand-dune systems**. Coastal access points could even be lost as sea level rises.

Public Services

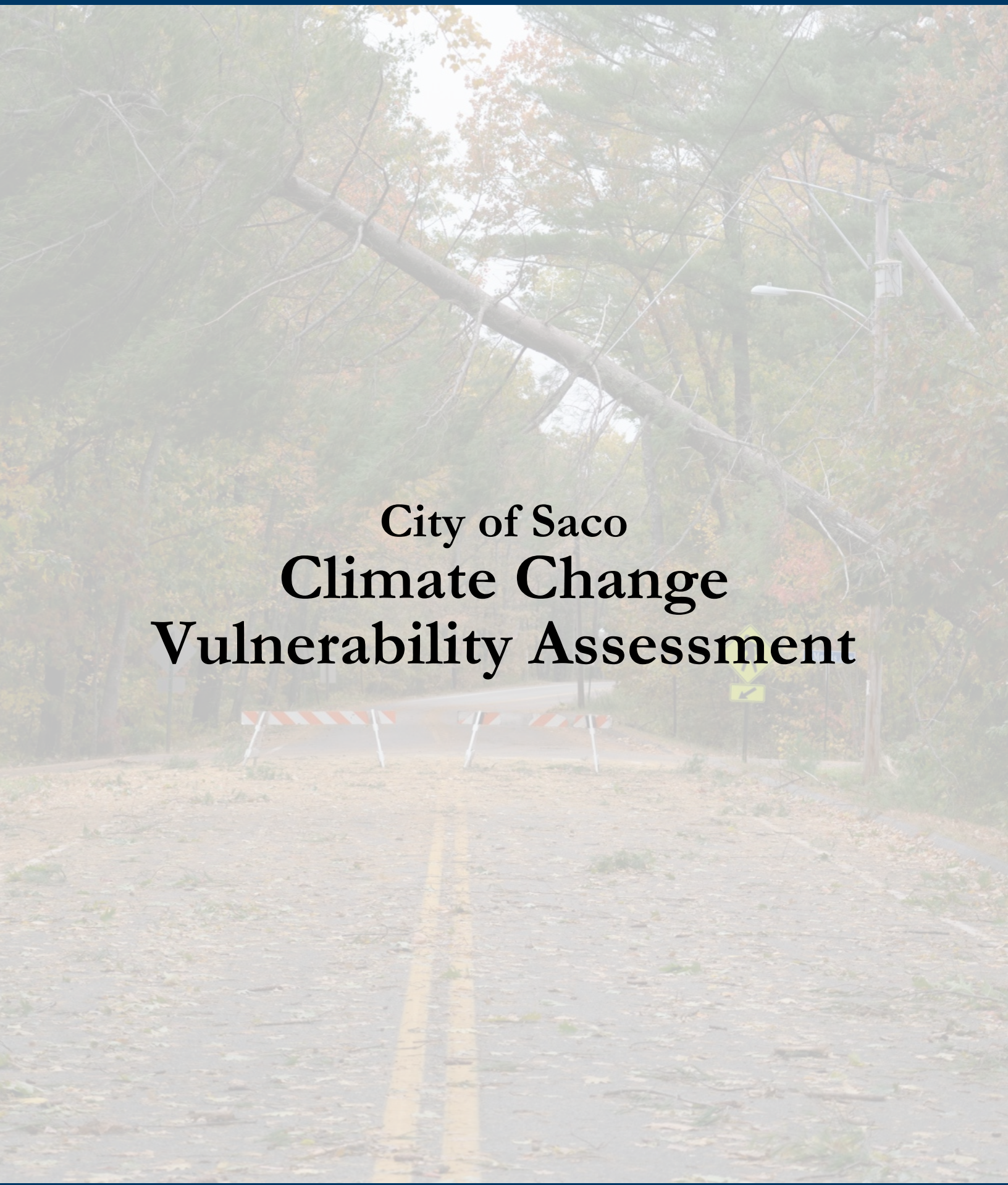
The essential public services that southern Maine municipalities provide will be greatly strained by climate change impacts.

- **More frequent flooding and extreme weather events will lead to higher costs and will stress municipal capacity** to respond to and repair after storm events.
- **Southern Maine municipal budgets are highly dependent on revenue from local property taxes, and in particular coastal development.**
  - Municipal fiscal health could be affected if coastal properties, which generate a large portion of local tax revenue and sustain community operations, services, and programs, are exposed to flooding and if development in flood prone areas continues.
- **Climate change is likely to lead to in-migration into areas like southern Maine that are perceived to be comparatively healthier and safer than areas considered to be at greater risk of climate impacts**.
  - Rapid increases in population could stress southern Maine's relatively small cities and towns. While climate migration presents an opportunity for the regional economy, fast population increases can stress housing markets, put additional demand on limited municipal resources, and overwhelm recreational facilities.
- **Higher sea levels and flooding may cut off emergency routes and access to neighborhoods during storm events, obstructing emergency services and disrupting local travel**.
  - During the December 23, 2022 storm event, roads and bridges throughout coastal York County were flooded by a 13.7 feet-high tide, the fourth highest on record. Road closures, power outages, and frigid temperatures compounded, increasing the need for emergency services as well as the difficulty in providing them.

Public Health

Climate change impacts are negatively affecting the health of southern Maine community members.

- **Warmer, shorter winters are contributing to increased tick-borne illnesses, such as Lyme disease**. Tick abundance and disease risk are expected to increase with warming temperatures.
- **Increasing temperatures and more high-heat days are putting people at risk**, especially those who are elderly, have health issues, or have limited access to home air conditioning.
- **Extreme weather may cause injuries and deaths, outbreaks of waterborne diseases, and food-borne illnesses following power outages, as well as mental health stress.**
- **Plant-based allergens have longer to affect Mainers during the year due to longer summers and shorter winters**. The length of the pollen season and the amount of pollen produced will likely increase with rising temperatures and carbon dioxide concentrations. Asthma and hay fever are also likely to increase with climate change.



City of Saco
Climate Change Vulnerability Assessment

CITY OF SACO

Climate Change Vulnerability Assessment Summary

CONTENTS

INTRODUCTION 33

Key Takeaways 34

Social Vulnerability 34

Demographic Profile 35

Key Takeaways 36

SUPPLEMENTAL COMMUNITY INFORMATION 39

Housing Characteristics 39

Key Takeaways 39

Age of Buildings 42

Household Heating Fuel Types 44

Key Takeaways 44

Zoning 50

Land Cover and Carbon Sequestration 50

EXTREME STORMS AND PRECIPITATION 52

Key Takeaways 52

Background Info, Trends, & Projections 52

Power Outages and Electric Grid Resilience 58

FLOODING: SEA LEVEL RISE AND STORM SURGE 60

Key Takeaways 60

Background Info, Trends, & Projections 60

Property Impacts 65

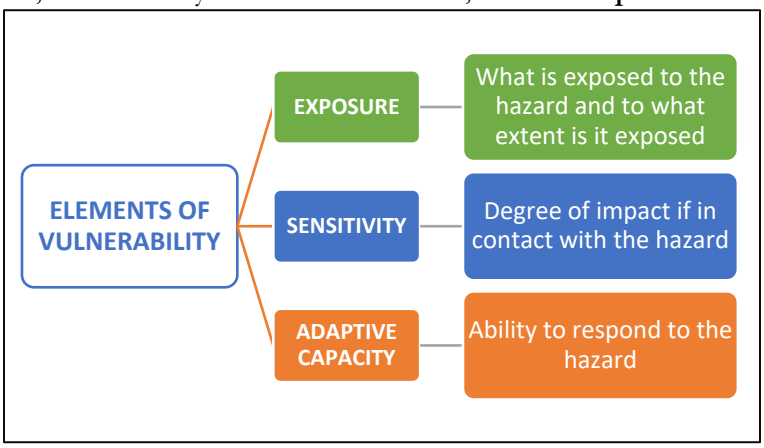
Infrastructure Impacts 68

Impacts to the Natural Environment 73

EXTREME TEMPERATURES 75
Key Takeaways 75
Background Information, Trends, & Projections 75
Urban Heat Islands 77
Public Health Impacts 80
Impacts to the Natural Environment 82
DROUGHT AND WILDFIRES 83
Key Takeaways 83
Background Info, Trends, & Projections 83
Water Supply Impacts 85
Impacts to the Natural Environment 89
Agricultural Impacts 92
CHANGING MARINE CONDITIONS 92
Key Takeaways 92
Background Info, Trends, & Projections 93
Habitat Shifts and Carbon Sinks 93
Economic Impacts 96

INTRODUCTION

One of the first steps to understanding how communities can plan for and address climate change impacts is to assess climate hazards that are projected to impact an area as well as the things, people, and places that are vulnerable to those hazards. **Climate vulnerability is commonly defined** as the product of **exposure** to climate hazards, **sensitivity** of the built, social, and natural systems to those hazards, and the **adaptive capacity** of those systems for responding to change and stressors. The more sensitive something or someone is to a hazard and the lower their adaptive capacity to respond to the hazard, the greater their vulnerability. Vulnerability also increases as exposure to the hazard does. Evaluating vulnerabilities, including what will be impacted by climate hazards, and to what extent those impacts will occur, provides a baseline for developing targeted strategies, measures, and solutions for reducing vulnerabilities.



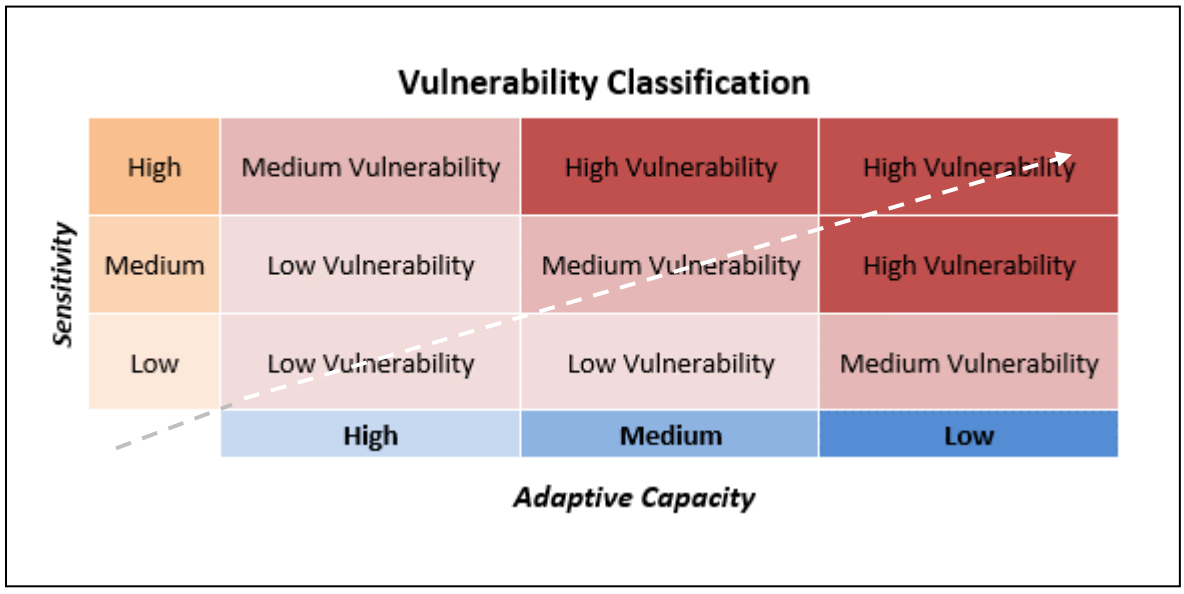


Figure 1 adapted from NOAA. 2022. Implementing the Steps to Resilience: a Practitioner's Guide.

This draft vulnerability assessment summary presents an overview of climate hazards and associated impacts and vulnerabilities for the City of Saco. The assessment uses local, regional, state, and national data pertaining to climate hazards, historical conditions, trends, and future projections to assess impacts of and local vulnerabilities associated with the following:

- Flooding from sea level rise and storm surge
- Precipitation and extreme storms
- Extreme temperatures

- Drought and wildfires
- Changing marine conditions

The assessment evaluates impacts of those hazards to the built, social, and natural environment; public health; and the economy. The 'desktop' vulnerability assessment generated quantitative-based information about Saco's climate hazard exposure. Information about adaptive capacity and sensitivity, which is usually more qualitative in nature and not readily captured by state or national datasets or numeric data, as well as information about what/where/who is of greatest concern to the community, will be added to this document based on input from City staff and the Energy and Sustainability Committee. **This assessment will be updated and refined by the project team throughout the CAAP process.**

Key Takeaways

- Saco's downtown area has the highest social vulnerability compared with all other areas of the community. This vulnerability is driven by the prevalence of people/households with low annual incomes, without a vehicle, no internet access, living alone, are disabled, renters, age 65+ and living alone, and have limited English abilities.
- Extreme heat and temperatures are increasing in Saco and areas of the community with existing social vulnerabilities, such as the downtown, are already urban heat islands. Increasing air temperatures will exacerbate existing vulnerabilities, especially for the elderly, young, people with existing health conditions, and those with limited access to air conditioning, and will pose a risk to people and the natural environment.
- Coastal areas of Saco, especially neighborhoods, roads, and infrastructure in Camp Ellis, Ferry Beach, and Kinney Shores, as well as low-lying areas along the Saco River, including the Water Resource Recovery Facility, are extremely vulnerable to the increasing impacts of flooding, storm surge, and sea level rise. Some of the areas most exposed to flooding also have a relatively high percentage of structures built before modern building codes, making them more sensitive to flood hazards.
- Roughly $158.5 million in assessed property value is located in areas expected to be impacted by flooding from 1% annual chance storm surge plus 1.6 feet of sea level rise level, representing 3.7% of the city-wide assessed property value.
- More than 3 miles of roadway is vulnerable to flooding from 1% annual chance storm surge combined with 1.6 feet of sea level rise, impacting access to and travel within coastal areas of Saco. Portions of designated evacuation routes out of the Camp Ellis area are vulnerable to flooding.
- Several pockets along tidal portions of the Saco River, especially near Camp Ellis, have been identified as being able to support future marsh migration. Most of those areas are not adjacent to conserved lands and some are identified as having development potential based on current zoning requirements (minimum lot size).
- Drought is becoming a hazard of increasing concern, particularly in the more rural regions where there could be negative impacts to private wells and agriculture, and could lead to increased wildfire risk.
- Compounding climate change vulnerabilities will impact all areas of life, including public health, natural areas, the local economy, municipal fiscal health, and community well-being.

Social Vulnerability

The impact of climate change will not be felt evenly across the community and will not be uniformly distributed among population groups. Individuals who already have increased social vulnerability will be disproportionately affected by climate hazards, as they generally have lower capacity to prepare for, respond

to, and recover from hazard events and disruptions. Demographic information can help determine local populations' adaptive capacity, or the ability to adapt and respond to a disaster.

Age can be correlated with decreased adaptive capacity, in the case of the very young, or older populations. Generally, families with children require more time and space to evacuate, and people who are 17 or younger are more dependent on family or other networks than other age brackets. Some people who are 65 and older may also be dependent on family, friends, or organizations, and may face challenges anticipating the event or finding information on how and when to evacuate or adapt. The unique physical and psychosocial challenges of the population ages 65 and over may impact their ability to prepare for, respond to, and recover from storms events.[1]

Maine is known to be one of the least diverse states in the country and demographic data collected from the 2021 American Community Survey supports that statistic. This highlights the need to pay specific attention to the minority populations that do live throughout the state, who may have cultural or language barriers to accessing information, resources, or accommodations. Gaps in resources, and access to those resources, leave many minority groups vulnerable to exclusion from adaptation based on economic factors.[2]

The coastal York County towns are among the wealthiest in the state, but they are not without low-moderate income households. Income is a significant indicator of social vulnerability with respect to natural hazards such as flooding. Households with lower income levels generally have a lower adaptive capacity to respond and adapt to natural hazards since someone with limited or no disposable income would have fewer resources to pay for evacuation, transportation, accommodation, and repair activities.

The following demographic information summarizes indicators of social vulnerability and adaptive capacity at the community level and US Census-designated block group level, which is the smallest geographic unit at which this demographic data is available. Information about the community's social vulnerability will be supplemented and contextualized with information gathered from the Task Force and community members through engagement approaches.

Demographic Profile

Table 1 outlines 17 demographic indicators of social vulnerability at the community-wide and block group levels, which align closely with those used for the Maine Social Vulnerability Index.[3] These data are from the 2021 American Community Survey (ACS), which is conducted by the U.S. Census Bureau. The 2021 ACS is the most current demographic data available because the results of the 2020 Decennial Census have not been released yet. Block groups are the smallest geographic unit for which the U.S. Census provides demographic data. Block groups are delineated based on population and contain between 600 to 3,000 people. There are a total of 13 block groups in Saco (Map 1).

The ACS is conducted annually on an ongoing basis throughout the year to collect information about the changing socioeconomic characteristics of communities. Unlike the Decennial Census which surveys every household, the ACS only surveys a portion of households in the community and uses the results to estimate demographic characteristics across the community. In small communities, like many of those along the coast of Maine, that accuracy of ACS estimates may be imperfect due to the small sample size. In larger communities the estimates tend to be more accurate because the sample size is more statistically robust. The

[1] EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. U.S. Environmental Protection Agency, EPA 430-R-21-003. www.epa.gov/cira/social-vulnerability-report
[2] EPA. 2021. Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts. U.S. Environmental Protection Agency, EPA 430-R-21-003. www.epa.gov/cira/social-vulnerability-report
[3] Johnson et al., 2018, A lifeline and social vulnerability analysis of sea level rise impacts on rural coastal communities

ACS also surveys seasonal residents which can make it difficult to understand the characteristics of the year-round population in seasonal communities. The Task Force can use the 17 demographic indicators to begin thinking about which parts of the community may be more socially vulnerable to the impacts of climate change. However, qualitative anecdotal information from the Task Force and City staff can improve the accuracy of this information.[4]

Demographic data are presented at the population and household level. The U.S. Census Bureau defines a household as a group of people who live within the same housing unit regardless of whether or not they are related. A housing unit is a room or group of rooms that is designed to be separate living quarters such as a house, apartment, or condo.[5]

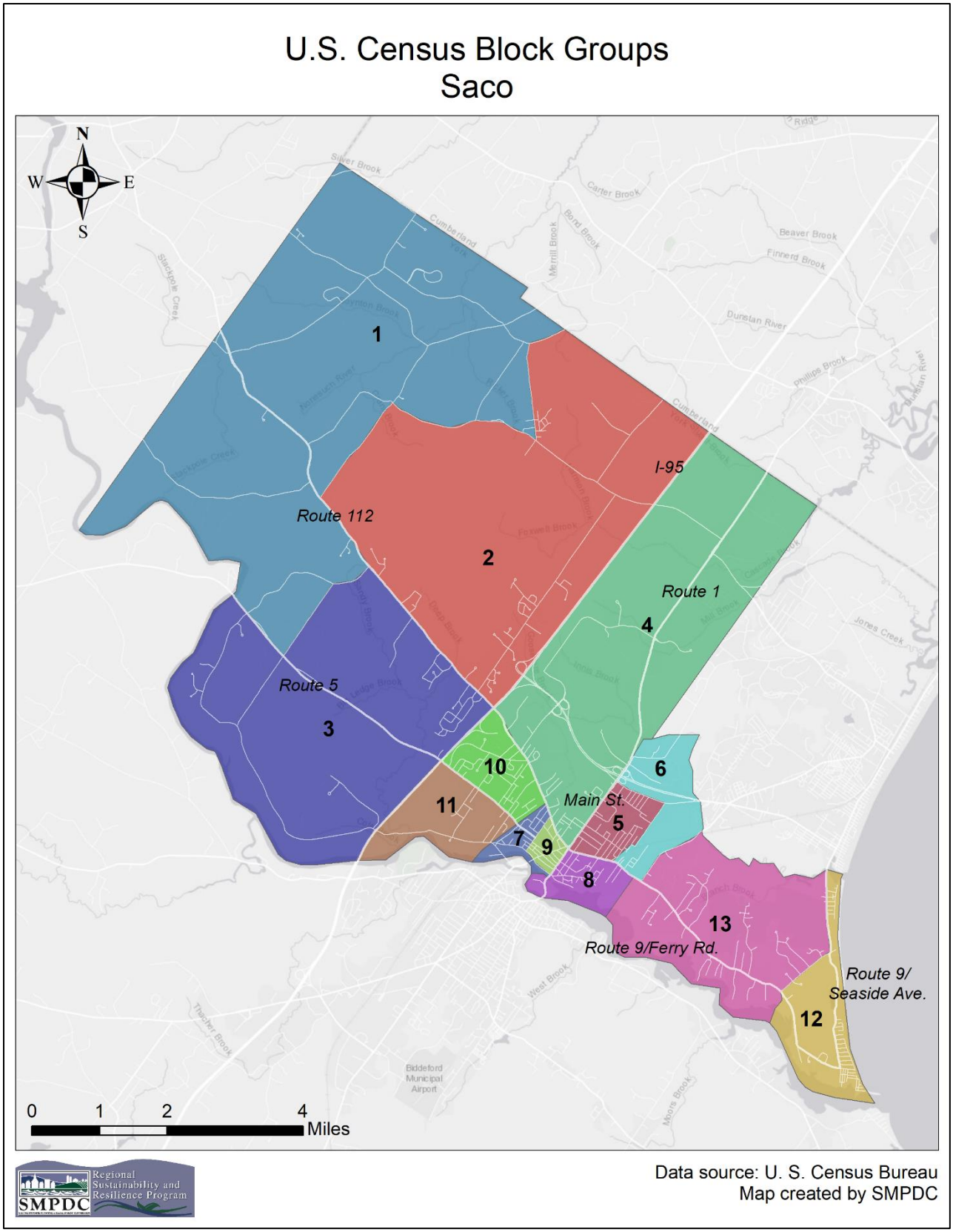
There are three income thresholds referenced in Table 1. These thresholds were selected because they approximate the US EPA climate change and social vulnerability income threshold ($51,500), the 2021 State median income ($64,767), and the 2021 York County median income ($73,856).

Key Takeaways

- Downtown Saco (block groups 8 and 9) is the most socially vulnerable area based on the 17 demographic indicators.
- The neighborhoods on Factory Island and around Pepperell Park (block group 8) have the highest percentage of the population and households within the block group that are 17 years old or younger, unemployed, are below the EPA climate change and social vulnerability income threshold, are below the County and State median incomes, have no internet, are living alone, and are 65 plus and living alone. An elevated percentage of the population and households within these neighborhoods have no high school diploma, have one or more persons with a disability, are below the national poverty level, and have no vehicle compared to the rest of the community.
- The neighborhood around Saco City Hall (block group 9) has the highest percentage of the population and households within the block group that speak English less than well, have one or more persons with a disability, are below the national poverty level, and have no vehicle. An elevated percentage of the population and households within this neighborhood are a minority, are below the EPA climate change and social vulnerability income threshold, are below the County and State median incomes, and are living alone compared to the rest of the community.
- The northeastern portion of the City, bounded by I-95 and Route 112 (block group 4), has the highest percentage of the population and households within the block group that are a minority, and have no high school diploma. An elevated percentage of the population and households within this neighborhood speak English less than well.
- Across the community 22% of the population is 17 years old or younger, 23% of households have at least one person with a disability, and 33% of households are below the EPA climate change and social vulnerability income threshold.

[4] Johnson et al., 2018, A lifeline and social vulnerability analysis of sea level rise impacts on rural coastal communities

[5] U.S. Census Bureau, Subject Definitions: https://www.census.gov/programs-surveys/cps/technical-documentation/subject-definitions.html#household



Map 1 Census block groups in Saco. Data source: U.S. Census Bureau 2021 American Community Survey

Table 1 Demographic Profile Summary Table. Data source: U.S. Census Bureau 2021 American Community Survey

	Community wide	Block Groups												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Total Population	13,416	1,402	1,999	1,927	2,292	2,321	797	1,171	1,507	874	2,382	687	826	2,018
Total Households	5,701	514	777	649	1,030	1,100	282	602	747	425	1,046	298	335	826
Age <18	2,917	318	504	457	459	496	219	56	408	146	363	114	208	310
% total population	22%	23%	25%	24%	20%	21%	27%	5%	27%	17%	15%	17%	25%	15%
Age 65+	1,967	202	260	257	466	305	70	113	294	96	354	95	116	686
% total population	15%	14%	13%	13%	20%	13%	9%	10%	20%	11%	15%	14%	14%	34%
Minority	1,574	137	80	9	627	391	103	152	75	145	186	47	6	58
% total population	12%	10%	4%	0%	27%	17%	13%	13%	5%	17%	8%	7%	1%	3%
Speaks English "Less than well"	119	1	0	12	95	11	0	0	0	49	0	0	0	22
% population age 5+	1%	0%	0%	1%	4.3%	0%	0%	0%	0.0%	6%	0%	0%	0.0%	1%
No HS Diploma	680	29	24	43	322	51	18	60	133	32	56	13	0	33
% population age 25+	7%	3%	2%	3%	18%	3%	3%	6%	12%	5%	3%	2%	0%	2%
1+ Persons with a Disability	1,313	107	182	127	315	191	32	87	272	175	273	63	116	236
% households	23%	21%	23%	20%	31%	17%	11%	14%	36%	41%	26%	21%	35%	29%
Below Poverty Level	645	17	85	0	108	230	16	39	150	144	72	0	11	69
% households	11%	3%	11%	0%	10%	21%	6%	6%	20%	34%	7%	0%	3%	8%
Unemployment	224	60	0	10	14	62	0	0	78	20	12	13	0	17
% population age 16+	2%	5%	0%	1%	1%	3%	0%	0%	7%	3%	1%	2%	0%	1%
Income <$50k	1,868	117	301	92	298	427	42	230	361	201	270	89	85	178
% households	33%	23%	39%	14%	29%	39%	15%	38%	48%	47%	26%	30%	25%	22%
Income <$60k	2,331	152	335	116	391	476	79	297	485	286	428	102	100	213
% households	41%	30%	43%	18%	38%	43%	28%	49%	65%	67%	41%	34%	30%	26%
Income <$75k	3,045	185	406	195	540	628	79	335	677	317	565	152	100	257
% households	53%	36%	52%	30%	52%	57%	28%	56%	91%	75%	54%	51%	30%	31%
No Internet	413	0	36	16	96	80	0	33	152	19	0	0	8	61
% households	7%	0%	5%	2%	9%	7%	0%	5%	20%	4%	0%	0%	2%	7%
No Vehicle	191	0	7	0	66	15	0	0	103	76	0	0	8	112
% households	3%	0%	1%	0%	6%	1%	0%	0%	14%	18%	0%	0%	2%	14%
Single Parent	675	53	63	27	57	312	33	51	79	52	91	15	0	19
% households	12%	10%	8%	4%	6%	28%	12%	8%	11%	12%	9%	5%	0%	2%
Living Alone	1,394	81	195	69	279	277	17	131	345	190	436	84	76	254
% total population	10%	16%	25%	11%	27%	25%	6%	22%	46%	45%	42%	28%	23%	31%
65+ Living Alone	600	13	61	26	129	170	17	0	184	36	28	24	39	205
% total population	4%	1%	3%	1%	6%	7%	2%	0%	12%	4%	1%	3%	5%	10%

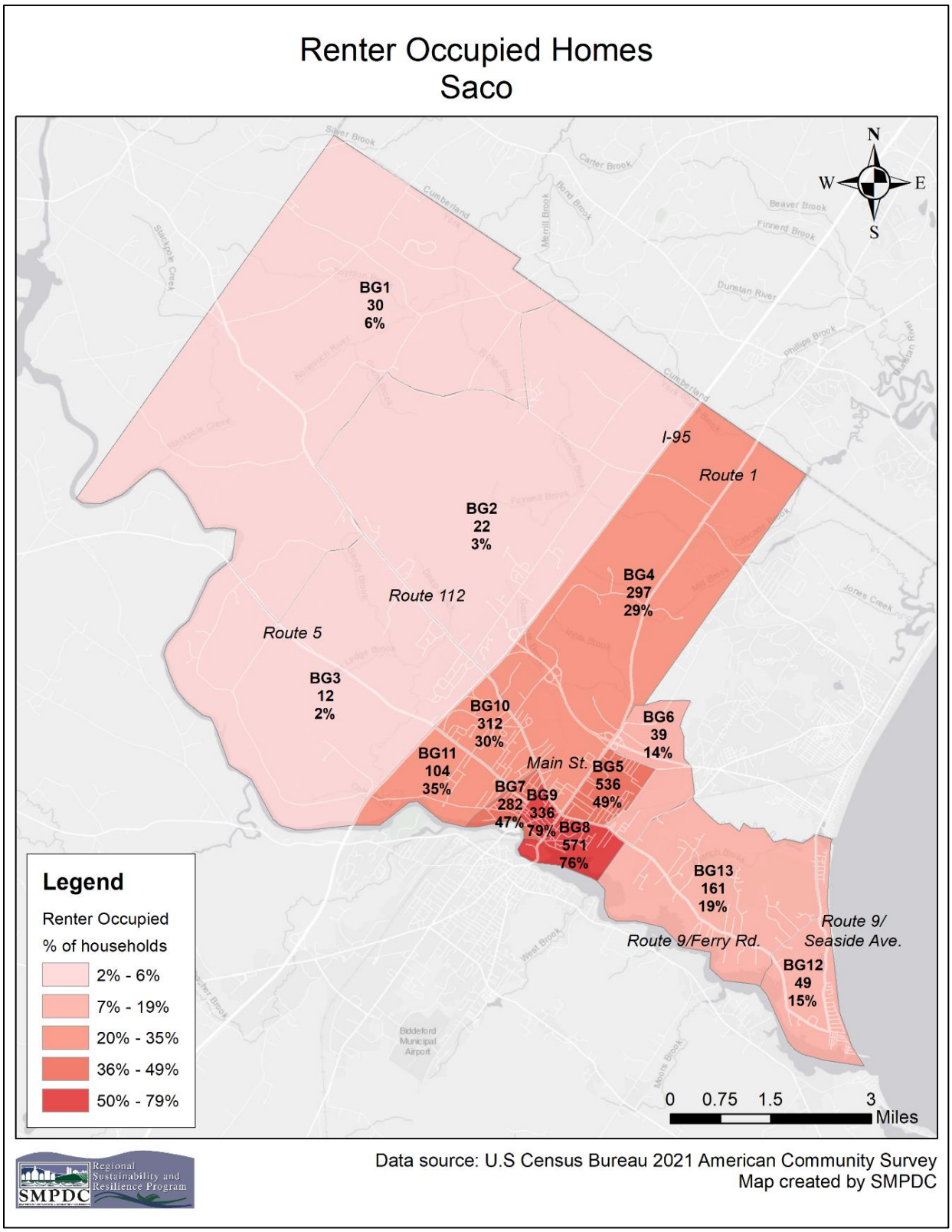
SUPPLEMENTAL COMMUNITY INFORMATION

Housing Characteristics

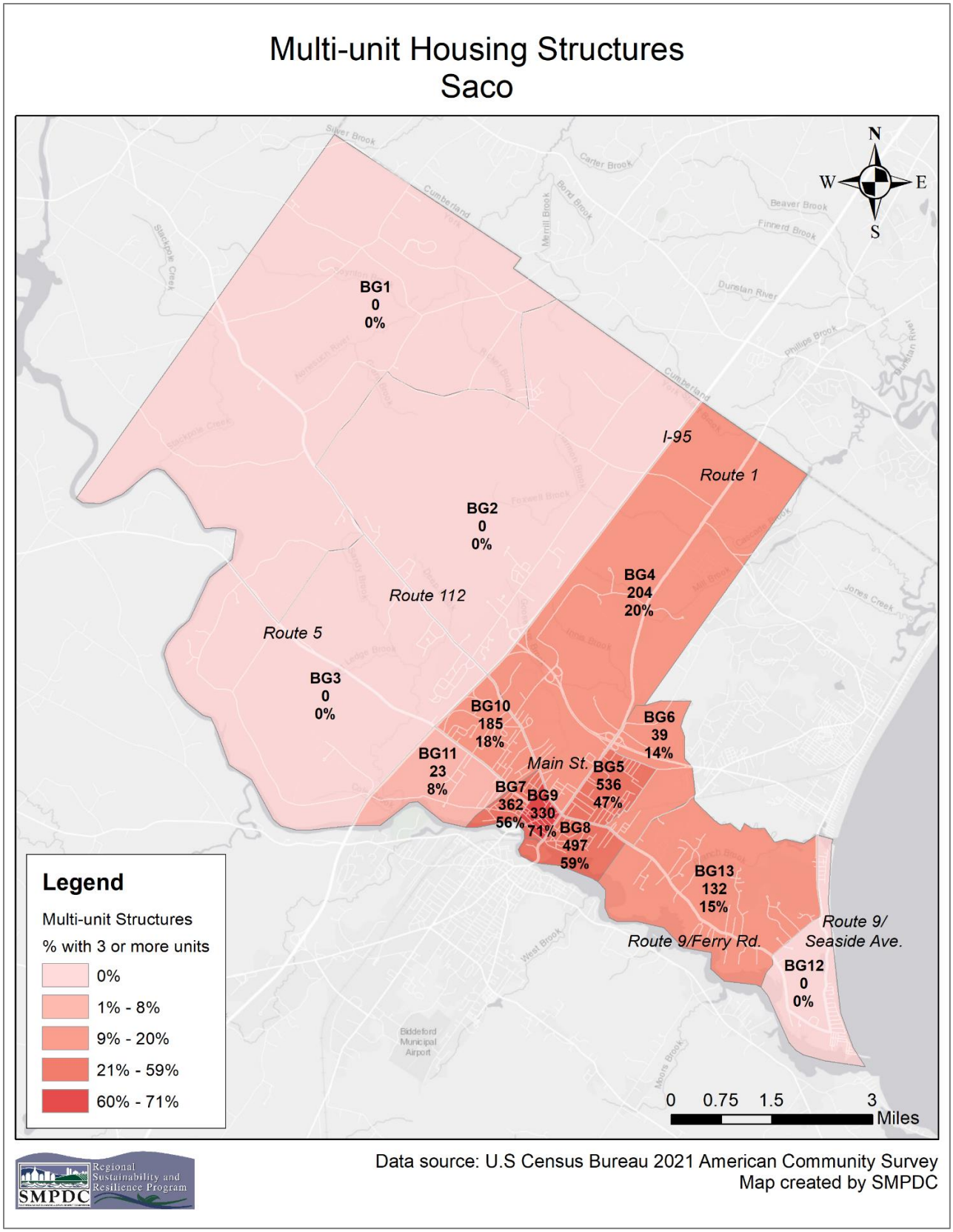
Map 2, Map 3, and Table 2 show data about housing characteristics including multi-unit housing structures, mobile homes, and renter occupied homes. Renter occupied households, multi-unit homes, and mobile homes are associated with elevated social vulnerability and/or reduced adaptive capacity. For example, renters and multi-unit households generally have less adaptive capacity than single family homeowners because they tend to have lower incomes/financial resources and have less ability to make property improvements. Additionally, multi-unit households are often occupied by renters, and landlords have little incentive to improve energy efficiency because energy costs are borne by tenants. Mobile homes have a higher energy cost per square foot than site-built homes and are generally more vulnerable to the impacts of climate hazards. Rented, multi-unit, and mobiles homes also tend to be associated with socially vulnerable populations. Data are from the 2021 American Community Survey (see Demographic Profile for a description of ACS data).

Key Takeaways

- Community-wide, 12% of households are renter occupied.
    - The neighborhood around Saco City Hall (block group 9) has the highest percentage of households within the block group that are renter occupied at 79%, followed by the neighborhoods around Pepperell Park and Factory Island (block group 8) at 76%. These areas also have elevated social vulnerability.
    - The neighborhoods west of I-95 (block groups 1-3) have the lowest percentage of households within the block group that are renter occupied ranging from 2% to 6%.
- Community-wide, 7% of Saco's housing stock is multi-unit (3 or more units).
    - The neighborhood around Saco City Hall (block group 9) has the highest percentage of housing structures within the block group that are multi-unit at 71%, followed by the surrounding downtown neighborhoods around Pepperell Park and Factory Island (block group 8) at 59%, and the Saco Valley Shopping Center (block group 7) at 56%. These areas also have elevated social vulnerability.
    - There are zero multi-unit housing structures west of I-95 (block groups 1-3)
- Community-wide, mobile homes account for 11% of Saco's housing stock.
    - The northeastern portion of the City, bounded by I-95 and Route 112 (block group 4), has the highest percentage of mobile homes within the block group. There are 277 mobile homes in this area representing 27% of the block group's housing stock, and 87% of all mobile homes in Saco.



Map 2 Breakdown of renter occupied households in Saco by block group. Households do not include vacant housing units, so this data is representative of occupied housing units in Saco. The block group is labeled (BG#) as well as the total number of renter-occupied households in the block group and the percent of renter-occupied households within the block group. Data source: U.S. Census Bureau 2021 American Community Survey



Map 3 Breakdown of multi-unit (3 or more units) housing stock in Saco by block group. Housing units include occupied households as well as vacant units and represent the total housing stock in Saco. The block group is labeled (BG#) as well as the total number of multi-unit housing structures in the block group and the percent of total housing units within the block group that are multi-unit. Data source: U.S. Census Bureau 2021 American Community Survey

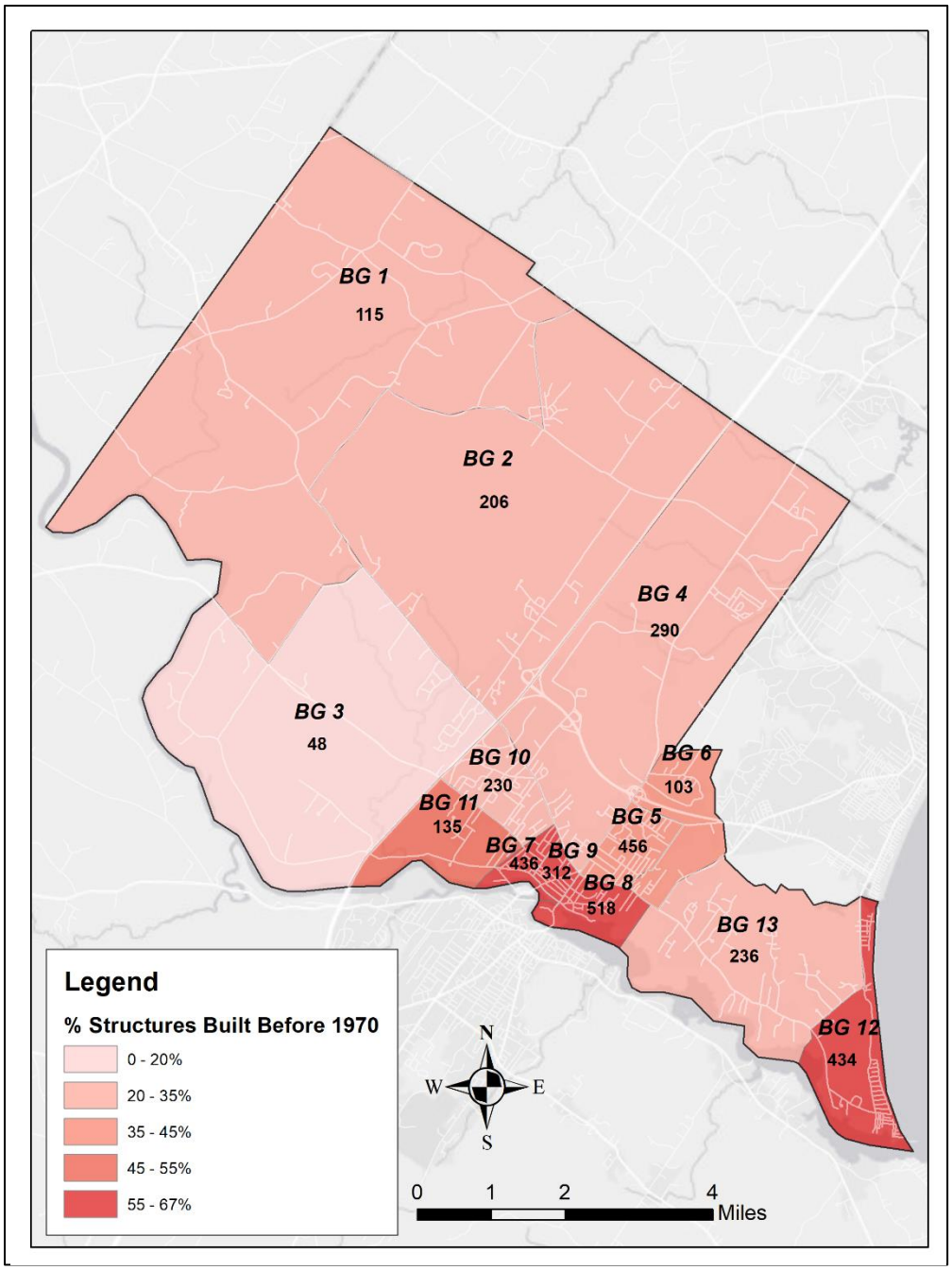
Table 2 Community-wide and block group level housing characteristics in Saco. Housing units include occupied households as well as vacant units and represent the total housing stock in Saco. Households do not include vacant housing units, so are representative of occupied housing units in Saco. Data source: U.S. Census Bureau 2021 American Community Survey

	Community wide	Block Groups												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Total Housing Units	3,075	514	882	649	1,030	1,149	282	651	843	467	1,046	298	741	858
Total Households	2,970	514	777	649	1,030	1,100	282	602	747	425	1,046	298	335	826
Renter Occupied	361	30	22	12	297	536	39	282	571	336	312	104	49	161
% households	12%	6%	3%	2%	29%	49%	14%	47%	76%	79%	30%	35%	15%	19%
Multi-unit	204	0	0	0	204	536	39	362	497	330	185	23	0	132
% total with 3+ units	7%	0%	0%	0%	20%	47%	14%	56%	59%	71%	18%	8%	0%	15%
Mobile Homes	317	34	6	0	277	51	0	0	0	0	12	0	0	0
% total units	11%	7%	1%	0%	27%	4%	0%	0%	0%	0%	1%	0%	0%	0%

Age of Buildings

Maine has one of the oldest housing stocks in the country. Older buildings tend to be less energy efficient, which is especially problematic during the winter and summer months when outdoor temperatures are at their extremes. Further, houses constructed before 1970 were built prior to the adoption of modern building codes and significant federal and state/local risk-reduction policies (National Flood Insurance Program (1968), Maine Shoreland Zoning (1971)). Older buildings are ideal targets for weatherization, energy efficiency upgrades, and resilience retrofits.

Map 4 shows the percentage of structures, at the block group level, built before 1970. In Saco, areas with the highest concentration of buildings constructed before 1970 are in the downtown area and along the coastline. These areas also have elevated social vulnerability based on demographic characteristics and are vulnerable to hazards, including coastal and riverine flooding, sea level rise, and urban heat islands. The concentration of older buildings in flood prone areas means that it is likely those structures are not built to modern codes and are not elevated above projected future flood levels, or even current flood levels.



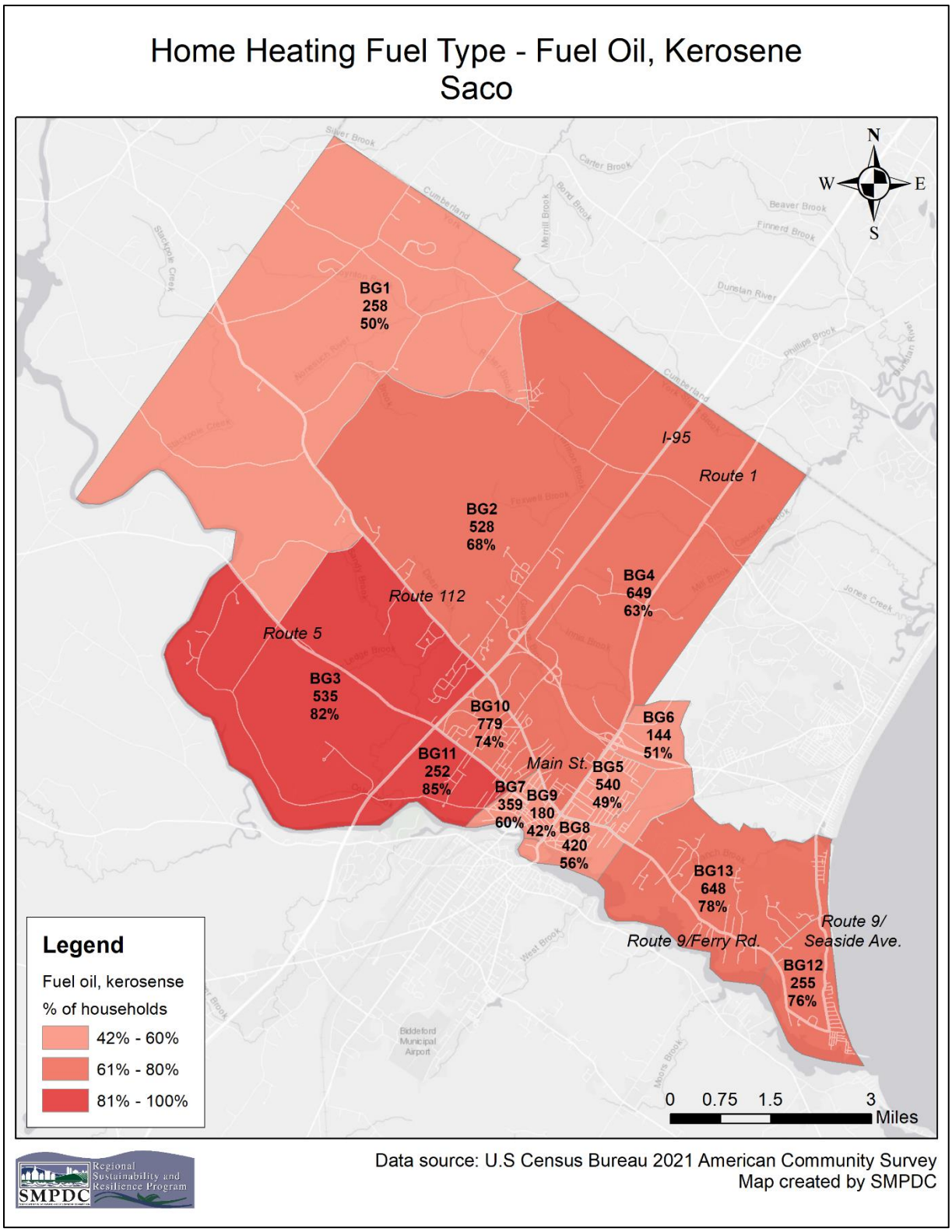
Map 4 Percent and actual number of structures built before 1970 presented at the block group level. The block groups are color-coded by the percentage of structures built before 1970 and are labelled with the block group and corresponding number of structures built before 1970. (Data source: year structures built: US Census American Community Survey; building footprints: Microsoft)

Household Heating Fuel Types

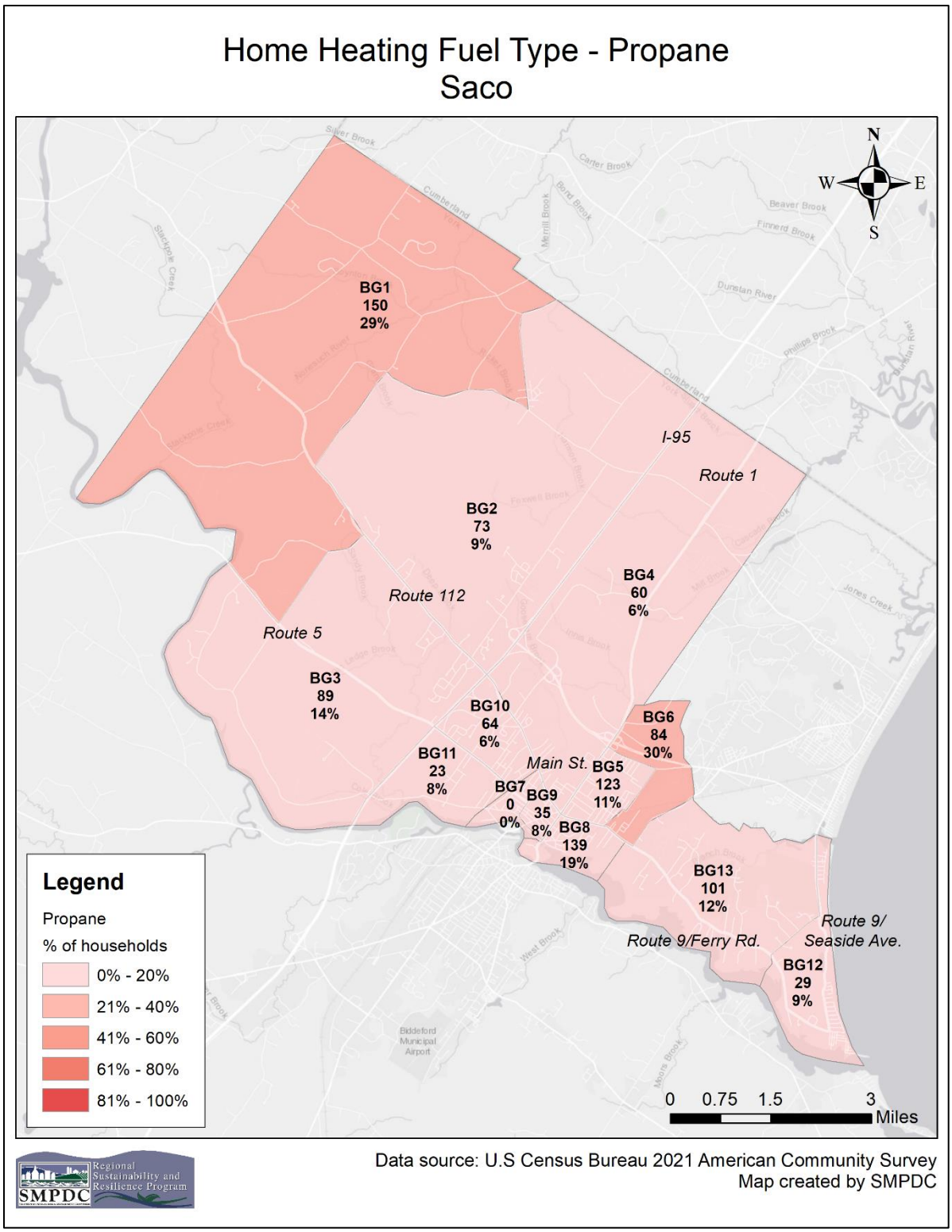
Household heating fuel data is from the 2021 American Community Survey. This section includes fuel oil, kerosene, propane, natural gas, and electricity used as households' primary heating sources. Understanding heating fuel trends is important for evaluating the potential impacts of electrifying the heating sector to reduce greenhouse gas emissions. Electrification must be paired with electricity grid resilience measures to ensure that the grid can withstand increased electricity consumption as well as climate hazards such as flooding, high winds, high temperatures, and wildfires (see Extreme Storms & Precipitation: Power Outages for more information about these impacts). Map 5, Map 6, Map 7, Map 8, and Table 3 show data about primary household heating fuel types, which provides context about where fossil fuels are used most heavily and where electrified heating is more common. Data are from the 2021 American Community Survey (see Demographic Profile for a description of ACS data).

Key Takeaways

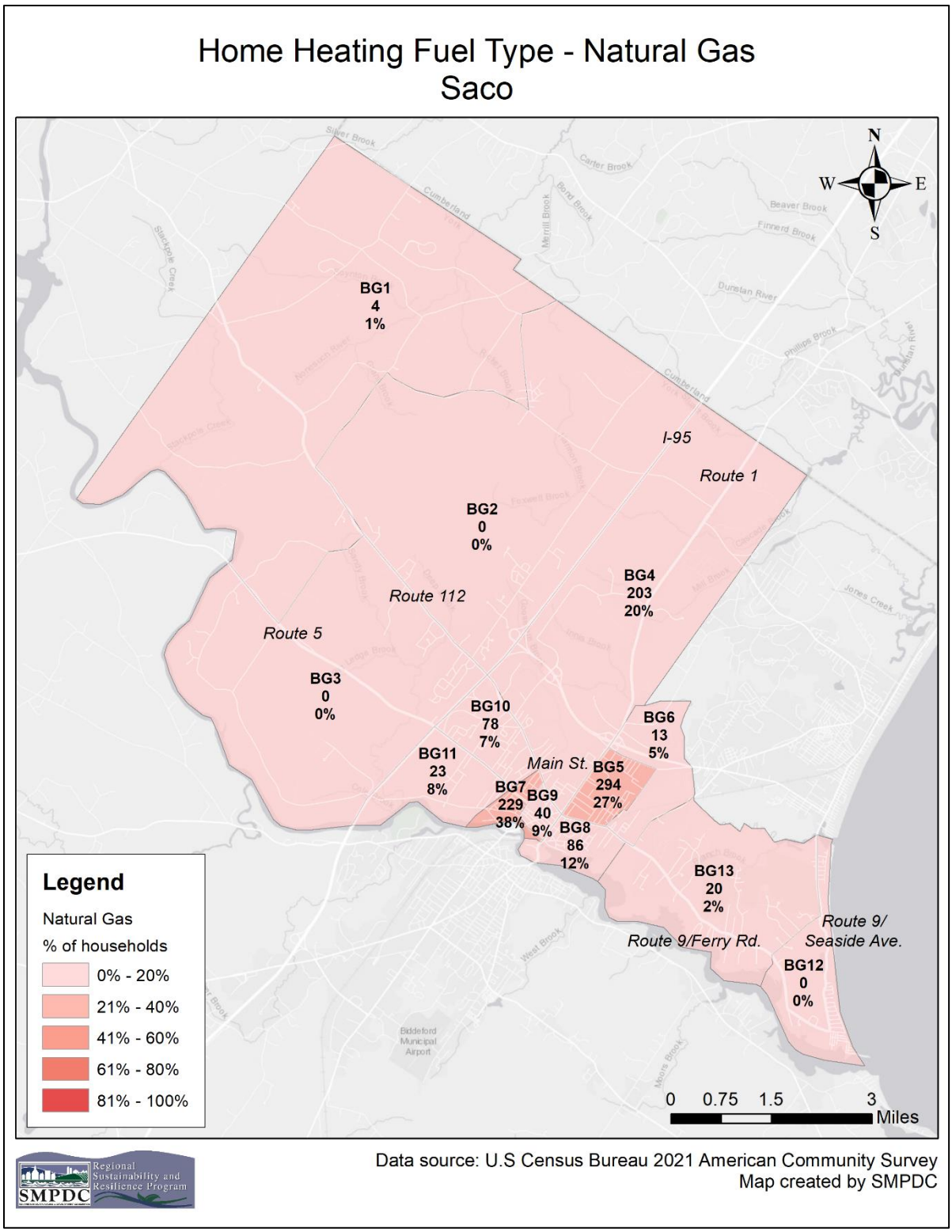
- Community-wide, the majority (66%) of households in Saco use fuel oil or kerosene to heat their homes.
    - The neighborhoods in the southwestern portion of Saco along the Saco River and surrounding the Deep Brook Golf Course and Saco Transfer Station (block groups 3 and 11) have the highest percentage of households within the block group that heat with fuel oil or kerosene, ranging from 82% to 85% of households.
    - The neighborhoods along Route 9 and the shore (block groups 12 and 13) have an elevated percentage of households within the block group that heat with fuel oil or kerosene compared to the rest of the community, ranging from 76% to 78% of households.
    - The neighborhood around Saco City Hall (block group 9) has the lowest percentage (42%) of households within the block group that heat with fuel oil or kerosene. This is also an area of elevated social vulnerability and has the highest percentage of multi-unit and renter occupied homes within the block group.
- Community-wide, 13% of households in Saco use propane to heat their homes.
    - The northwestern portion of Saco bordering Buxton (block group 1) and the neighborhood along Goosefare Brook bordering Old Orchard Beach (block group 6) have the highest percentage of households within the block group that heat with propane.
    - The neighborhood around the Saco Valley Shopping Center (block group 7) is the only area where there is no propane usage. This area also has an elevated percentage of multi-unit housing structures within the block group.
- Community-wide, 7% of households in Saco use natural gas to heat their homes.
    - The neighborhood around the Saco Valley Shopping Center (block group 7) has the highest percentage (38%) of households within the block group that heat with natural gas. This area also has an elevated percentage of multi-unit housing structures within the block group.
    - The northeastern portion of the City, bounded by I-95 and Route 112 (block group 4) and the neighborhood east of Main Street (block group 5) have an elevated percentage of households within the block group that heat with natural gas compared to the rest of the community, ranging from 20% to 27%.
- Community-wide, 7% of households in Saco use electricity to heat their homes.
    - The neighborhood around Saco City Hall (block group 9) has the highest percentage (38%) of households within the block group that heat with electricity. This is also an area of elevated social vulnerability and has the highest percentage of multi-unit and renter occupied homes within the block group. The neighborhood along the Saco River east of I-95 (block group 11) is the only area where no households heat with electricity. This is also the area with the highest percentage of households within the block group that heat with fuel oil or kerosene.



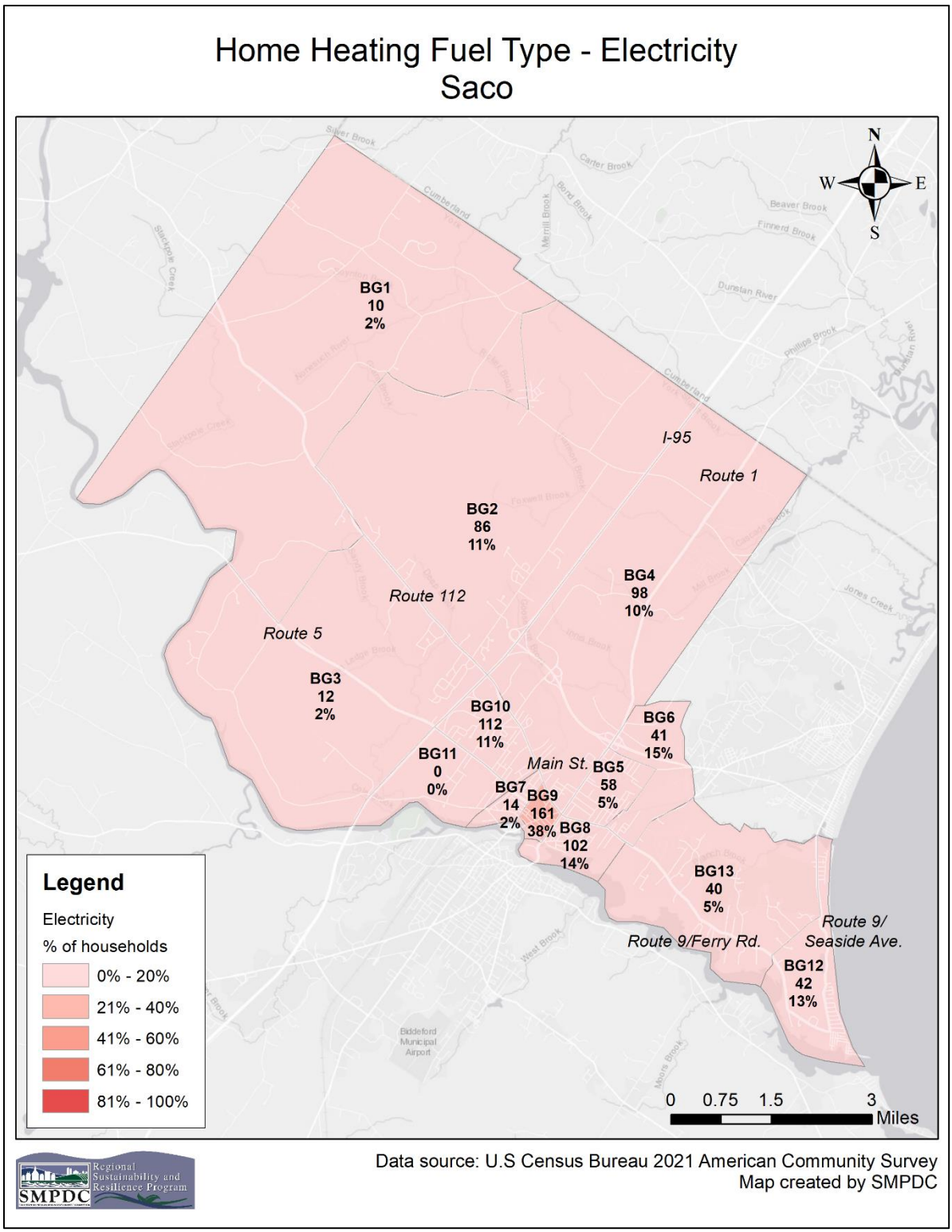
Map 5 Breakdown of households in Saco that use fuel oil or kerosene for heating by block group. Households do not include vacant housing units, so this data is representative of occupied housing units in Saco. The block group is labeled (BG#) as well as the total number of households and the percent of households within the block group that heat with fuel oil or kerosene. Data source: U.S. Census Bureau 2021 American Community Survey



Map 6 Breakdown of households in Saco that use propane for heating by block group. Households do not include vacant housing units, so this data is representative of occupied housing units in Saco. The block group is labeled (BG#) as well as the total number of households and the percent of households within the block group that heat with propane. Data source: U.S. Census Bureau 2021 American Community Survey



Map 7. Breakdown of households in Saco that use natural gas for heating by block group. Households do not include vacant housing units, so this data is representative of occupied housing units in Saco. The block group is labeled (BG#) as well as the total number of households and the percent of households within the block group that heat with natural gas. Data source: U.S. Census Bureau 2021 American Community Survey



Map 8 Breakdown of households in Saco that use electricity for heating by block group. Households do not include vacant housing units, so this data is representative of occupied housing units in Saco. The block group is labeled (BG#) as well as the total number of households and the percent of households within the block group that use electricity for heating. Data source: U.S. Census Bureau 2021 American Community Survey

Table 3 Community wide and block group level household heating fuel types in Saco. Households do not include vacant housing units, so this data is representative of occupied housing units in Saco. Data source: U.S. Census Bureau 2021 American Community Survey

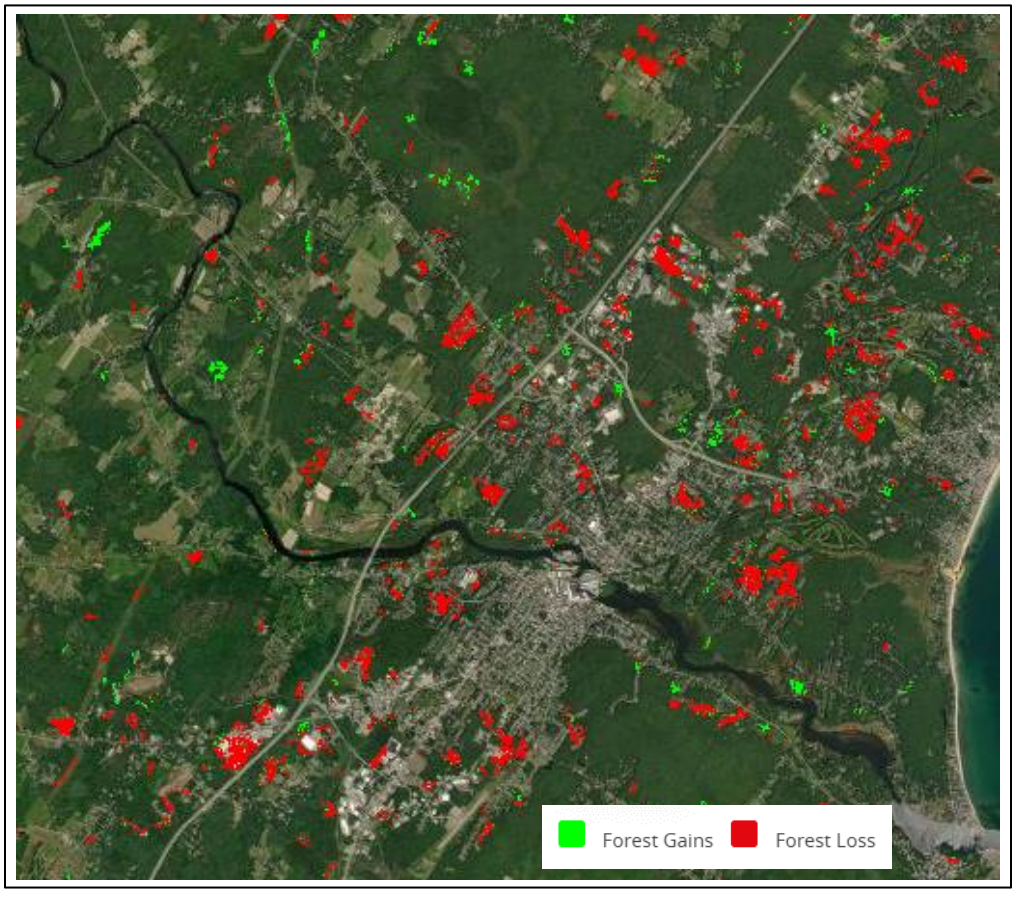
	Community wide	Block Groups												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Total Households	2,970	514	777	649	1,030	1,100	282	602	747	425	1,046	298	335	826
Fuel oil, kerosene	1,970	258	528	535	649	540	144	359	420	180	779	252	255	648
% households	66%	50%	68%	82%	63%	49%	51%	60%	56%	42%	74%	85%	76%	78%
Propane	372	150	73	89	60	123	84	0	139	35	64	23	29	101
% households	13%	29%	9%	14%	6%	11%	30%	0%	19%	8%	6%	8%	9%	12%
Natural gas	207	4	0	0	203	294	13	229	86	40	78	23	0	20
% households	7%	1%	0%	0%	20%	27%	5%	38%	12%	9%	7%	8%	0%	2%
Electricity	206	10	86	12	98	58	41	14	102	161	112	0	42	40
% households	7%	2%	11%	2%	10%	5%	15%	2%	14%	38%	11%	0%	13%	5%

Zoning

Local zoning will impact where in the community (*i.e.* particular geographic areas) certain types of development-related climate mitigation and adaptation strategies would likely have more impact due to where different types of development are allowed and what the standards are for those types of development. The zoning map on the following page is provided for reference to show where areas zoned for commercial, industrial, and residential uses are located.

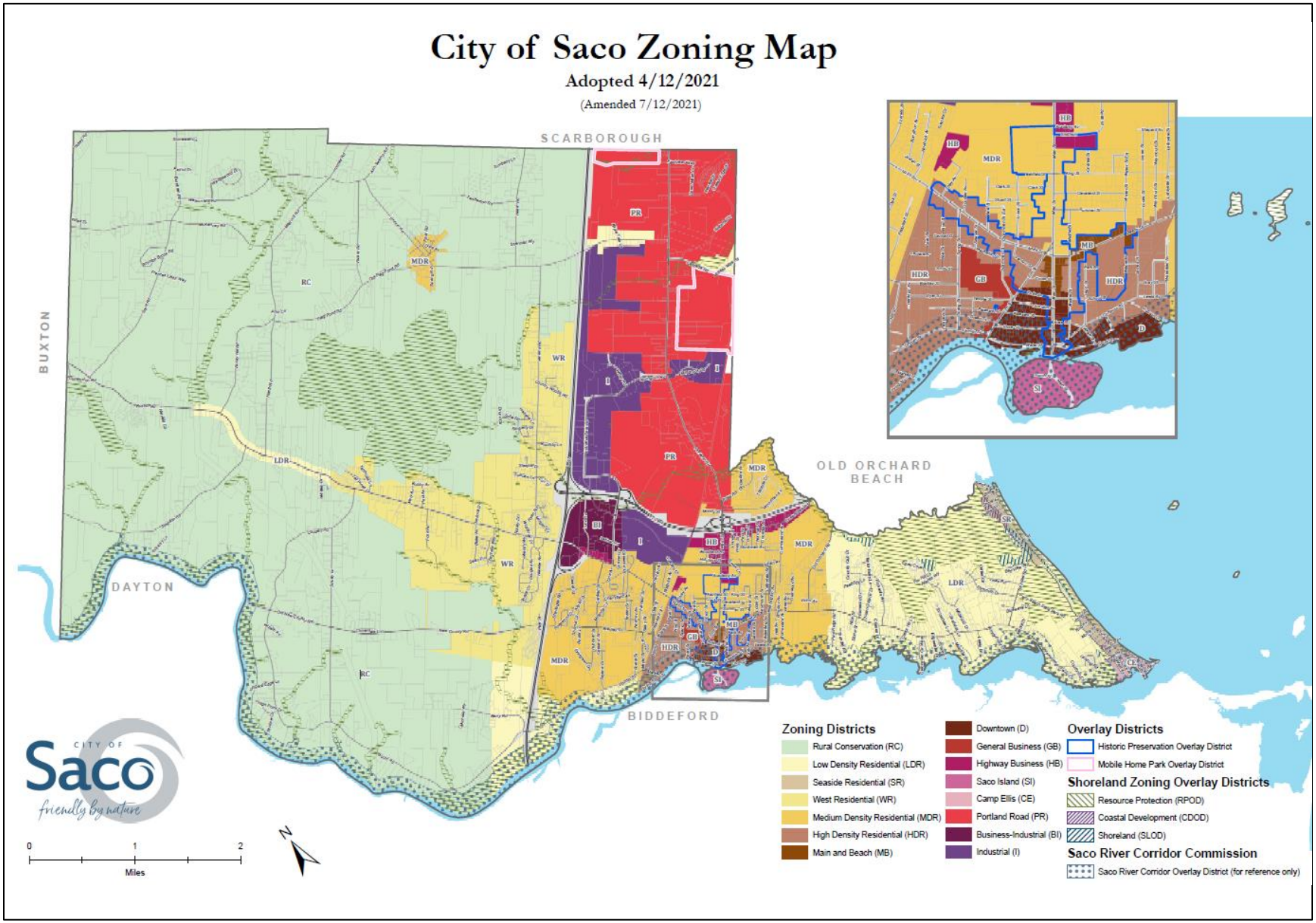
Land Cover and Carbon Sequestration

Forests, wetlands, and grasslands store high amounts of organic carbon. Coastal wetlands are among the largest natural carbon sinks of all terrestrial ecosystems, particularly on a per unit area basis. Undisturbed forest soils also store substantial amounts of carbon. Certain land use activities can enhance carbon storage, such as soil health and conservation practices, whereas others can be a source of carbon release [6]. In built environments, carbon is stored in trees, grassy areas, gardens, and in wooden structures and are increasingly important for reducing carbon in the atmosphere. Changes in land cover, such as conversion of forest to developed land, impacts not only the health of the natural environment, but the carbon sequestration potential of land. Map 9 shows the change in forested land coverage in Saco from 1996 to 2016. Overall, Saco has experienced more forest loss than gain, spread across various parts of the city.



Map 9 Changes in forested land cover from 1996 to 2016. Green areas indicate a transition of non-forested land to forested, while red areas indicate a transition from forested land to a different type of land cover (e.g., impervious, grassland, wetland, shrub-scrub habitat, etc.). Source: NOAA Coastal Change Analysis Program (C-CAP) Land Cover Atlas.

[6] State of Maine. 2022. Maine Soil Carbon Incentives Study Policy Recommendations.


City of Saco Zoning Map
Adopted 4/12/2021
(Amended 7/12/2021)
SCARBOROUGH
BUXTON
DAYTON
OLD ORCHARD BEACH
BIDDEFORD
CITY OF Saco
friendly by nature
0
1
2
Miles
N
Zoning Districts
Rural Conservation (RC)
Low Density Residential (LDR)
Seaside Residential (SR)
West Residential (WR)
Medium Density Residential (MDR)
High Density Residential (HDR)
Main and Beach (MB)
Downtown (D)
General Business (GB)
Highway Business (HB)
Saco Island (SI)
Camp Ellis (CE)
Portland Road (PR)
Business-Industrial (BI)
Industrial (I)
Overlay Districts
Historic Preservation Overlay District
Mobile Home Park Overlay District
Shoreland Zoning Overlay Districts
Resource Protection (RPOD)
Coastal Development (CDOD)
Shoreland (SLOD)
Saco River Corridor Commission
Saco River Corridor Overlay District (for reference only)

EXTREME STORMS AND PRECIPITATION

Key Takeaways

- Since 1895 annual precipitation in York County has increased 6.9 inches, and extreme precipitation events (greater than 2 inches in a day) have become more frequent. Future projections indicate that annual precipitation will likely continue to increase, and extreme precipitation events will become even more frequent.
    - Flooding events are the most common type of disaster in York County and the most destructive. In the last quarter century, flooding events have caused nearly $45 million in property damage across coastal York County, and coastal floods alone have caused about $22 million in property damage.
    - Downtown Saco and the corridors along I-95 and Route 1 are particularly vulnerable to flooding and stormwater overflow during extreme precipitation events because of a high degree of impervious surfaces. Downtown Saco is also an area of high social vulnerability in the community.
    - The shorefront from Kinney Shores to Camp Ellis also has a high degree of impervious surfaces and is more vulnerable to the combined flooding impacts of extreme precipitation and coastal flooding during severe storms.
    - Increases in extreme storms are likely to cause more frequent and longer duration power outages in Saco.

Background Info, Trends, & Projections

Storms and heavy rainfall are becoming more frequent and intense with climate change. From 1895 to 2022 total annual precipitation in York County increased 6.9 inches (Figure 2), which is slightly higher than the statewide trend of about 6 inches. Shifting weather patterns are causing more precipitation to fall as rain rather than snow,[7] and extreme precipitation events (greater than 2 inches in a day) are becoming even more frequent. Coastal communities like Saco are experiencing even more frequent extreme storms and precipitation events because of the influence of Atlantic storm tracks.[8] Hurricanes and tropical storms are tracking further northward and there is a high increase in the probability of lower category storms impacting the East Coast. A recent national study found that the Northeast is expected to see the largest increases in the annual probability of at least tropical storm wind conditions or higher, as hurricanes are expected to move further up the Atlantic coast in the future. This may have a significant impact on buildings not built to a code considering the wind speeds they will likely face over the next 30 years.[9]

[7] ME Climate Council, Scientific Assessment of Climate Change and Its Effects in Maine, 2020: http://climatecouncil.maine.gov/reports

[8] University of Maine, Maine's Climate Future, 2020: https://climatechange.umaine.edu/climate-matters/maines-climate-future/

[9] First Street Foundation. 2023. Embargoed: The 7th National Risk Assessment: Worsening Winds

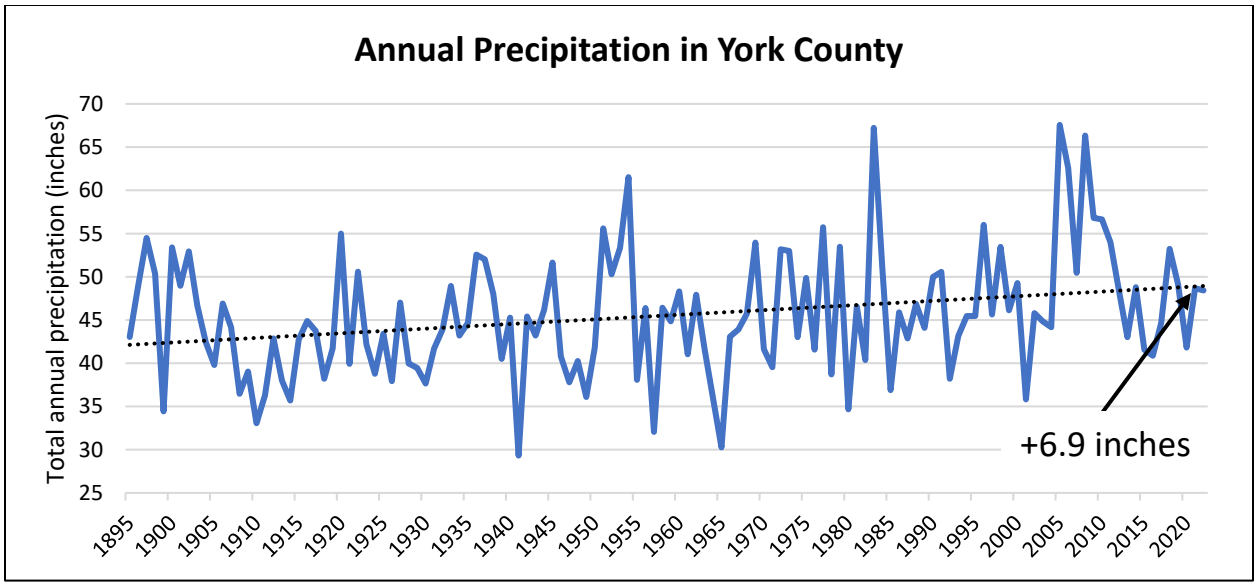


Figure 2 Total annual precipitation in York County from 1895 to 2022 based on monthly data from the NOAA National Centers for Environmental Information. Over this time period total annual precipitation increased by 6.9 inches.

Since 1970 there have been 34 federally declared disasters in York County related to storm events. Severe storms with heavy rains, strong winds, and coastal flooding have been the most common type of event and have occurred most frequently during the months of February and March followed by October.[10] NOAA maintains a database of all reported storm events, including storms that did not qualify for a disaster declaration. Since 1996, there have been a total of 361 storm events in coastal York County, and 122 events that caused significant property damage totaling about $54 million (Table 4). Flooding events, including coastal flooding, have caused nearly $45 million in damage across the region and coastal flooding events alone have caused approximately $22 million in damage.[11]

Table 4 Cumulative storm events and property damage in coastal York County from 1996 to 2022. Data source: NOAA Storm Events Database.

Storm Events in Coastal York Co. from 1996-2022		
Event Type	**Number**	**Property Damage**
Coastal Flood	58	$21,659,000
Flash Flood	8	$12,625,000
Flood	10	$10,653,500
Ice Storm	2	$7,930,000
High/Strong Wind	28	$537,500
High Surf	8	$229,000
Lightning	8	$145,000
TOTAL	**122**	**$53,779,000**

Recent notable storms include:

[10] FEMA Disaster Declarations Summary, as of 2022: https://www.fema.gov/openfema-data-page/disaster-declarations-summaries-v1

[11] NOAA Storm Events Database, as of 2022: https://www.ncdc.noaa.gov/stormevents/

- December 23rd Storm, 2022 – The highest water level recorded at the Portland tide gauge was 13.72 ft MLLW, the third highest ever recorded. Heavy rainfall, high winds, and storm surge caused extensive power outages, coastal flooding, and property damage along the coast of Maine. Governor Mills requested a disaster declaration in February 2023, but FEMA has not made a determination yet.
- Flash flood, October 2021 – (Federally declared disaster) Biddeford reported 6.7 inches of rain in a 6-hour period. A stone embankment supporting the RiverWalk near the Pepperell Mill on the Biddeford side of the Saco River was washed away during the storm causing millions of dollars in damage. It also caused widespread power outages and flooded roads. [12]
- Nor'easters, March 2018 – (Federally declared disaster) Two nor'easters, only days apart, brought heavy rainfall, high storm surge, and high winds which caused severe coastal flooding and damage.[13]
- Patriot's Day Storm, April 2007 – (Federally declared disaster) High wind, waves, and coastal flooding caused severe damage to roads, bridges, and wastewater treatment plants as well as private homes and businesses. Extensive power outages left residents without electricity for days. The most extensive damage occurred along coastline caused by flooding and storm surge.[14]
- Mother's Day Storm, May 2006 – Southern Maine received up to 16 inches of rain, exceeding precipitation amounts associated with the 100-year storm event and resulting in extensive flooding and damage.[15]

In the future, as sea level rises and storms become more frequent and intense, Saco can expect to see more damage from coastal flooding, high winds, and heavy rainfall. With 1.6 feet of sea level rise by 2050, it's estimated that cumulative damage costs caused by coastal flooding could be $16.9-$18.2 billion statewide.[16]

Historically, flooding has been the most common type of disaster in York County, particularly coastal flooding caused by nor'easters.[17] Storm tides cause extensive coastal flooding and occur when a storm surge coincides with an astronomical high tide. The highest water level recorded at the Portland tide gauge (the closest official NOAA tide gauge to Saco) occurred during the Blizzard of 1978 and exceeded 14 feet MLLW (Figure 3). The 2018 nor'easter and 2007 Patriot's Day Storm also caused storm tides within the top 20 water levels recorded at the Portland tide gauge. During the recent December 23rd storm (which is not included in Figure 3) a water level of 13.72 feet MLLW was recorded in Portland, about an inch lower than the 2018 nor'easter storm tide.[18]

[12] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management
[13] SMPDC, Economic Resilience Planning for Coastal York County, 2022: https://smpdc.org/coastal
[14] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management
[15] SMPDC, Tides, Taxes, and New Tactics, 2021: https://smpdc.org/coastal
[16] ME Climate Council, Assessing the Impacts Climate Change May Have on the State's Economy, Revenues, and Investment Decisions, Summary Report, 2020: http://climatecouncil.maine.gov/reports
[17] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management
[18] NOAA Tides and Currents https://tidesandcurrents.noaa.gov/waterlevels.html?id=8418150

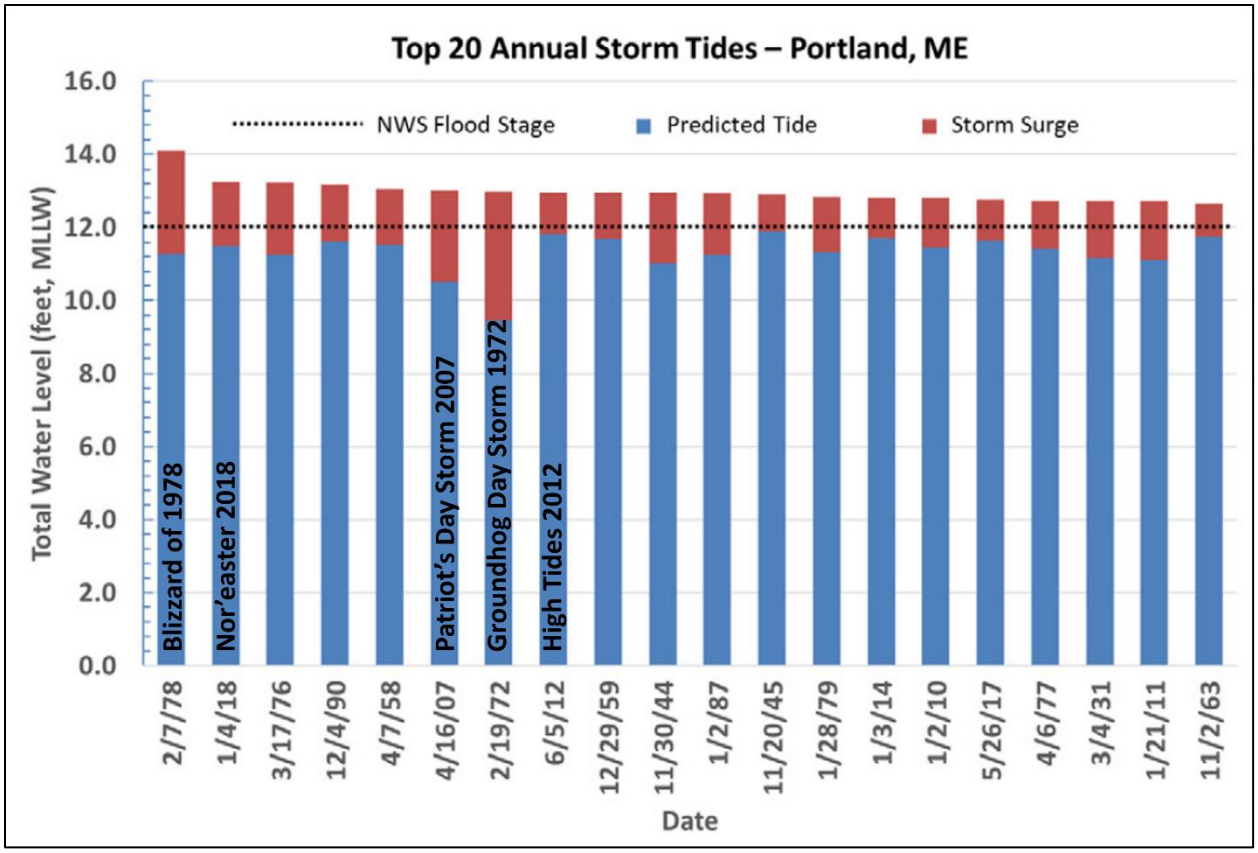


Figure 3 Major storm events and the top 20 storm tides recorded at the Portland tide gauge from 1912-2019. The National Weather Service Flood Stage of 12 feet MLLW is shown as a dashed line. This threshold indicates when elevated water levels begin to create a hazard to public safety, property, and infrastructure. Graph was created by Pete Slovinsky at the Maine Geological Survey for the ME Climate Council, Scientific Assessment of Climate Change and Its Effects in Maine, 2020.

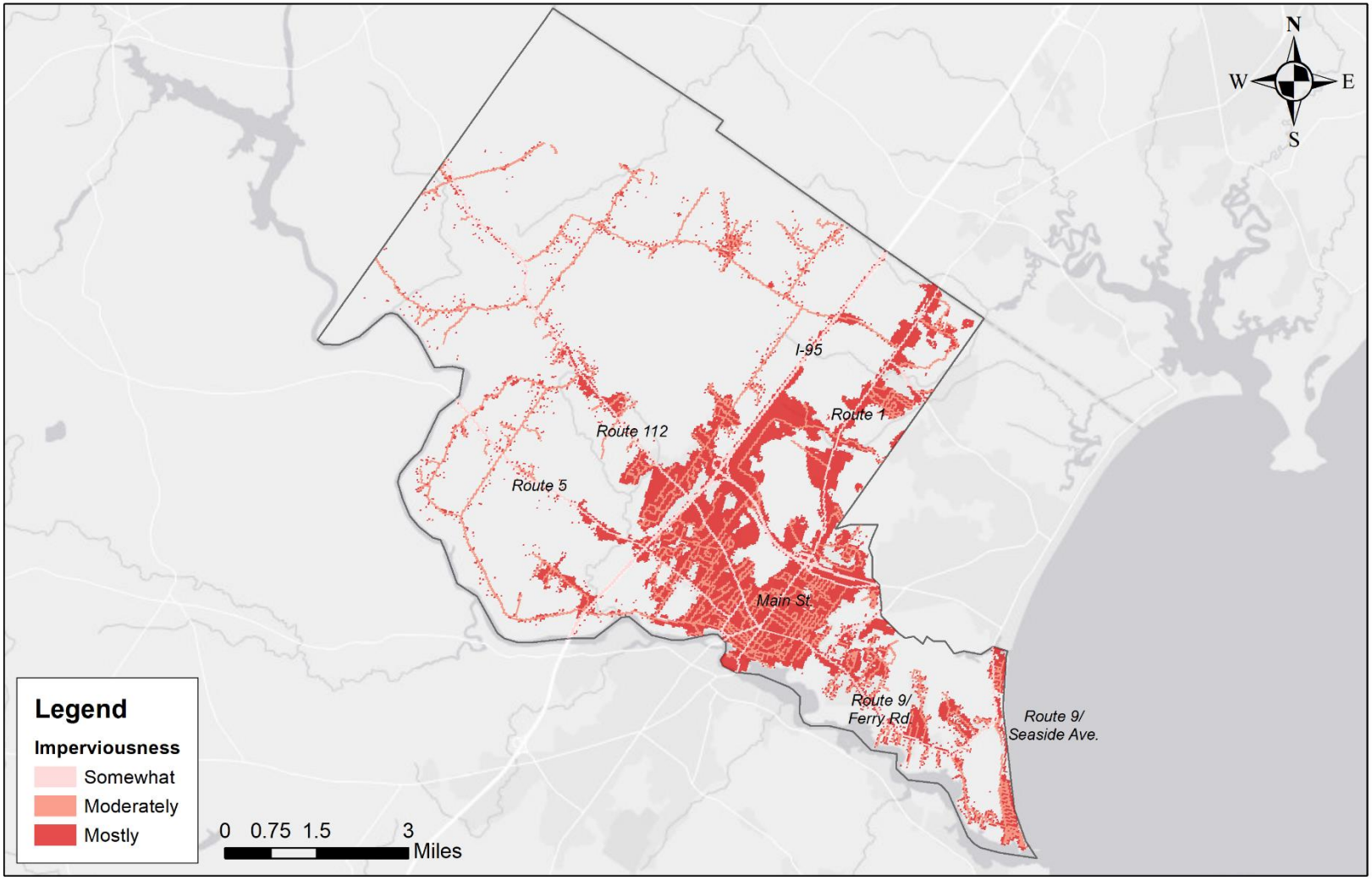
Intense storms and heavy precipitation can cause inland flooding along rivers and streams and exacerbate coastal flooding. Developed areas with lots of impervious surfaces such as roads, parking lots, sidewalks, and buildings experience more flooding during heavy rainfall because the water has nowhere to go. Stormwater systems can overflow because of limited capacity to handle high water volumes, causing runoff into lakes and rivers. Inland and urban flooding poses a threat to public safety, infrastructure, and property. Runoff also increases the risk of contaminated drinking water supplies and degraded water quality in coastal areas, making it unsafe to swim.[19]

Like coastal flooding, inland and urban flooding may occur during winter nor'easters, but also occur during summer and fall tropical storms or intense thunderstorms. Flash floods are historically uncommon in Maine, but in October 2021 a flash flood dropped 6.7 inches of rain on Biddeford in 6 hours. It caused extensive damage, especially along the developed areas of the Saco River. Inland flooding is difficult to predict but changing weather patterns and more frequent and intense hurricanes in the southern U.S. have the potential to cause more inland and urban flood events in coastal communities like Saco. [20]

[19] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management
[20] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management

Saco's proximity to the Saco River and its tributaries increases the community's risk of inland flooding. Furthermore, Saco's downtown is highly impervious as are the corridors along I-95 and Route 1 (Map 10). The shorefront from Kinney Shores to Camp Ellis also has a high degree of impervious surfaces. There is an elevated risk of flooding from extreme precipitation and stormwater overflow in Saco's downtown and developed areas. Along the shorefront, heavy rainfall coupled with a high degree of impervious surfaces can exacerbate the impacts of coastal flooding. In the future, with more intense storms and extreme precipitation events these areas will be at an even higher risk of flooding.

Impervious Surfaces
Saco



Regional Sustainability and Resilience Program
SMPDC

Data source: National Landcover Dataset (2019)
Map created by SMPDC

Map 10 Impervious surfaces in Saco based on their level of imperviousness (somewhat, moderately, or mostly impervious). Data is from the 2019 National Landcover Dataset.

Power Outages and Electric Grid Resilience

The reliability of the electric grid is vital to the day-to-day well-being and quality of life of Saco's community members, the City's operations, and local economic activities. Breakdowns in grid operations and infrastructure result in power outages that can have significant impacts and hazards for a community. Power outages can jeopardize essential public safety services as well as drinking water and wastewater systems. Downed wires during power outages can make roads impassable or dangerous. Lack of heating/cooling and electricity during power outages puts vulnerable community members at risk. Homes and businesses also face significant costs due to power outages.

Saco is served by the ISO-New England Electric Grid, which oversees the day-to-day operation of New England's electricity grid. Grid components, including substations, transmission lines, and distribution lines, are owned by energy delivery service companies. In Saco the delivery service company is Central Maine Power, who provides Kittery with electricity on several circuits that link Saco with the surrounding communities of Biddeford, Dayton, and Scarborough.

The New England electricity grid is aging and is characterized by an extensive network of older, lower-capacity transmission lines serving as feeder lines to transformers and other critical system components. It is also increasingly vulnerable to several climate impacts, including extreme storms and precipitation as well as increasing temperatures.

Currently, the greatest source of power outages in Saco and the broader region is storm events, including nor'easters, ice storms, snowstorms, and high wind events. A combination of high storm frequency, aging electric grid infrastructure, and an abundance of trees results in Maine having some of the worst power outages in the country. From 2015-2019 Maine had the highest average annual frequency of power outages per customer of any state (3.9 outages per year). Maine also had the second longest average duration of power outages per customer annually (14.1 hours), only behind Florida (14.6 hours).

Major weather events and storms significantly increase the duration of power outages, greatly impacting the number of hours Mainers spend without power. In 2020, a greater number of severe weather events meant that CMP customers experienced an average of 29.5 hours without power. However, in 2021 (a year with far fewer extreme weather events) CMP customers experienced only an average of 5.25 hours of power outages.[21]

In Saco, the leading cause of power outages is tree limbs falling on power lines due to high winds or heavy ice or snow loads on trees. Tree limbs can cause outages by leaning on conductor lines, pulling lines down completely, or by damaging utility poles. In Saco, tree impacts caused 72% of all customer hours without power in 2021.[22]

In the future, increases in extreme storm frequency and duration will likely result in more power outages from downed lines, blown transformers, and other damage to regional grid infrastructure. Additional climate impacts will also strain grid infrastructure and cause power outages in the following ways:

- Increased likelihood of equipment breakdown from flooding of coastal and inland grid infrastructure from increases in storm surge and extreme precipitation events. In particular, substations can be significantly damaged by flooding. Substations are a key part of electrical power generation, transmission and distribution systems and often serve circuits that span multiple municipal jurisdictions. Flooding can damage substation components, leading to power outages and even fires.

[21] Annual Electric Power Industry Report, Form EIA-861 detailed data files, https://www.eia.gov/electricity/data/eia861/

[22] Data supplied by Central Maine Power

Also, during extreme storms, damage to roads and other infrastructure can prevent utility services from reaching and repairing sub-stations, prolonging power outages. The City of Saco is served by several CMP substations. Several are located near the I-95 connector, one is off of New Country Road, and one is located on Saco Island. While located close to the Saco River, the substation on Saco Island is well elevated and therefore unlikely to be at high risk of flooding.

- Reduction in the grid transmission capacity and increase in the risk of damage to transformers due to higher average temperatures and nighttime temperatures.
- Increased risk of physical deformation of powerlines, damage to transformers, and disruptions to service due to extreme high temperatures.
- Increased demand for electricity, due to both the electrification of other energy systems as well as increased average and peak cooling demand during warmer temperatures and longer, more frequent, and more severe heat waves.

Taken together, these impacts mean that the regional electric grid is extremely vulnerable to climate change, while at the same time electrification and electricity demand are going up. These vulnerabilities are exacerbated by aging grid infrastructure that has an increasingly limited capacity to take on more electricity transmission. At the same time, increases in average and extreme temperatures lead to greater health risks for Saco's vulnerable community members, which in turn amplifies the need for reliably electrified and conditioned spaces to ensure their safety.

FLOODING: SEA LEVEL RISE AND STORM SURGE

Key Takeaways

- Neighborhoods and infrastructure located in Camp Ellis, Ferry Beach, and Kinney Shores and along the Saco River are vulnerable to flood hazards associated with climate change. As sea levels rise, and storms become more frequent and intense, these neighborhoods can expect more frequent coastal flooding events and associated damage to property, infrastructure, and the coastline. These areas also have elevated vulnerability due to a high percentage of structures built before 1970, meaning that they are likely not constructed to modern building codes increasing sensitivity to flooding.
- Saco's coastal neighborhoods (block group 12) are the most vulnerable to flooding and have elevated social vulnerability based on several indicators; 35% of households have at least one person with a disability, 51% of households have annual incomes of less than $75k, and 23% of households are just one person living alone. These factors increase those individuals' sensitivity to storm and sea level rise impacts and also limit their adaptive capacity to respond to climate hazards.
- Saco's wastewater recovery facility is critical to community function and health and is exposed to flooding from sea level rise and storms, making the facility and surrounding area extremely vulnerable. Significant efforts to assess site-specific vulnerabilities have been undertaken by the City and a major adaptation project to increase the facility's resilience to flooding and sea level rise is underway.
- Tourism activity driven by Saco's sandy beaches and a healthy coastline could decline as flooding becomes more frequent and the amount of dry beach decreases as sea level rises.
- As coastal properties become increasingly exposed to flooding, their market and assessed values could decline, reducing local tax revenues from affected parcels and potentially straining municipal fiscal health. $158.5 million in assessed property value is vulnerable to flooding from storm surge associated with the 1% annual chance event plus 1.6 feet of sea level rise, representing 3.7% of the city-wide assessed property value.
- Road access to 358 parcels will be cut off by flooding from storm surge plus 1.6 feet of sea level rise, putting the people who live there and emergency access to them at risk.
- Road access to the Camp Ellis, Ferry Beach, and Kinney Shores coastal neighborhoods is at-risk of flooding, placing residents and visitors in those areas particularly vulnerable.
- A section of Route 9 / Ferry Road, a designated evacuation route, is vulnerable to sea level rise.
- Future sea level rise will cause regular inundation of low-lying coastal areas during high tide, likely leading to increased erosion of sandy beaches, dunes, and salt marshes.
- The majority of engineered coastal structures (e.g., seawalls, riprap, etc.) in Saco along tidal portions of the Saco River and Atlantic coastline are vulnerable to overtopping by water from the 1% annual chance event.
- Several pockets along tidal portions of the Saco River, especially near Camp Ellis, have been identified as being able to support future marsh migration. Most of those areas are not adjacent to conserved lands and some are identified as having development potential based on current zoning requirements (minimum lot size).

Background Info, Trends, & Projections

Sea level in Maine has been rising in the long-term, but over the past few decades the rate of rise has accelerated. That rise is increasing the frequency of nuisance or high tide flooding, with southern Maine seeing 4 times as many nuisance flooding events over the last decade compared with the average of the past

100-years. According to a recent State assessment, there is a 67% probability that sea level will rise between 1.1 and 1.8 feet by 2050, and between 3.0 and 4.6 feet by the year 2100 under intermediate global greenhouse gas emissions scenarios, with higher sea level rise amounts possible. With that rate of sea level rise, not accounting for increased intensity and frequency of storms, Maine will see a 15-fold increase in coastal flooding by 2050. Those scenarios do not account for more intense rainfall that climate change is bringing to the region, which will exacerbate flood risk.

As sea level rises in the future, normal high tides will be higher and storms, and accompanying storm surge, will be more impactful, causing extensive coastal flooding to roads, homes, and businesses. Storm surge is the abnormal rise in ocean water level during a storm event, measured as the height of the water above the normal predicted astronomical tide. It is caused primarily by storm winds pushing ocean water onshore. This rise in water level can cause extreme flooding in coastal areas, especially when storm surge coincides with normal high tide. While future sea level rise will occur gradually over time, extreme storm events can cause damaging flooding episodically in the short-term.

In addition to rising seas, storm surge, and more nuisance flooding events, southern Maine's coastal areas are seeing more frequent and intense precipitation events. Further, the intensity and frequency of precipitation is expected to increase in the future with climate change. Stormwater runoff from rainfall events combined with surge and future sea level rise will lead to more extensive flooding in coastal areas.

Coastal flooding threatens public health and safety by putting transportation corridors, evacuation routes and provision of emergency services at risk; disrupts economic activity through lost business and reductions in tourism; reduces property values; and imperils municipal revenue and budgets. Additionally, individuals who already have increased social vulnerability will be disproportionately affected by sea level rise and climate change as they have less capacity to prepare for, respond to, and recover from coastal hazard events.

Sea level rise threatens not only the landscape above ground, but also the below-grade environment. Along the coast, groundwater and saltwater are naturally separated by the seaward movement of groundwater. As seas rise, landward intrusion of seawater pushes groundwater levels up and shifts the interface of fresh groundwater and saltwater inland. Low-lying coastal communities and critical infrastructure are at risk of impacts including intrusion of saltwater into groundwater and drinking water resources, increased flooding from higher coastal water tables, and water damage to pavement from below. Potential impacts of unmitigated groundwater rise include:

- Water quality degradation
- Premature septic system failure
- Mobilization of hazardous waste
- Saltwater intrusion into drinking water supplies
- Wetland expansion, transition, or drowning
- Flooding due to higher coastal water tables
- Damage to pavement and other hardscape surfaces

To plan for sea level rise and associated impacts, the Maine Climate recommends an approach of committing to manage for a higher probability, lower risk scenario, but also preparing to manage for a lower probability, higher risk scenario. That concept involves building flexibility into designs and decisions so that adjustments can be made to address more extreme sea level rise. It accounts for some of the variability and uncertainty regarding global emissions reductions efforts and evolving science about potential future melting of land-based ice. The State recommends that Maine commit to manage for 1.5 feet of relative sea level rise by 2050, and 3.9 feet of sea level rise by the year 2100, but prepare to manage for 3.0 feet by 2050, and 8.8 feet by 2100, all in relation to 2000 local sea level. When planning for sea level rise, consideration should be given to

the risk tolerance of different kinds of infrastructure. In other words, the intended lifespan, criticality, and exposure of infrastructure and assets to flood hazards should be considered when evaluating what sea level rise scenarios and planning horizons to account for in design and maintenance decisions.

In Saco, future sea level rise will cause regular inundation of low-lying coastal areas during high tide, leading to contamination of groundwater aquifers and wells from saltwater intrusion, and increased erosion of sandy beaches, dunes, and salt marshes.

This section presents assessment results of the impacts of modeled flooding from storm surge combined with sea level rise to represent what flooding from storm events could look like in the future. The two flooding scenarios, listed below, align with the Maine Climate Council's planning recommendation of committing to manage 1.5 feet of rise by 2050 and preparing to manage 3.0 feet by 2050.

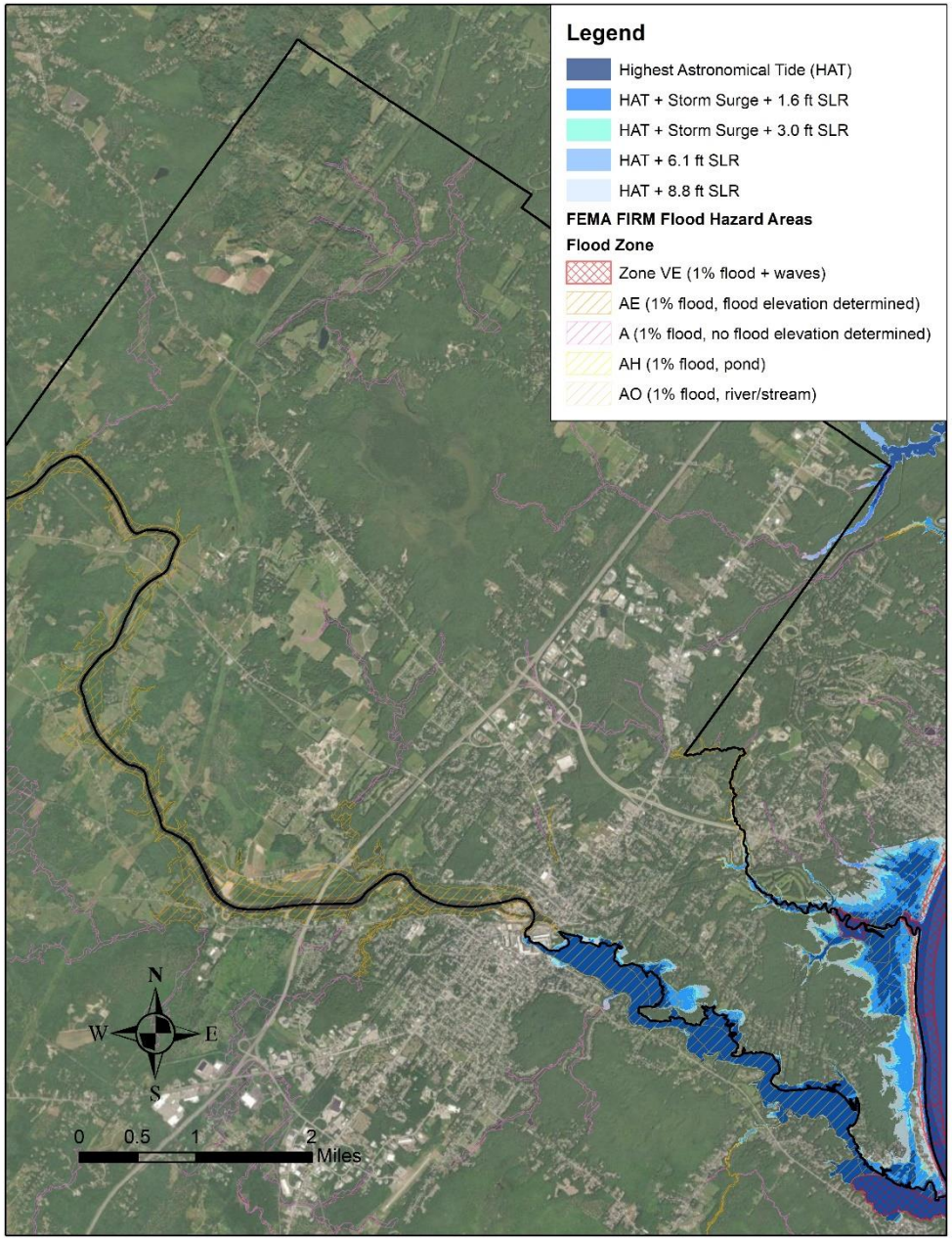
Flooding scenarios used for assessment[23]:

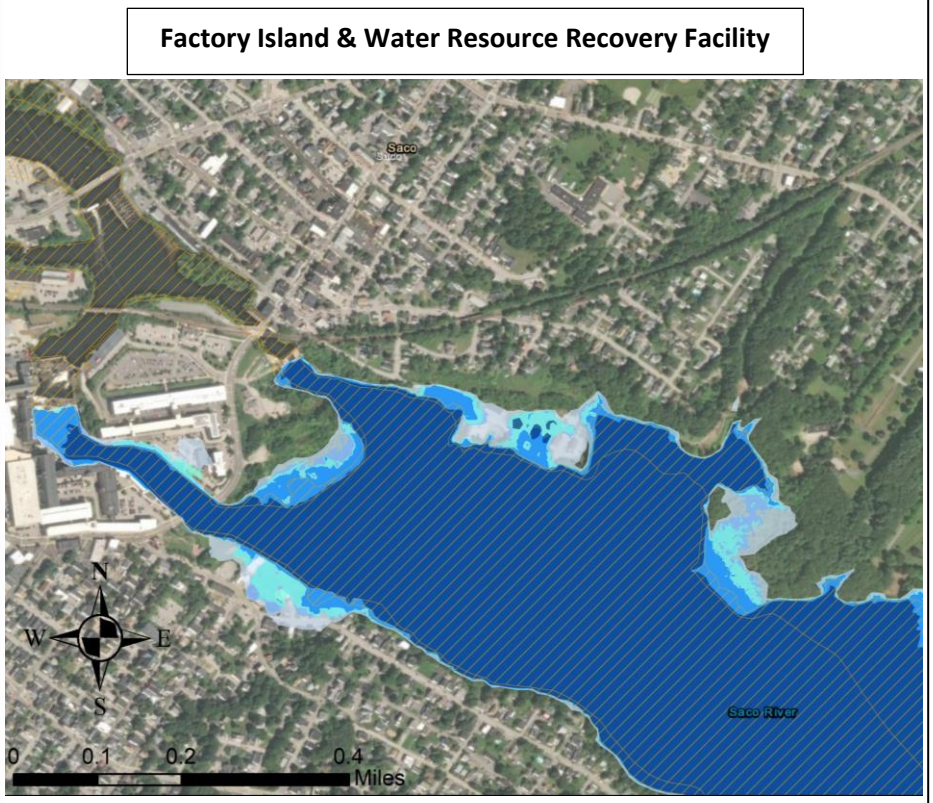
- **Storm surge from 1% annual chance storm event (*i.e.* 100-year storm) + 1.6 feet of sea level rise**
- **Storm surge from 1% annual chance storm event + 3.0 feet of sea level rise**

The assessment results presented below use the terms 'vulnerable', 'impacted', and 'at-risk' to describe impacts. All three terms mean that the parcel, asset, or area is touched by water under the given inundation scenario. It is important to note that the modeled flood scenarios show inundation at high tide, so not every area or thing that is directly impacted by the flood scenarios will be permanently inundated.

Map 11 and Map 12 show modeled inundation from the two flood scenarios noted above, as well as the regulatory flood zones (*i.e.*, Special Flood Hazard Areas) from Saco's preliminary Flood Insurance Rate Map (FIRM) published by FEMA.

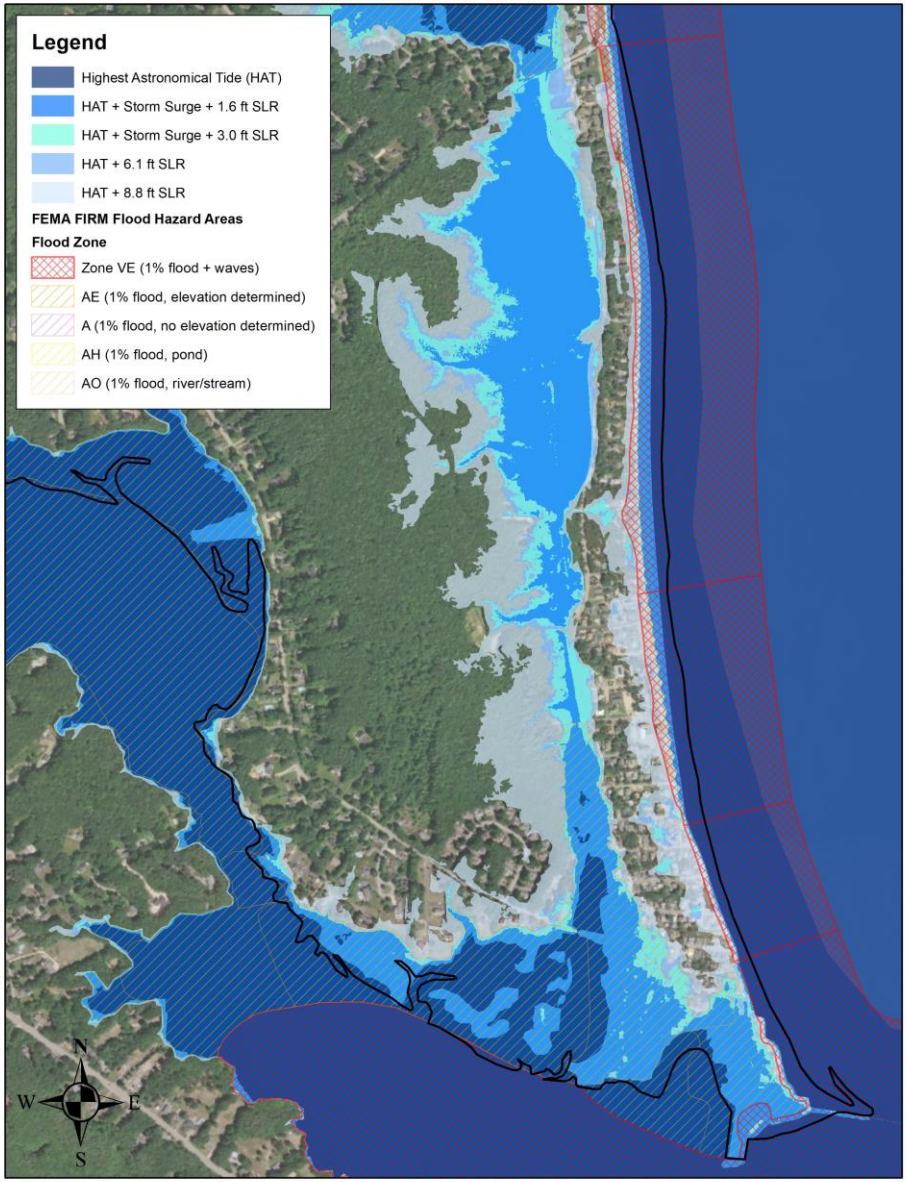
[23] The sea level rise scenarios were developed by the Maine Geological Survey and do not account for wave action or precipitation. The storm surge values were provided by Ransom Consulting, LLC, and consist of storm surge and static wave set-up, without additional wave action due to crests or wave runup.



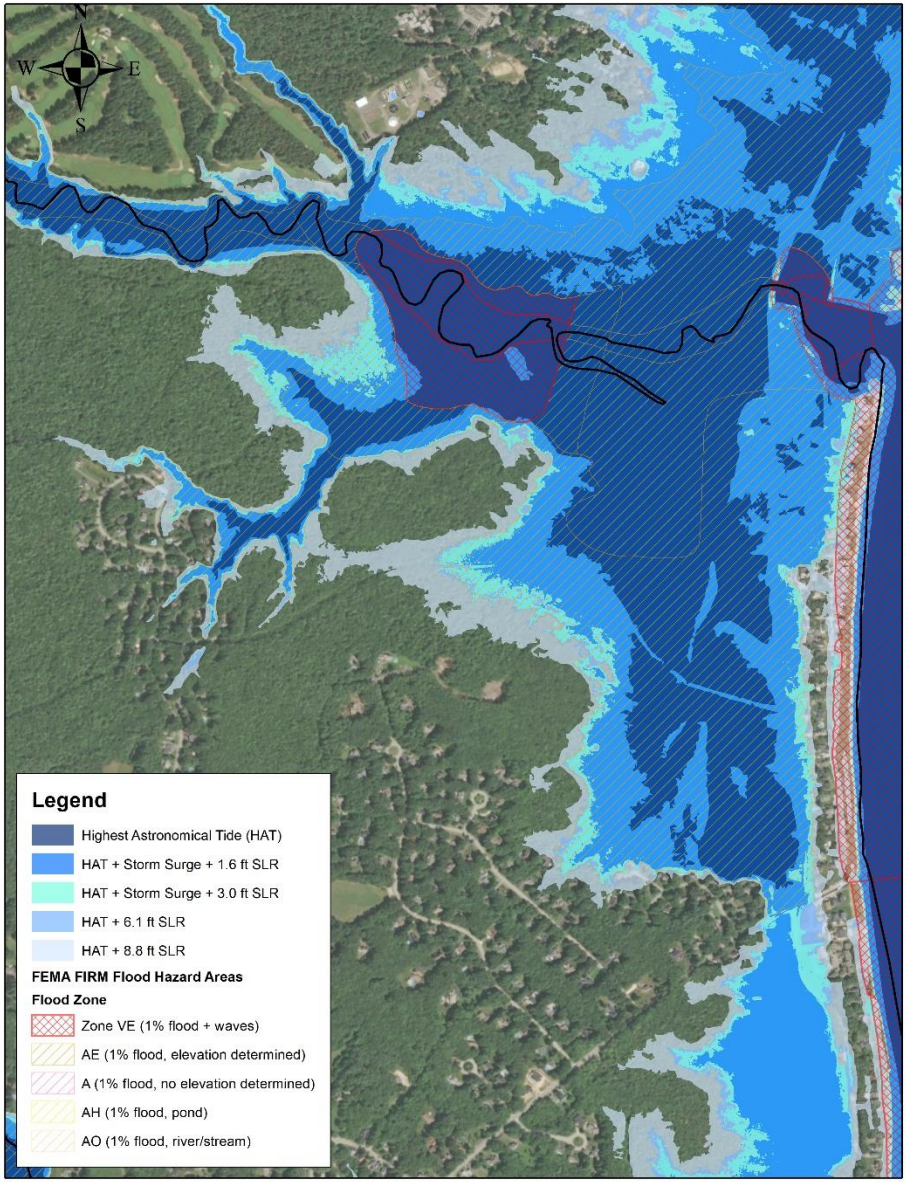


Map 11 Modeled inundation from sea level rise (SLR), storm surge, and the 1% annual chance storm event (Special Flood Hazard Area depicted on the FEMA-Issued Flood Insurance Rate Map

Camp Ellis & Ferry Beach



Kinney Shores



Map 12 Modeled inundation from sea level rise (SLR), storm surge, and the 1% annual chance storm event (Special Flood Hazard Area depicted on the FEMA-Issued Flood Insurance Rate Map).

Property Impacts

Where and how we choose to develop land profoundly impacts the resilience of our community. Buildings located in areas exposed to natural hazards like flooding are at greater risk of climate change impacts. Saco's municipal budget, like most southern Maine coastal communities, is highly dependent on revenue from local property taxes and coastal development provides a substantial portion of the municipal tax base, generating vital funds that sustain community operations, services, and programs. However, it is that same development that is most susceptible to coastal flooding, placing residents, visitors, and municipal fiscal health at risk. Studies have shown that coastal hazards and climate change diminish the value of impacted properties[24]. Municipal fiscal health could be negatively impacted if coastal properties, which generate a large portion of local tax revenue, are exposed to flooding and if development in vulnerable areas continues. In addition, the coastal areas and resources, especially sandy beaches, that serve as the economic engine for towns, the region, and state are particularly vulnerable to storms and rising seas as increasing water levels reduce the area of dry beach available.

- Parcels that are expected to be impacted by flooding from the 1.6 ft sea level rise scenario total almost **$158.5 million in assessed property value, representing 3.7% of the city-wide assessed property value** (
- Table 5).
- **Road access to 358 parcels is projected to be cutoff** by flooding from the 1.6 ft scenario and 222 will be cut off with the 3.0 ft scenario, putting the people who live there and emergency access to them at risk (the number decreases because with the higher sea level rise scenario, more of the parcels cutoff by the 1.6 ft scenario become directly impacted by flooding).

	Parcel Value: Only Land Impacted	**Parcel Value: Buildings & Land Impacted**	**Total Assessed Value Impacted**	**% of City-Wide Assessed Value (2022)**
Storm surge + 1.6 ft SLR	$27,658,660	$130,754,600	$158,413,260	3.7%
Storm surge + 3.0 ft SLR	$33,833,135	$178,817,600	$212,650,735	5.0%

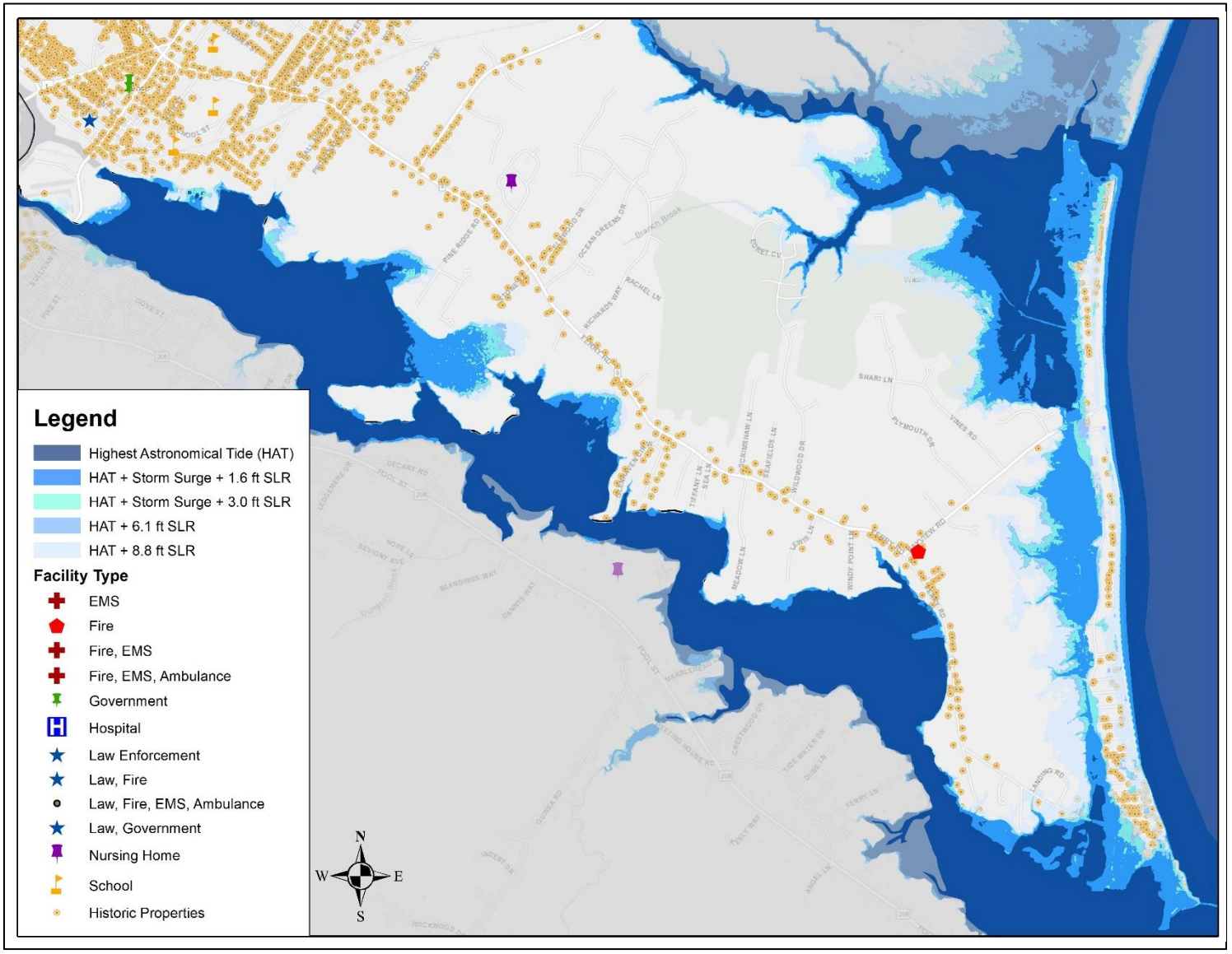
- Properties along **Camp Ellis**, **Ferry Beach**, **Kinney Shores** are vulnerable to flooding from both the 1.6 ft and 3.0 ft scenarios. These areas also have a high percentage of structures built before 1970, meaning that they are likely not constructed to modern building codes increasing sensitivity to flooding.
    - A recent study of Camp Ellis found that with 1.5 of sea level rise, the majority of buildings in the Camp Ellis neighborhood will experience 1 – 3 feet of inundation above grade during a more extreme 1% annual chance extreme water level[25].
    - Roughly 15% of households in the coastal areas at greatest risk of flooding and sea level rise are renter-occupied. Renters generally have lower adaptive capacity to adapt to flood hazards because they usually lack the ability to make substantive changes to the properties in which they are living.
- Areas of **Ferry Beach State Park** are exposed to flooding from the modeled scenarios, but road access to the park is not.

[24] Shi, L., Varuzzo, A. M. (2020). *Surging seas, rising fiscal stress: Exploring municipal fiscal vulnerability to climate change*. Cities 100 (2020) 102658.
[25] Kleinfelder. 2022. Camp Ellis Architectural Survey and Climate Resiliency options.

- There is a **high concentration of designated historic properties** along Saco's Atlantic Coastline and the Saco River that are **located in areas that are vulnerable to flood hazards**, including sea level rise, storm surge, and flooding from the 1% annual chance event.
- There are no emergency management buildings or schools in Saco that are located in areas vulnerable to the mapped scenarios of storm surge and sea level rise. However, as noted in the following section, the Water Resource Recovery Facility and other sewer and stormwater infrastructure, which are critical to community health, function, and well-being, are vulnerable to flooding.
- Most coastal properties in areas vulnerable to flooding from sea level rise are on public water and sewer, reducing the risk of drinking water contamination from saltwater intrusion and water quality issues stemming from septic system failures associated with age, malfunctioning, and/or rising groundwater caused by sea level rise.

Table 5 Assessed value of parcels impacted by flooding from storm surge combined with sea level rise (Source: SMPDC. 2022 coastal economic resilience assessment, phase 2. Unpublished.)

	Parcel Value: Only Land Impacted	**Parcel Value: Buildings & Land Impacted**	**Total Assessed Value Impacted**	**% of City-Wide Assessed Value (2022)**
Storm surge + 1.6 ft SLR	$27,658,660	$130,754,600	$158,413,260	3.7%
Storm surge + 3.0 ft SLR	$33,833,135	$178,817,600	$212,650,735	5.0%



Map 13 Mapped locations of historic properties, emergency management and public health facilities, and schools.

Infrastructure Impacts

Sea level rise threatens not only the landscape above ground, but also the environment below. Inundation of surface infrastructure can cause short-term disruptions due to road closures and limited access to infrastructure. It can also cause substantial damage to infrastructure, including pavement, culverts, stormwater infrastructure, and utility infrastructure. Higher water levels can reverse or reduce efficiency of stormwater drainage and wastewater outfall operations.

Along the coast, groundwater and saltwater are naturally separated by the seaward movement of groundwater. As seas rise, landward intrusion of seawater pushes groundwater levels up and shifts the interface of fresh groundwater and saltwater inland. Studies conducted in coastal New Hampshire show that sea level rise induced groundwater rise is projected to extend up to three to four times further inland than surface tidal water inundation from sea level rise.

Low-lying coastal communities and important infrastructure are at risk of impacts including intrusion of saltwater into groundwater and drinking water resources, increased flooding from higher coastal water tables, and water damage to roadways and other infrastructure from below. Researchers are working to model and assess this phenomenon in New England to better understand coastal hazards stemming from sea level rise. No assessment has yet been completed for Saco, however, subsurface stormwater, transportation, and utility infrastructure; contaminated sites; septic systems; and drinking water wells in coastal areas will likely be negatively impacted by rising groundwater and saltwater intrusion. Rising groundwater can impede the ability of septic systems to function properly as the vertical separation between the groundwater table and leachfield is reduced. This can result in contamination from septics into groundwater and nearby surface waters. Saltwater intrusion can contaminate wells with salt water, threatening drinking water supplies.

- **Stormwater and Sewer Infrastructure**: Storm and sewer infrastructure vulnerable to flooding are located along Camp Ellis, Ferry Beach, and Kinney Shores neighborhoods, and along Front Street where the Water Resource Recovery Facility is located (Map 15,
- Table 6).

Infrastructure Type		**Vulnerable to Surge + 1.6 ft SLR Scenario**	**Vulnerable to Surge + 3.0 ft SLR Scenario**	**Not vulnerable to 1.6 ft or 3.0 ft Scenarios**
Sewer	Wastewater Treatment Facility	Yes	Yes	-
	Pump stations	3 *Bay View, Camp Ellis, & Fish Pier Pump Stations*	3 *Bay View, Camp Ellis, & Fish Pier Pump Stations*	
	Manholes, CSO, other points	81	105	2,057
	Gravity & force mains, laterals	19,693 ft	26,239 ft	560,089 ft
Stormwater	Catch basins, manholes, outfalls, pond outlet controls	96	126	4,162
	Gravity mains, laterals, culverts, ditches	8,914 ft	12,402 ft	769,498 ft

  - The **Water Resource Recovery Facility** is extremely vulnerable to flooding and sea level rise. It is within two feet of the tidally influenced Saco River and already experiences the harmful effects of flooding during storm events and is located in an area that is exposed to

flooding from 1.6 feet of sea level rise. The estimated replacement cost of the plant, in 2018 dollars, is between roughly $14.6 million and $43.8 million[26].

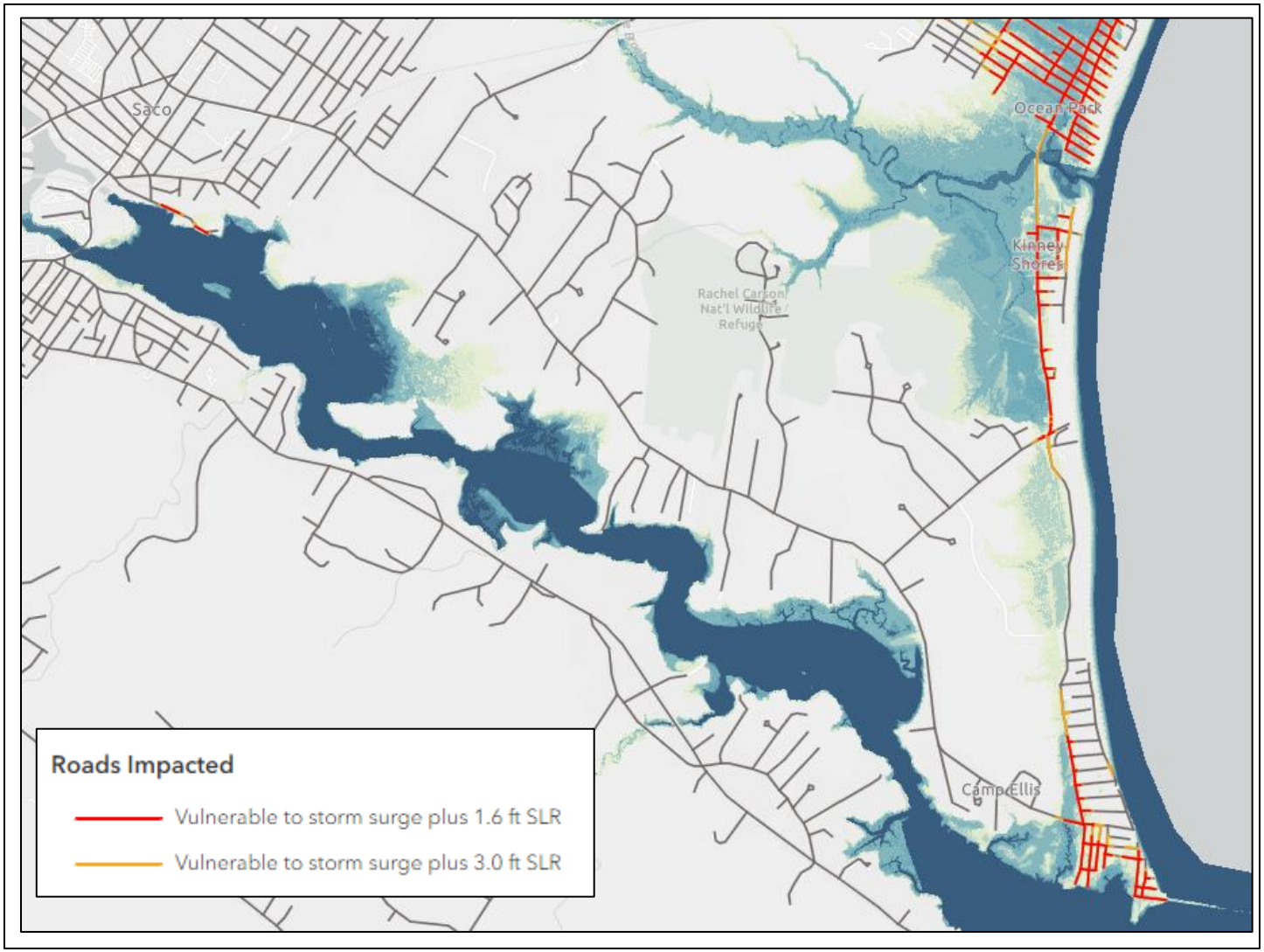
- **3 sewer pump stations** (Bay View, Camp Ellis, and Fish Pier Pump Stations) **are located in areas at risk of flooding** from both modeled scenarios, increasing their vulnerability as flooding could impact their function and/or disrupt access to them.

- **Water Infrastructure**: Saco is served by Maine Water and public water infrastructure (mains, hydrants, etc.) around coastal neighborhoods and Front Street, are located in areas that are vulnerable to flooding from the 1.6 ft scenario.
- **Transportation Infrastructure**: More than 3 miles (16,211 feet) of roadway are vulnerable to flooding with the 1.6 ft scenario and roughly 4.5 miles are vulnerable to the 3.0 ft scenario. Vulnerable roads are concentrated along the beach areas (Map 14, Table 7).
    - Section of **Route 9 / Ferry Road** near the intersection with Seaside Avenue and Lower Beach Road is a **designated evacuation route and is vulnerable to both the 1.6 ft and 3.0 ft scenarios**.
    - Road access to and within the Camp Ellis, Ferry Beach, and Kinney Shores neighborhoods is vulnerable to both modeled flood scenarios.
    - **Route 9, a significant local and regional route, over Goosefare Brook** is vulnerable to flooding from the 3.0 ft scenario, which would significantly impact travel and emergency access to coastal areas
- Based on an assessment by the Maine Geological Survey, coastal engineered structures (e.g., seawalls, bulkheads, jetties, etc.) in the following areas are vulnerable to overtopping by flooding from the modeled current 1% annual chance storm event, not including sea level rise.
    - Most rip-rap and bulkhead areas along the mouth of the Saco River.
    - The majority, but not all, of structures along the beach between the jetty and Riverside Avenue.
    - Most of the beachfront rip-rap in the area from Lower Beach Road to Fairhaven Avenue.
    - Most of the structures at the mouth of Goosefare Brook, however, nearly structures along the ocean-facing side of Kinney Shores are above the base flood (e.g., will not be overtopped).

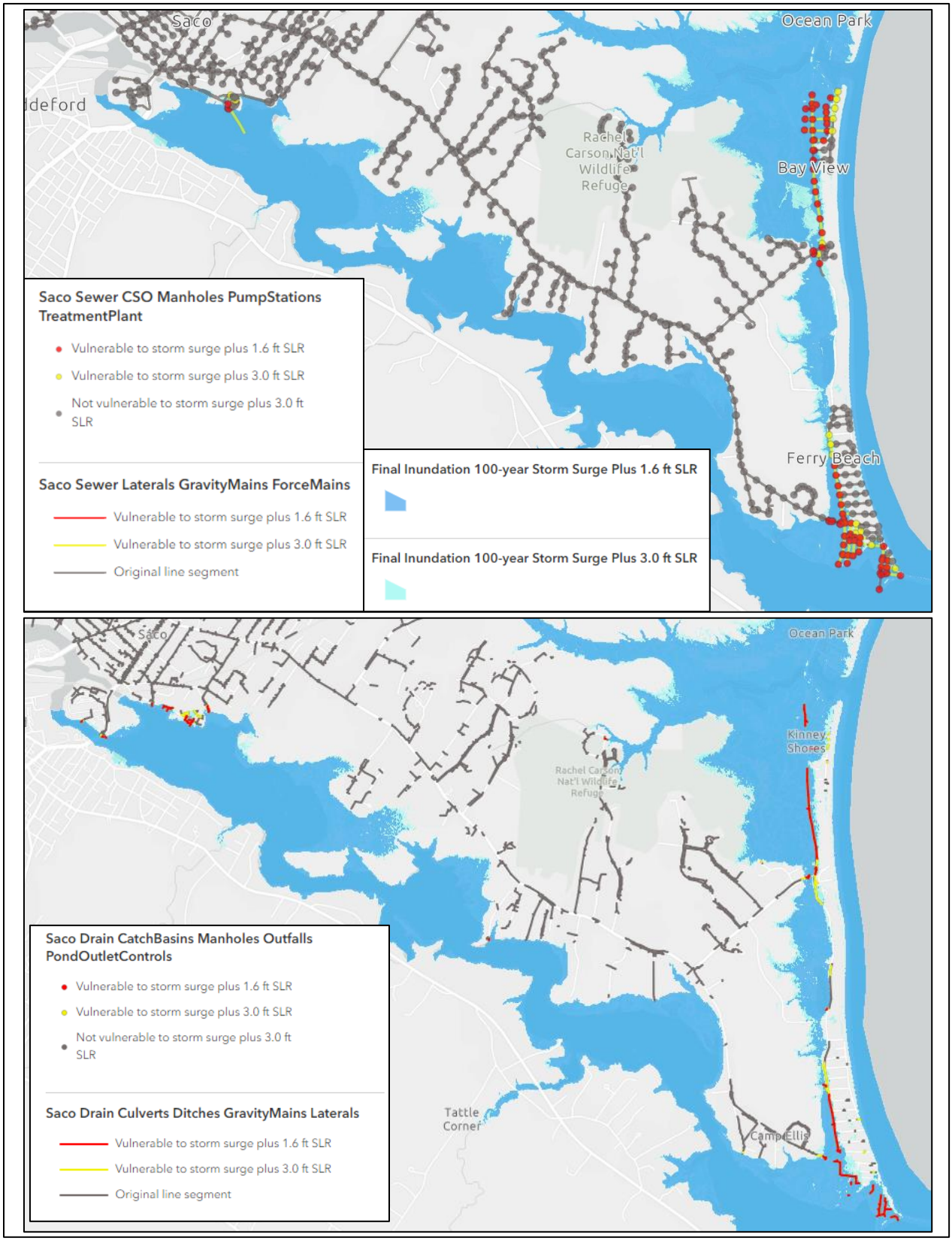
Table 6 Sewer and stormwater infrastructure vulnerable to storm surge plus 1.6 feet and 3.0 feet of sea level rise. (SMPDC. 2022 coastal economic resilience assessment, phase 2. Unpublished)

Infrastructure Type		Vulnerable to Surge + 1.6 ft SLR Scenario	Vulnerable to Surge + 3.0 ft SLR Scenario	Not vulnerable to 1.6 ft or 3.0 ft Scenarios
Sewer	Wastewater Treatment Facility	Yes	Yes	-
	Pump stations	3 *Bay View, Camp Ellis, & Fish Pier Pump Stations*	3 *Bay View, Camp Ellis, & Fish Pier Pump Stations*	
	Manholes, CSO, other points	81	105	2,057
	Gravity & force mains, laterals	19,693 ft	26,239 ft	560,089 ft
Stormwater	Catch basins, manholes, outfalls, pond outlet controls	96	126	4,162
	Gravity mains, laterals, culverts, ditches	8,914 ft	12,402 ft	769,498 ft

[26] Eastern Research Group, Inc. State of Maine. 2020. Assessing the Impacts Climate Change May have on the State's Economy, Revenues, and Investment Decisions: Volume 2: Cost of Doing Nothing Analysis.



Map 14 Roads vulnerable to flooding from 1% annual storm surge plus 1.6 ft and 3.0 ft of sea level rise. (Source: SMPDC. 2022 coastal economic resilience assessment, phase 2. Unpublished.)



Map 15 Sewer and storm infrastructure located in areas exposed to flooding from 1% annual storm surge plus 1.6 ft and 3.0 ft of sea level rise. (Source: SMPDC. 2022 coastal economic resilience assessment, phase 2. Unpublished.)

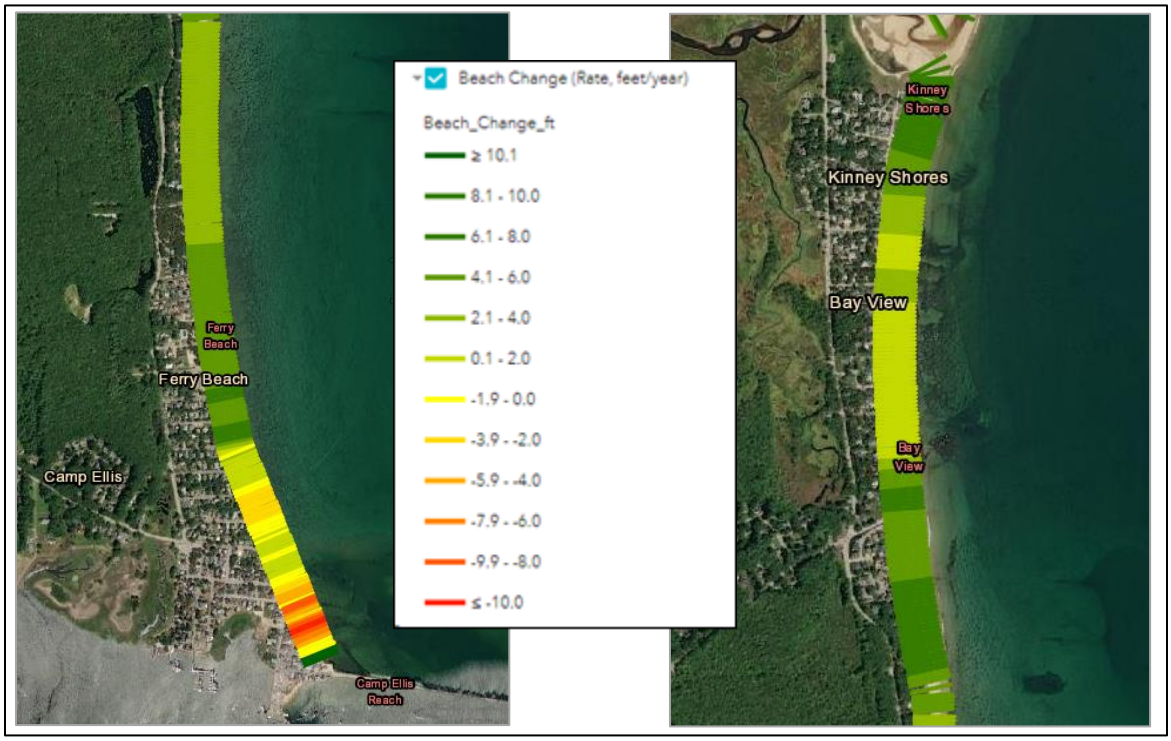
		Storm Surge + 1.6 ft SLR	Storm Surge + 3.0 ft SLR
Road Name	**Classification**	**Feet of Roadway Impacted**	**Feet of Roadway Impacted**
Anthony Est	Private	97.2	166.8
Bay Ave	Local	522.2	535.7
Bay View Rd	Local	173.1	430.5
Beach Ave	Local	303.8	347.5
Beacon Ave	Local	77.1	96.9
Boardwalk Dr	Local	-	98.2
Camp Ellis Ave	Private	1,041.1	1,041.1
Cottage Ave	Local	157.2	224.2
Cove Ave	Local	371.6	552.3
Curtis Ave	Local	144.4	190.3
Driftwood Ln	Local	-	75.9
Dune Ave	Local	331.5	357.7
Eagle Ave	Local	39.7	52.8
Eastern Ave	Local	420.5	479.6
Fairhaven Ave	Local	61.8	114.4
Ferry Park Ave	Local	-	24.1
Ferry Rd	Secondary	307.7	475.3
Fore St	Local	246.3	246.3
Front St	Local	556.7	771.4
Island View Ave	Local	65.5	81.9
Island View St	Local	-	52.5
Lower Beach Rd	Local	167.4	339.0
Main Ave	Local	380.5	703.9
Meadow Ave	Local	145.3	145.3
North Ave	Local	766.6	823.9
Oceanside Dr	Local	-	1,091.0
Outlook Ave	Local	174.0	206.8
Palmer Ave	Local	614.4	732.1
Pearl Ave	Local	77.6	113.8
Pine Tree Ave	Local	493.0	769.8
Piney Woods Rd	Local	614.5	680.4
Riverside Ave	Local	425.7	545.7
Saltaire Ave	Local / Private	677.7	677.7
Seagrass Ln	Private	253.5	378.0
Seaside Ave	Secondary	4,896.8	7,777.4
Shore Ave	Local	507.6	587.3
Sunrise Ave	Local	85.2	111.5
Sunset Ave	Local	170.4	203.2
Surf St	Local	-	245.1
West Ave	Local	843.6	1,035.0

Table 7 Roads vulnerable to flooding from 1% annual chance storm surge plus 1.6 ft and 3.0 ft of sea level rise. The table shows the length of each road vulnerable to flooding and is color-coded by relative length impacted. Brighter red cells indicate roads with the greatest amount of length vulnerable to flooding.

Impacts to the Natural Environment

Rising seas and coastal storms threaten local beaches and dune systems through erosion and flooding. Hardened coastal structures, like seawalls, roads, and homes, prevent beach systems from migrating inland as ocean levels increase. Additionally, how beaches will fare with increased sea level is related to sediment supply, both sources and volumes of the supply. Sand and gravel for beaches can come from rivers, eroding bluffs, the offshore seafloor, or marine shells. Shorelines that have been engineered to prevent erosion, protect property, and stabilize the shoreline offer reduced sediment supply to beaches.

- With 1.6 ft of sea level rise (no storm surge), Saco's dry beach width (distance from the mean high water to seawall or dune edge) is projected to decrease by 3.5 acres, or by 26.5% from existing conditions. With 3.9 feet of sea level rise, the dry beach width is projected to decrease by almost 60%[27].
- Sea level rise is expected to lead to loss of coastal habitat. Along Saco's coast, loss of dry beach will impact local species, including piping plovers and other shorebirds that use the beach for nesting.
- Monitoring data from the Maine Geological Survey show that most of Saco's sandy beaches have been relatively stable in terms of measured beach width over the past several years (2016 – 2020). Camp Ellis is the exception and has experienced significant erosion, a known and much-discussed issue related to impacts stemming from the jetty constructed by the U.S. Army Corps of Engineers. Sea level rise will likely exacerbate erosion in areas already experiencing it and lead to additional erosion along all beach areas.



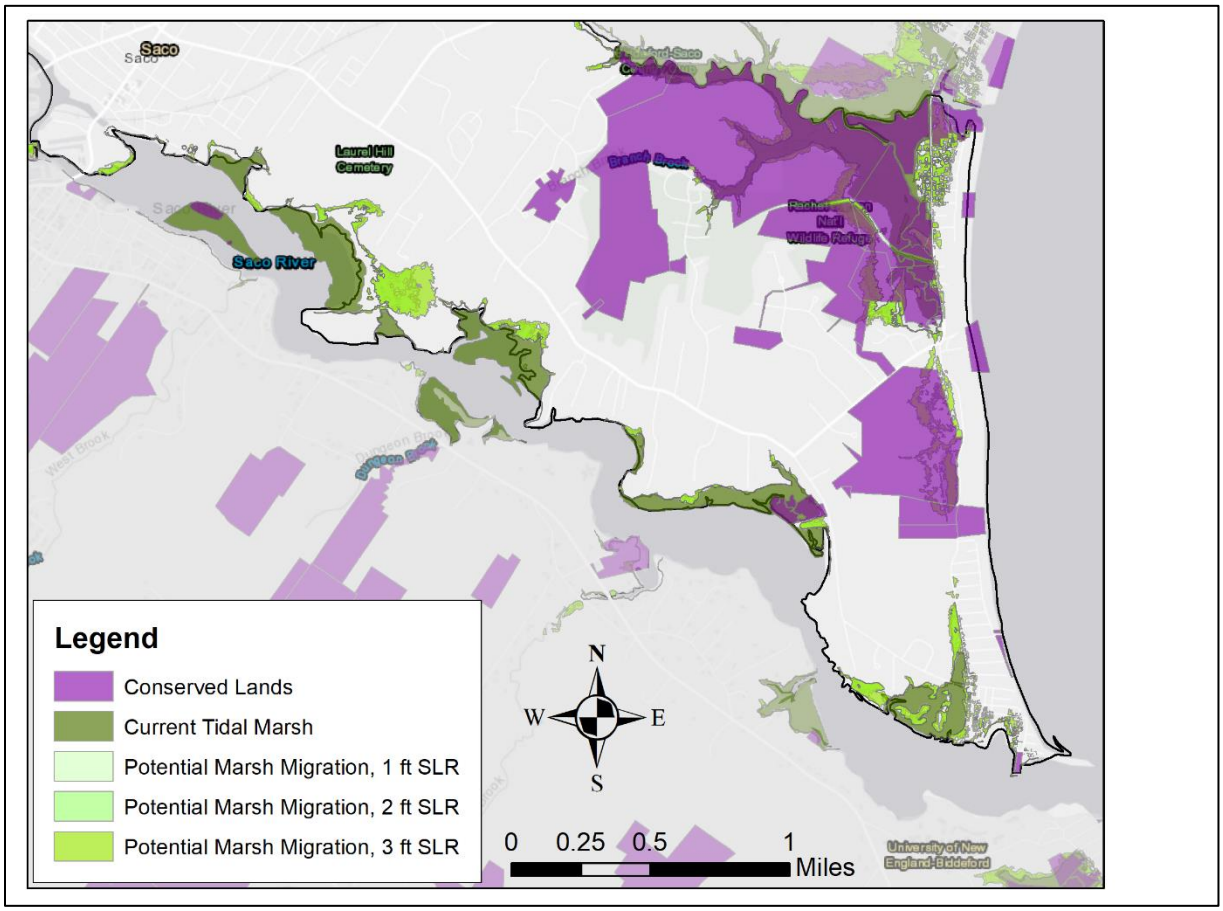
Map 16 Mapped shoreline change in Saco. This map shows the rate of beach change, in feet per year, from data collected from 2016 through 2020. A positive value (green lines) represents a rate of beach growth, while a negative value (yellow/orange/red lines) represents a rate of beach loss. (Source: Maine Geological Survey. Maine Beach Mapping Program. Maine Beach Mapping viewer)

While sea level rise threatens inundation of the beach system, it also has the potential to facilitate the landward expansion, or migration, of tidal marshes. However, this landward migration can only occur if saltmarshes are healthy and there are not physical barriers, such as stonewalls, roads, or buildings, that inhibit the movement of marsh vegetation as sea level increases. The Maine Natural Areas Program (MNAP) has

[27] Maine Geological survey. 2021. Unpublished analysis of the impact of sea level rise on dry beach width of Maine's sandy beaches.

mapped areas that could support marsh migration with future sea level rise (Map 17). Protecting these areas will be crucial for ensuring the long-term viability of local tidal marshes, which provide tremendous natural benefits and services including wildlife habitat, flood control, and water quality protection.

- Several pockets along tidal portions of the Saco River, especially near Camp Ellis, have been identified as being able to support future marsh migration. Most of those areas are not adjacent to conserved lands and some are identified as having development potential based on current zoning requirements (minimum lot size).
- Areas around Goosefare Brook and Long Pond in Ferry Beach State Park have been identified as future marsh migration areas and are adjacent to existing conserved lands, which can enable migration as there are not physical barriers (roads, buildings, etc.) inhibiting the landward movement of the marsh.



Map 17 Existing conserved lands (purple) and areas that could support future migration of existing tidal marshes with future sea level rise. The areas are non-tidal lands within existing tidal estuaries that could be inundated and facilitate the development of new areas of tidal marsh if sea level rises by 1, 2, or 3.3 feet above current highest annual tide (HAT). (Source: Maine Natural Areas Program. Sea level rise scenarios are from the Maine Geological Survey.)

EXTREME TEMPERATURES

Key Takeaways

- Maine's average annual temperature has increased by 3.2°F since 1895 and could warm an additional 2-4°F by 2050.
- Southern Maine is expected to experience roughly 4.5 times more 'extreme heat' days by the 2050s.
- Exposure to extreme heat is a significant public health concern and can be especially dangerous for older adults, infants, people with existing health conditions, and those who have limited access to air conditioning.
- Extreme heat will exacerbate the impacts of urban 'heat islands', the locations of which overlap with areas of socially vulnerable populations in Saco, such as in the downtown area.
- There are fewer days with below-freezing temperatures and snow cover, leading to an increase in pest outbreaks and prevalence vector-borne diseases like Lyme disease.

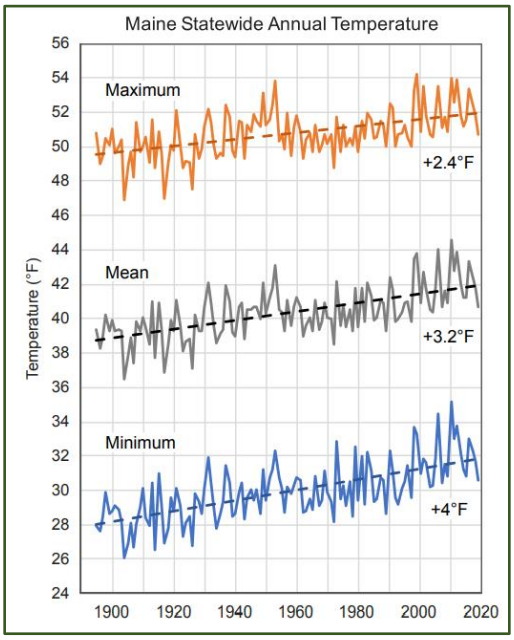


Figure 4 Maximum, mean, and minimum statewide annual temperatures from 1895 to 2019. (Source: MCC STS. 2020.)

Background Information, Trends, & Projections

Climate change is causing increased temperatures and more frequent extreme temperature occurrences. In Maine, the average annual statewide temperature has increased by 3.2°F since 1895[28] (Figure 4). Winters are warming faster than other seasons, and coastal areas have warmed more than the interior of the State. Climate models project that Maine could warm an additional 2 to 4°F by 2050 and up to 10 °F by 2100 depending on global greenhouse gas emissions. Extreme heat days are expected to be 2 - 4 times more frequent in Maine by 2050, increasing the likelihood of heatwaves. Southern Maine is expected to experience roughly 4.5 times more 'extreme heat' days, where the heat index (a combination of temperature and relative humidity that approximates the 'felt' temperature) exceeds 95°F (Figure 5)[29].

Extreme heat is one of the most significant impacts of climate change on human health and is the leading cause of weather-related deaths across the United States. Exposure to extreme heat has been linked with a wide range of health issues, including heatstroke, heat exhaustion, impacts on kidney function, dehydration, fetal health, mental health, and exacerbation of pre-existing health conditions (28). Extreme heat is also linked with increased deaths and emergency department visits. From 2011 to 2015 and 2017 to 2019, York County had the second highest number of annual emergency department visits for heat-related illness across Maine, with Cumberland County seeing the highest numbers[30]. Figure 6 shows peak emergency department visits for heat-related illnesses to hospitals in York County between 2018 and 2023, the years for which monthly data is available.

[28] MCC STS. 2020. Scientific Assessment of Climate Change and Its Effects in Maine. A Report by the Scientific and Technical Subcommittee (STS) of the Maine Climate Council (MCC). Augusta, Maine. 370 pp.
[29] Fernandez, I.J., Schmitt, C.V., Birkel, S.D., Stancioff, E., Pershing, A.J., Kelley, J.T., Runge, J.A., Jacobson, G.L. & Mayewski, P.A. (2015). Maine's Climate Future: 2015 Update. Orono, ME: University of Maine.
[30] Maine Health Data Organization (MHDO). Data analyzed and display prepared by the Environmental Public Health Tracking Program. Data updated: 06/2021.

Residents of cooler climates, like Maine, are less physiologically adapted to extreme heat exposure, and experience disproportionate health effects on hot days when compared to residents of warmer climates. Additionally, the prevalence of air conditioning, one of the most effective tools for preventing heat illness, is significantly lower in Maine than in the rest of the region and the country [31]. Certain populations, including older adults, infants, pregnant women, and people who have chronic diseases or who are sick already may feel much worse or have serious problems in extreme heat. Further, people with limited access to air conditioning, outdoor laborers, and unhoused populations are also more vulnerable to the impacts of extreme heat. A survey conducted by the Maine Behavior Risk Factor Surveillance System found that in 2014, 70.8% of homes in York County had some form of air conditioning, the highest percentage of all Maine counties. However, as noted above, York County also had the second highest number of heat illness emergency department visits.

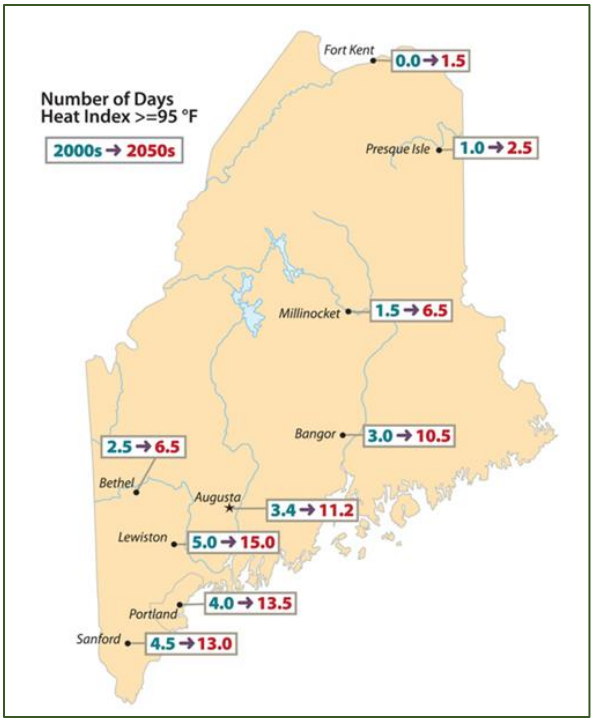


Figure 5 Average number of days when the heat index is greater than or equal to 95°F at selected sites for 2000 - 2004 and 2050 – 2054. Predicted values derived from a 48-km downscale simulation of one ensemble member of the CCSM3 model for the IPCC A2 emissions scenario. Source: Fernandez et al. (2015). (Figure from MCC STS. 2020.)

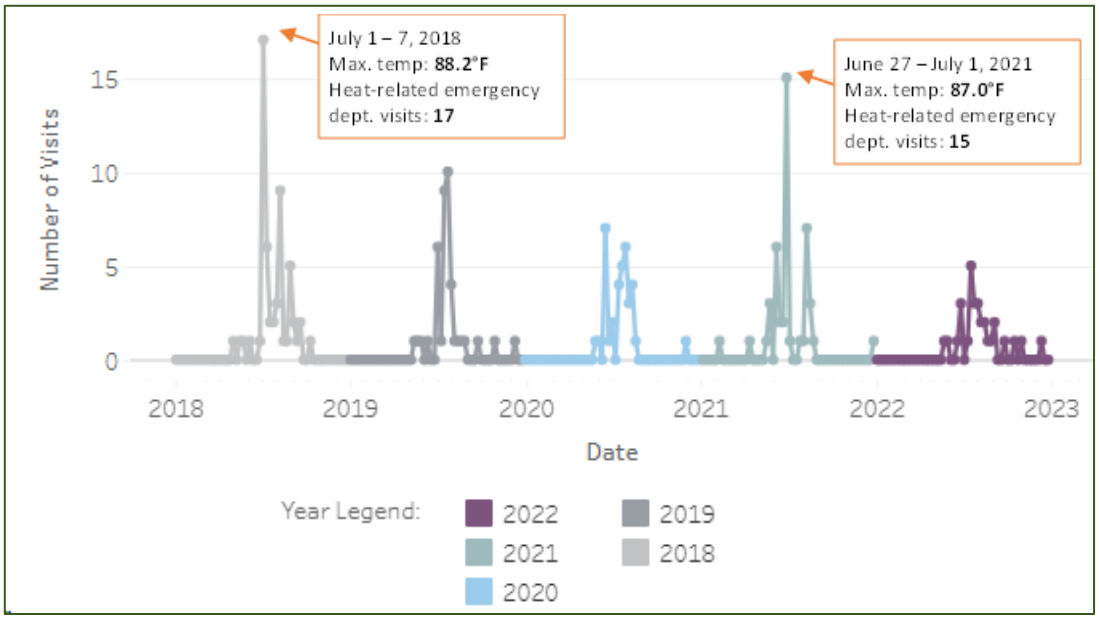


Figure 6 Number of heat illness visits to emergency departments in York County from 2018 to 2023. (Source: Maine Center for Disease Control and Prevention, Maine Tracking Network.)

Five of the ten warmest years on record have occurred within the past ten years, based on average annual temperatures from National Weather Service (NWS) data collected between 1989 and January of 2023 in Kennebunkport, the NWS data collection station closest to Saco (Table 8). The warmest average monthly

[31] MCC STS. 2020. Scientific Assessment of Climate Change and Its Effects in Maine. A Report by the Scientific and Technical Subcommittee (STS) of the Maine Climate Council (MCC). Augusta, Maine. 370 pp.

temperatures for the summer months (June, July, and August) have also occurred within the past ten years and have been 3.1 – 4.3°F warmer than the monthly mean temperature. (Table 9). 2023 was the warmest January on record, with an average temperature of 31.9°, which is 8.5° warmer than the January mean temperature.

Table 8 The top ten warmest years based on average annual air temperatures measured in Kennebunkport, 1989 – January 2023. (Source: National Weather Service).

	Year	Average Annual Temperature (°F)
1	1989	49.9°
2	1998	49.0°
3	2021	47.8°
4	2010	47.7°
5	2012	47.6°
6	2020	47.2°
7	1999	47.0°
8	2006	47.0°
9	2022	46.8°
10	2016	46.7°
1989-2023 Average		45.3°

Table 9 The warmest average monthly temperatures of the three summer months and years in which they occurred compared with the mean monthly temperatures for those months measured in Kennebunkport, 1989 – January 2023. (Source: National Weather Service.)

Month	Year	Average Temperature (°F)	Mean Temperature (°F), 1989 - 2022	Difference Between Mean and Average of Warmest Month
June	2021	65.7°	61.6°	+4.1°
July	2013	70.5°	67.4°	+3.1°
August	2018	70.4°	66.1°	+4.3°

Urban Heat Islands

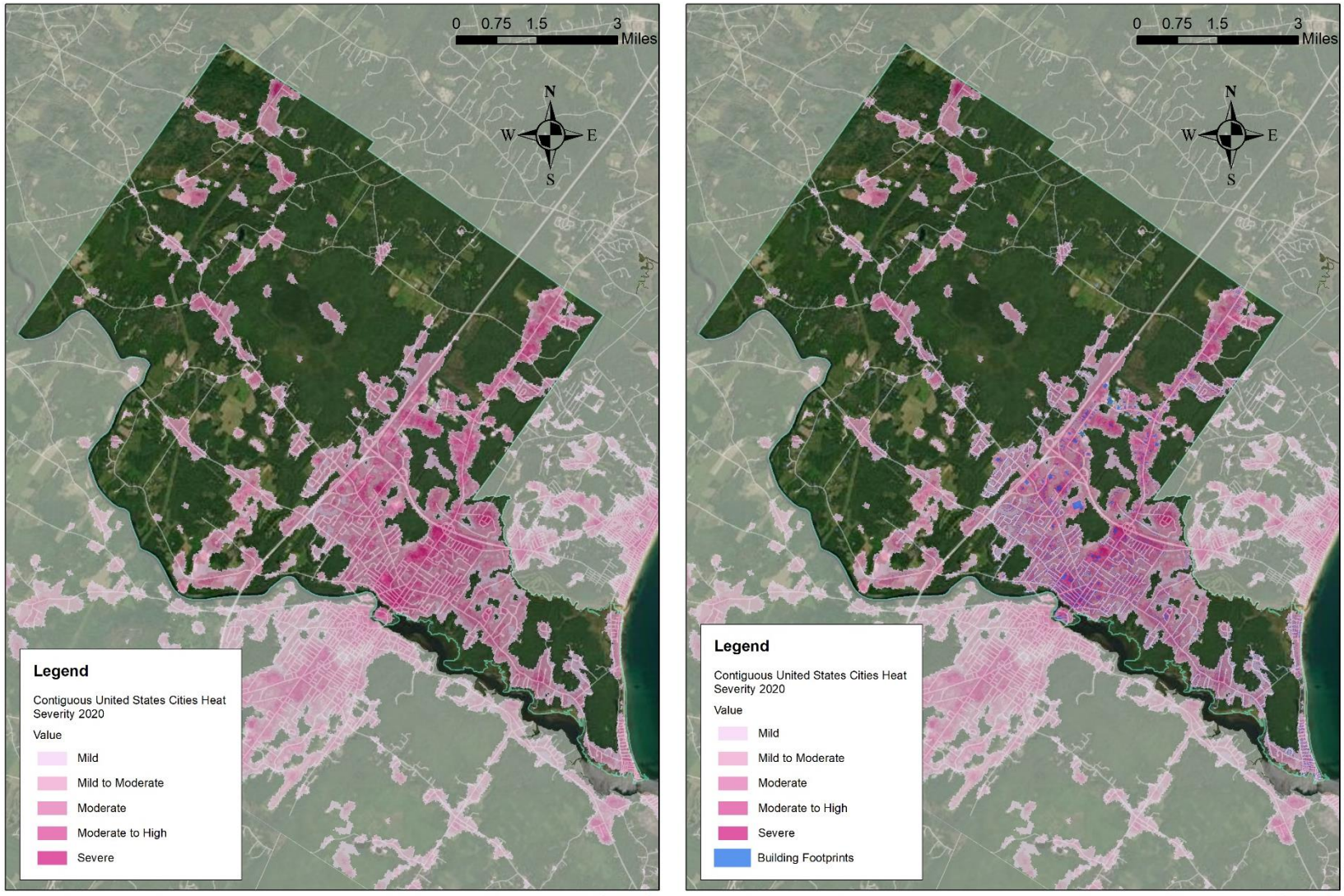
Extreme heat days in Maine will exacerbate the severity and impacts of "heat islands", or areas with a lot of impervious surfaces, such as buildings and pavement, that absorb and re-emit heat. The Trust for Public Land notes that extreme heat exacerbated by urban heat islands can lead to increased respiratory difficulties, heat exhaustion, and heat stroke.

The two maps below show areas in Saco that are hotter than the average temperature for the community as a whole. The map on the right shows the location of building footprints in relation to heat islands. The maps show the relative heat severity measured on a scale of 1 to 5, with 1 being a relatively mild heat area (slightly above the mean for the city), and 5 being a severe heat area (significantly above the mean for the city). (*Heat island temperature data: 30-meter resolution based on data derived from Landsat 8 imagery band 10 (ground-level thermal sensor) from the summers of 2019 and 2020.*)

In Saco, the majority of the southern portion of the city is identified as having moderate to severe heat island effect in relation to the rest of the community (Map 18). Areas in and around the downtown, along I-95, Route 9, Route 112 between Route 1 and I-95, on Factory Island, and along the immediate coastline are mapped as having elevated ground temperatures in relation to the rest of the community. The downtown,

areas along the northeaster portion of Main Street, and areas along Ferry Road/Route 9 that are mapped as moderate to severe heat severity also have elevated social vulnerability. Additionally, areas along the Saco River and coastline of elevated heat severity are also exposed to flood hazards, making these areas particularly vulnerable. Knowing where areas of high heat are located can inform mitigation and adaptation strategies.

Urban Heat Island Severity



Map 18 Urban heat island severity (left) overlaid with building footprints (right). Heat island severity data source: Trust for Public Land. Map created by SMDPC

Public Health Impacts

Extreme heat is one of the most significant impacts of climate change on human health and is the leading cause of weather-related deaths across the United States. Exposure to extreme heat has been linked with a wide range of health issues, including heatstroke, heat exhaustion, impacts on kidney function, dehydration, fetal health, mental health, and exacerbation of pre-existing health conditions (28). Extreme heat is also linked with increased deaths and emergency department visits. From 2011 to 2015 and 2017 to 2019, York County had the second highest number of annual emergency department visits for heat-related illness across Maine, with Cumberland County seeing the highest numbers[32]. Figure 19 shows peak emergency department visits for heat-related illnesses to hospitals in York County between 2018 and 2023, the years for which monthly data is available.

Residents of cooler climates, like Maine, are less physiologically adapted to extreme heat exposure, and experience disproportionate health effects on hot days when compared to residents of warmer climates. Additionally, the prevalence of air conditioning, one of the most effective tools for preventing heat illness, is significantly lower in Maine than in the rest of the region and the country [33]. Certain populations, including older adults, infants, pregnant women, and people who have chronic diseases or who are sick already may feel much worse or have serious problems in extreme heat. Further, people with limited access to air conditioning, outdoor laborers, and unhoused populations are also more vulnerable to the impacts of extreme heat. A survey conducted by the Maine Behavior Risk Factor Surveillance System found that in 2014, 70.8% of homes in York County had some form of air conditioning, the highest percentage of all Maine counties. However, as noted above, York County also had the second highest number of heat illness emergency department visits.

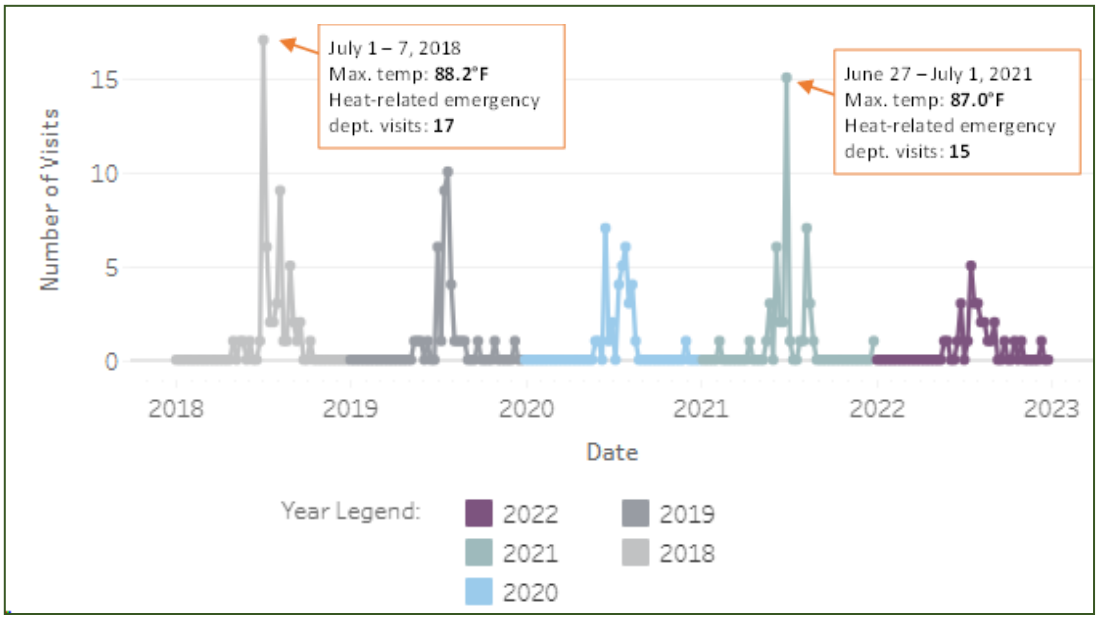


Figure 19. Number of heat illness visits to emergency departments in York County from 2018 to 2023. (Source: Maine Center for Disease Control and Prevention, Maine Tracking Network.)

[32] Maine Health Data Organization (MHDO). Data analyzed and display prepared by the Environmental Public Health Tracking Program. Data updated: 06/2021.
[33] MCC STS. 2020. Scientific Assessment of Climate Change and Its Effects in Maine. A Report by the Scientific and Technical Subcommittee (STS) of the Maine Climate Council (MCC). Augusta, Maine. 370 pp.

Climate change can impact air quality and lead to worsening air pollution. Atmospheric warming associated with climate change has the potential to increase ground-level ozone in many regions, which may cause public health issues and present challenges for compliance with the ozone standards in the future. The impact of climate change on other air pollutants, such as particulate matter, is less certain, but research is underway to address these uncertainties.[34] Figure 7 shows the number of days in York County with an 8-hour average ozone concentration that exceeded the National Ambient Air Quality Standard of 0.070 ppm, established December 28, 2015. Previous standards were set at .075 ppm from 2008-2015 and .080 prior to 2008. Research for this assessment could find no cause of the relatively high number of exceedances between 2001 and 2007. An analysis by the Maine Department of Environmental Protection affirmatively demonstrates that Maine emissions are insignificant contributors to non-attainment of ozone for the 8-hour ozone air quality standards[35]. Regardless of the cause, individuals with existing health conditions, older populations, and children are especially vulnerable to poor air quality.

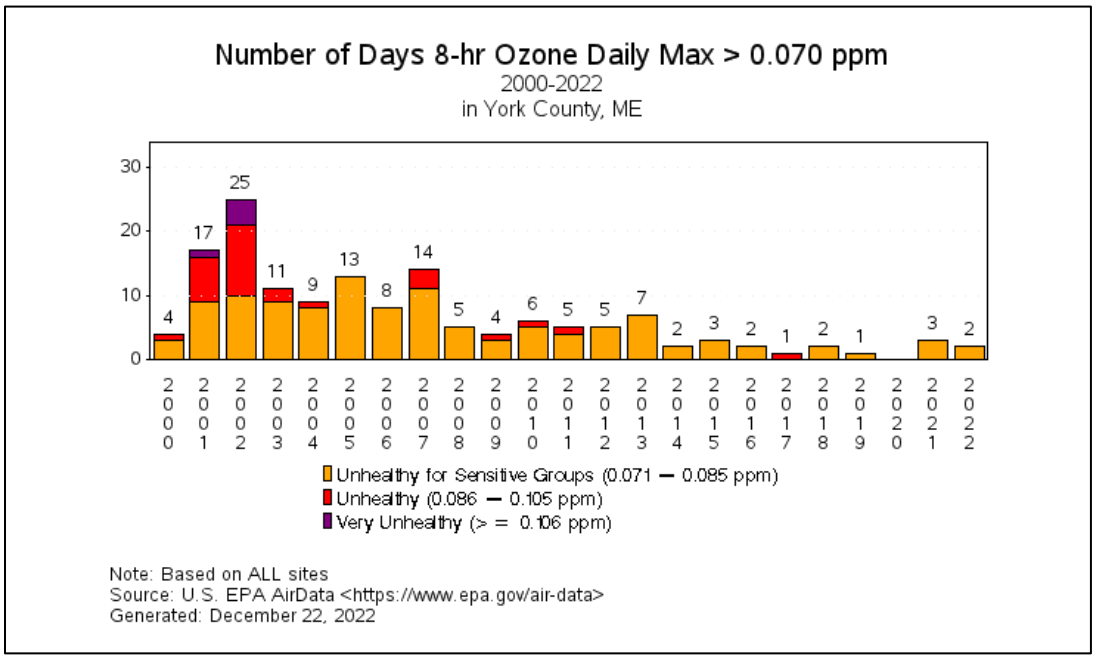


Figure 7 Number of days during which the 8-hour average ozone concentration exceeded national air quality standards. (Source: US EPA AirData portal)

The prevalence of tickborne diseases, including Lyme, anaplasmosis, and babesiosis, has increased in York County in recent years. Figure 8 shows that rates of all three diseases have increased since 2001. Table 10 shows the incidence rate (per 100,000 people) of confirmed and probable cases of tickborne disease in Saco. Between 2016 and 2020, Saco had the third lowest rate of anaplasmosis and fifth lowest rate of Lyme of all York County communities.

[34] US Environmental Protection Agency. Air Quality and Climate Change Research webpage.
[35] State of Maine Clean Air Act Section 176A(a)(2) Petition. 2020.

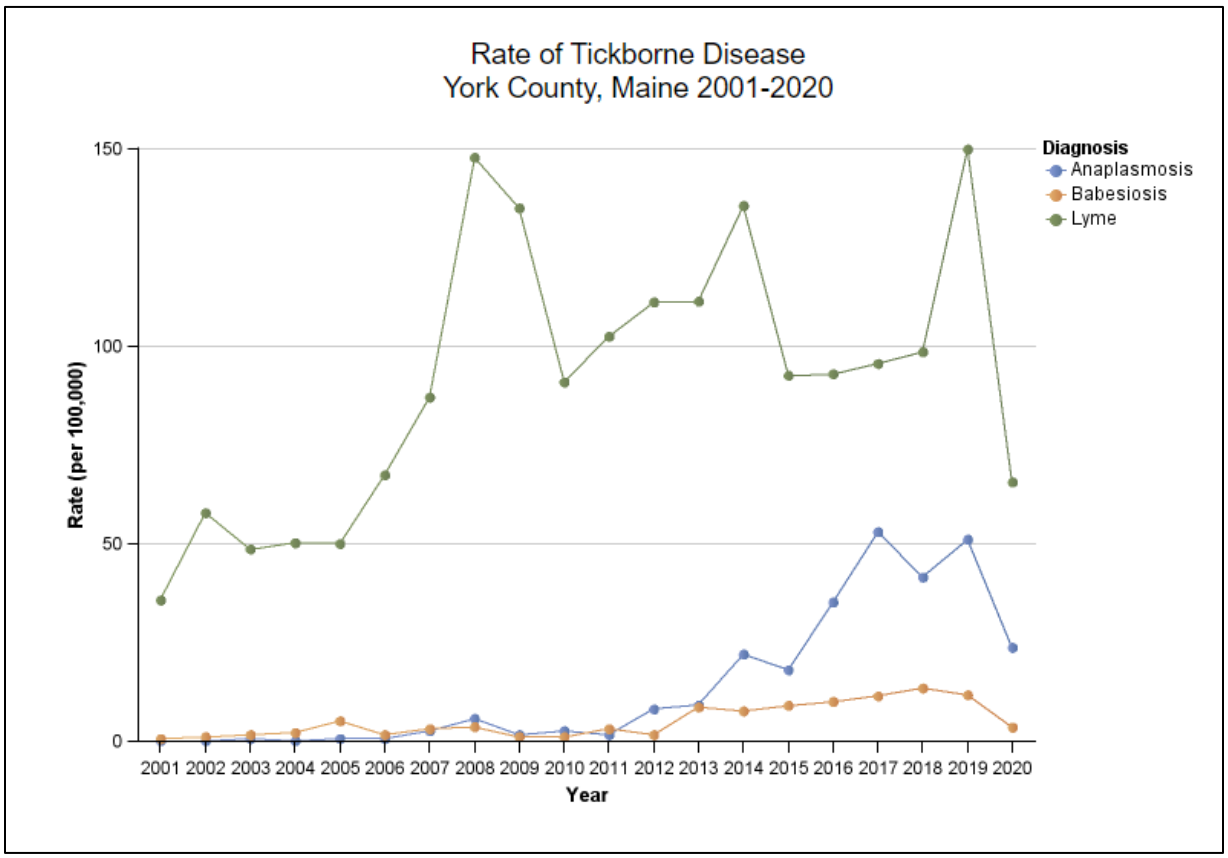


Figure 8 Annual incidence rate (per 100,000 people) of confirmed and probable cases of tickborne diseases of the population in York County. Maine CDC's Infectious Disease Program obtained these data through notifiable conditions surveillance based upon reports from healthcare providers, laboratories, and other healthcare partners. (Data Source: Maine CDC's Infectious Disease Program collected and analyzed population data from the U.S. Census Bureau to calculate state and county rates of tickborne disease. Maine CDC used population data from Maine CDC Data, Research, and Vital Statistics (DRVS) to calculate town-level rates of tickborne disease. The Maine Environmental Public Health Tracking Program prepared the data display. Data updated: 05/2021. Display updated: 05/2021.

Table 10 Rate and number of confirmed and probable cases of tick-borne disease in Saco, 2016 -2020. (Source: Maine Center for Disease Control and Prevention. Infection Disease Program. Maine Tracking Network Data Portal.)

Rate and Number of Tickborne Diseases in Saco, 2016 - 2020			
	Anaplasmosis	Babesiosis	Lyme
Confirmed and probably cases	9	3	50
Rate (per 100,000 people)	9.4	3.1	52.1

Impacts to the Natural Environment

Increasing and shifting temperatures will impact the natural environment and Maine's wildlife and vegetation. Shorter winters, less snow, a rapid expansion of pests (e.g., winter ticks), presence of parasites previously only found further south, heat stress, more frequent and higher flooding of tidal marshes, invasive species, and changes in available prey species all threaten local species and natural areas. Increasing temperatures impact biodiversity and affect ranges where species can live. Scientists predict that 34%–58% of species will go extinct given current climate change scenarios if they are unable to disperse to new locations, while 11–33% will still go extinct even if they can disperse to future areas that are within their current climatic niche (28).

Rising temperature and shorter winters will impact to Saco's natural areas, vegetation, and wildlife, in addition to how the community interacts with those areas and species.

While Maine's growing season has lengthened overall due to warming temperatures, some years have seen killing frosts in late spring and early fall. It is uncertain whether such events will become more or less frequent in the future, but the trend of longer growing seasons and warmer falls is expected to continue. Climate model projections indicate that in the future, it is likely that increased evaporation will dry surface soil layers, particularly in the warm season[36]. These changes will impact local agricultural activities as well as home gardeners.

DROUGHT AND WILDFIRES

Key Takeaways

- Despite wetter conditions overall, changing precipitation patterns caused by climate change have contributed to the emergence of drought conditions in southern Maine in recent years.
    - There have been four periods of severe to extreme drought in York County since 2000, 3 of which have occurred in the last 7 years.
- Average annual snowfall across the state has decreased about 2 inches since 1895 because more precipitation is falling as rain rather than snow. Lower spring snowpack reduces aquifer recharge, contributing to the emergence of drought.
    - Historic snowfall data in Saco are limited but align with the statewide trend of decreasing annual snowfall amounts.
- Communities supplied by groundwater wells, rivers, or smaller lakes are at greater risk of water quantity and quality impacts from drought.
    - Streamflow in the Saco River, Saco's sole public water source, reached historically low levels during 3 of the most recent droughts.
    - There are 842 private wells in Saco and groundwater levels in York County were historically low during the 4 most recent droughts.
    - During the 2020 and 2022 droughts, 45 and 15 dry wells were reported in York County respectively.
- Wildfire risk may increase with more frequent, severe, and intense droughts, and though the likelihood of wildfires may remain low, such an event could have major impacts on the community.
    - Between 1992 and 2018, Biddeford and Saco were a hotspot for wildfire occurrences compared to the rest of the county.

Background Info, Trends, & Projections

Annual precipitation in York County has increased 6.9 inches since 1895 (see Extreme Storms & Precipitation) and is expected to continue to increase with climate change. Despite wetter conditions overall, changing precipitation patterns caused by climate change have contributed to the emergence of drought conditions in southern Maine in recent years.[37] During the winter, precipitation is increasingly falling as rain

[36] MCC STS. 2020. Scientific Assessment of Climate Change and Its Effects in Maine. A Report by the Scientific and Technical Subcommittee (STS) of the Maine Climate Council (MCC). Augusta, Maine. 370 pp.
[37] ME Drought Task Force Report, 10/6/2022: https://www.maine.gov/mema/hazards/drought-task-force

rather than snow. Average annual snowfall across the state has decreased about 2 inches since 1895, and reduced snowpack depth has been even more pronounced in southern, coastal areas.[38] Spring snowmelt recharges freshwater aquifers, so less snowpack in the spring diminishes spring recharge and results in a lower water table. Low rainfall during the spring and summer along with higher-than-average temperatures can further deplete the water table, increasing the risk of summer and fall droughts.[39]

In the last few years Maine has experienced some of the driest periods in over a century. The driest May to September period since 1895 occurred during the 2020 drought, and September 2020 was the driest month since 1895.[40] In York County, there have been four periods of severe to extreme drought since 2000. These droughts occurred during the summer and fall months of 2001-2002, 2016, 2020, and 2022. There was also an extended period of moderate drought in 2015 (Figure 9).

- 2001-2002: 73%-100% of the county was in a severe drought for 28 weeks from the end of October to May 2002
- 2016: 67%-100% of the county was in a severe drought for 22 weeks from August to December, and 95% of the county was in an extreme drought for 4 weeks from the end of September to mid-October
- 2020: 74%-100% of the county was in a severe drought for 12 weeks from September to December, and 70%-76% of the county was in an extreme drought for 6 weeks from late September to the end of October
- 2022: 66% of the county was in a severe drought for 4 weeks in August

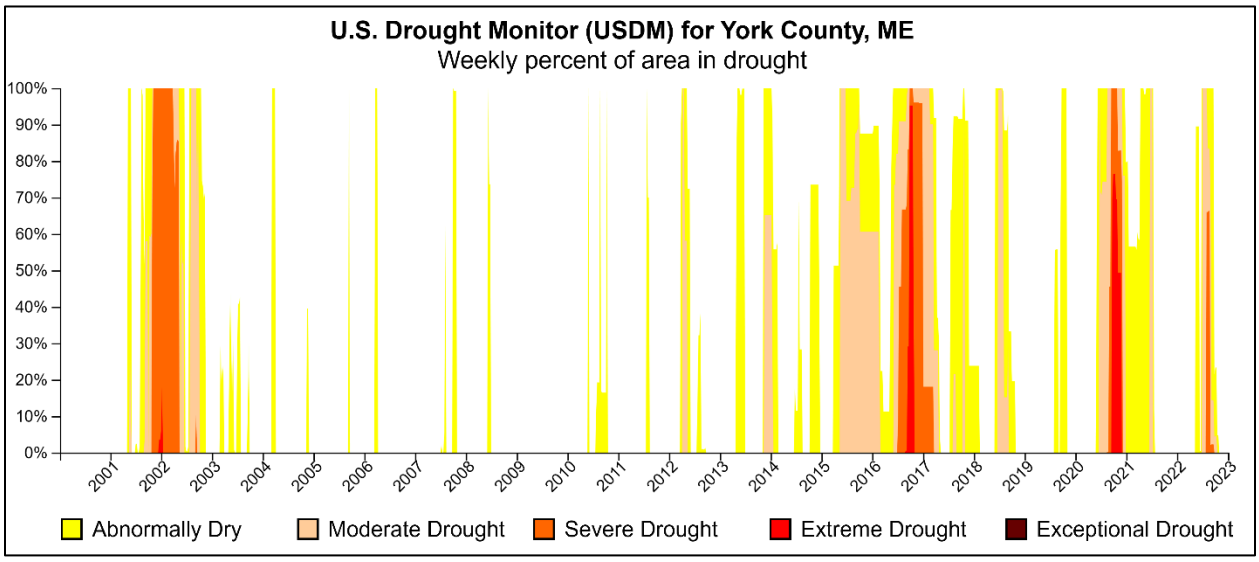


Figure 9 Drought conditions in York County from 2000 to 2022. Four severe to extreme droughts have occurred over the last 20 years and droughts have occurred more frequently in the last decade. Data source: U.S Drought Monitor.

There is limited data for snowfall and snowpack depth in Saco. From 1994 to 2017, snowpack depth was collected at the Tannery Waste Pits site in Saco and reported to the Maine Geological Survey as part of the Maine Cooperative Snow Survey (Figure 10). Historically, March has been the snowiest month in this area.

[38] University of Maine, Maine's Climate Future, 2020: https://climatechange.umaine.edu/climate-matters/maines-climate-future/
[39] ME Drought Task Force Report, 10/6/2022: https://www.maine.gov/mema/hazards/drought-task-force
[40] ME Climate Council, Maine Climate Science Update 2021: http://climatecouncil.maine.gov/reports

Though data are limited in more recent years, the maximum monthly snowfall amounts recorded at this site in February 2012 and April 2017 were 0 inches.

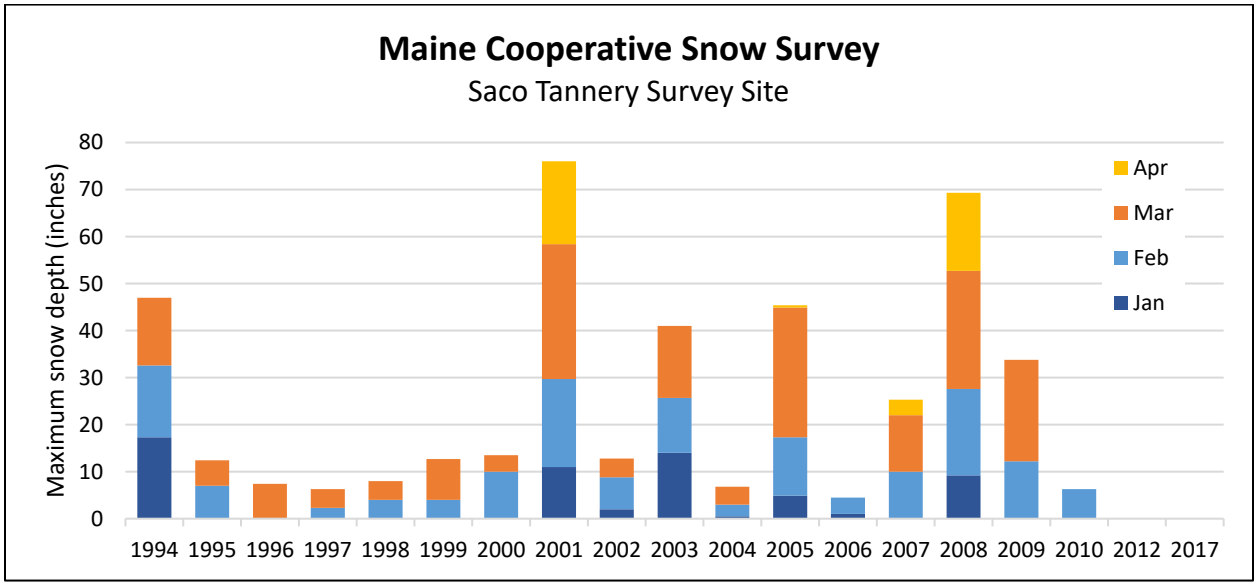


Figure 10 Maximum snow depth at Saco Tannery Survey Site, 1994-2017. Data source: Maine Geological Survey Cooperative Snow Survey

Combined snowfall amounts in Saco during the winters of 2020-21 and 2021-22 were about 2-4 feet less than the previous 30 years, based on data from the Maine Drought Task Force. The snowfall deficit over these two winters resulted in reduced spring snowpack and aquifer recharge, contributing to the emergence of a summer and fall drought in 2022.[41] As future precipitation patterns in southern Maine continue to shift towards more rain and less snow, the risk of drought will likely increase.

Water Supply Impacts

Intense and prolonged droughts have the potential to diminish surface and groundwater supplies and degrade water quality.[42] Communities supplied by groundwater wells, rivers, or smaller lakes are at greater risk of water quantity and quality impacts from drought.[43] The City of Saco is serviced by the Biddeford and Saco Division of the Maine Water Company, and the Saco River is the sole source of Saco's public water supply.[44]

The United States Geological Survey (USGS) monitors daily streamflow conditions in the Saco River. Since 2000, the lowest recorded streamflows occurred in September 2002, October 2016, and September 2020, coinciding with the three most prolonged and intense droughts in the region.[45]

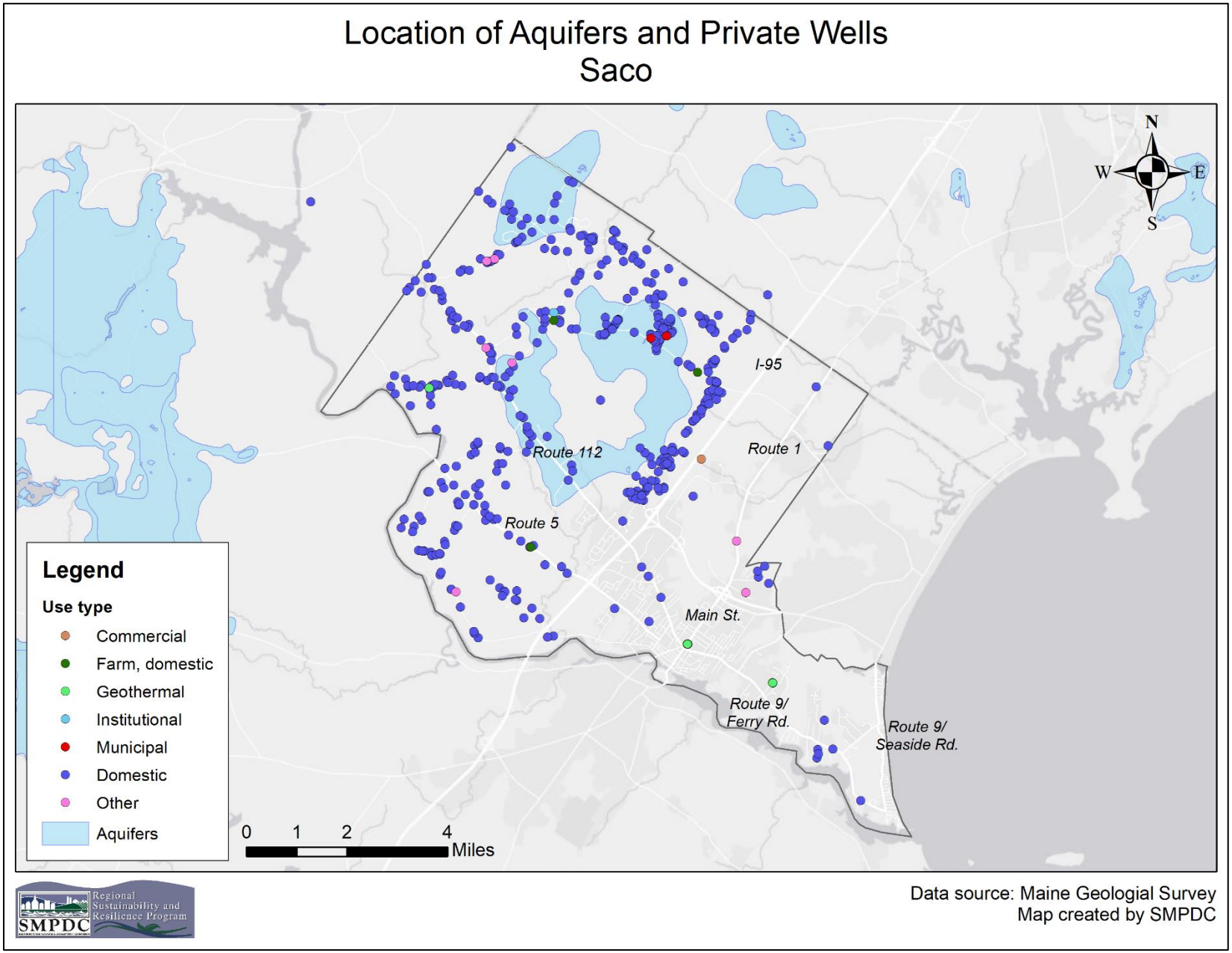
To date, it does not appear that the Biddeford and Saco Division of the Maine Water Company has experienced significant water quality or quantity issues because of drought.[46] However, the Maine CDC Drinking Water Program did receive reports of low water quantity from public water suppliers during the

[41] ME Drought Task Force Report, 10/6/2022: https://www.maine.gov/mema/hazards/drought-task-force
[42] ME Climate Council, Maine Climate Science Update 2021: http://climatecouncil.maine.gov/reports
[43] Casco Bay Estuary Partnership, Climate Trends in Casco Bay, 2015: https://www.cascobayestuary.org/publication/climate-trends-in-the-casco-bay-region/
[44] Maine Water Company, Biddeford and Saco 2021 Water Quality Report: https://www.mainewater.com/water-quality/water-quality-report
[45] USGS Streamflow monitoring data: https://waterdata.usgs.gov/monitoring-location/01066000/#parameterCode=00065&period=P7D
[46] EPA Safe Drinking Water Information System: https://ordspub.epa.gov/ords/sfdw/f?p=SDWIS_FED_REPORTS_PUBLIC:PWS_SEARCH:::::PWSID:ME0090170

2022 summer drought.[47] Additionally in the summer of 2022, the public water supply in Berwick, sourced by the Salmon Falls River, contained elevated levels of manganese due to low water levels, making it unsafe for children to drink.[48] In the future, more frequent, prolonged, or intense droughts have the potential to cause similar types of issues with Saco's public water supply.

Drought can also impact water quantity and quality in private wells. There are a total of 842 private wells in Saco (476 wells have location data and are displayed on Map 19), and 95% of these wells are for domestic use.

[47] ME Drought Task Force Report, 8/4/2022: https://www.maine.gov/mema/hazards/drought-task-force
[48] Maine Public, 8/4/2022: https://www.mainepublic.org/environment-and-outdoors/2022-08-04/berwick-issues-drinking-water-advisory-due-to-ongoing-drought-conditions



Map 19 Location of aquifers and private wells in Saco, including well use type. Data source: Maine Geological Survey

The USGS monitors groundwater levels in York County at an index well in Sanford (Figure 11). Since 2000, the lowest recorded groundwater levels occurred in November 2002, October 2015, and October 2016, coinciding with the 2002 and 2016 severe droughts and the 2015 moderate drought. Groundwater levels were also low in October 2020, coinciding with the 2020 drought.

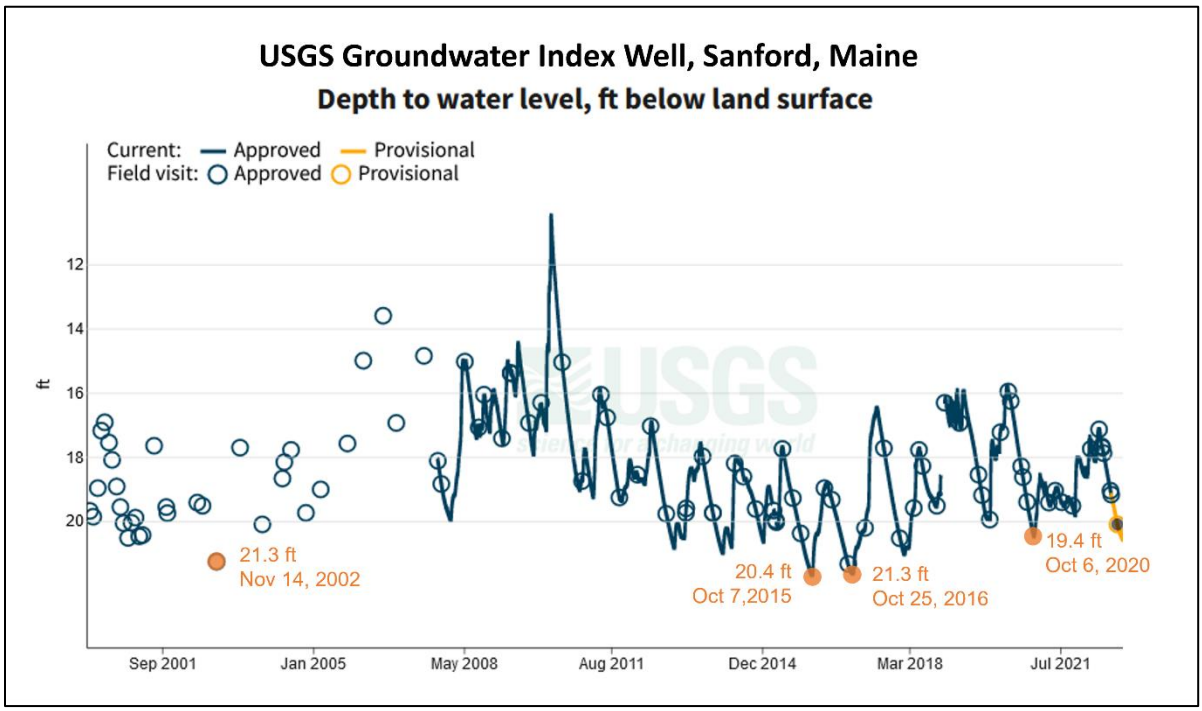


Figure 11 Groundwater levels in York County measured at an index well in Sanford, 2001-2021. Data source. United States Geological Survey

Since 2020, the Maine Drought Task Force has collected data about wells that run dry due to drought (Table 11). In 2020, 45 wells in York County ran dry compared to 2 in 2021, and 15 in 2022. Though these data are limited, they correlate with the intensity of the 2020 drought compared to the 2022 drought. In the future, more frequent, prolonged, or intense droughts could pose a risk to the hundreds of homeowners and businesses in Saco who rely on groundwater wells as their water source.

Table 11 Number of dry wells reported in York County, 2020-2022. Data source: Maine Emergency Management Agency

Maine Dry Well Survey			
Year	**2020**	**2021**	**2022**
York County	45	2	15

Impacts to the Natural Environment

Some of the environmental impacts of drought are listed in Table 12.

Table 12 Environmental impacts of drought. Data source: 2018 York County Hazard Mitigation Plan, Pennsylvania

Damage to animal species	Damage to plant communities
• lack of feed and drinking water • disease • loss of biodiversity • migration or concentration • degradation of fish and wildlife habitats	• loss of biodiversity • loss of trees from urban landscapes and wooded conservation areas • Increased number and severity of fires • Reduced soil quality

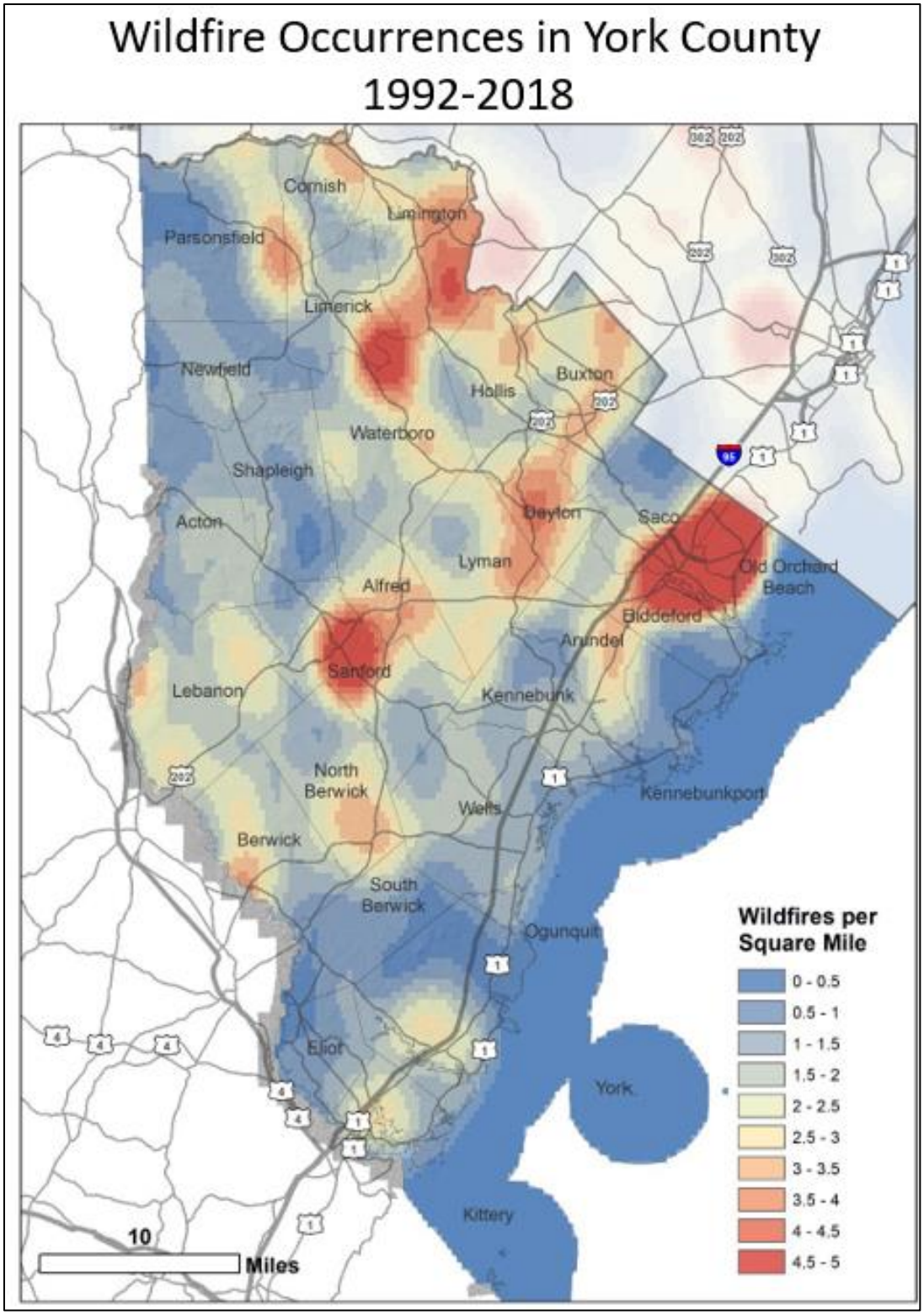
Although wildfire risk may seem small in Maine compared to the western U.S., wildfires do occur and are often associated with periods of drought. In 1947, drought induced wildfires burned over 200,000 acres across the state.[49] The Maine Drought Task Force reported a higher number of wildfires in 2020, compared to 2021 and 2022, coinciding with the long, intense drought that summer and fall (Table 13).[50]

Table 13 Annual number of wildfires statewide 2020-2022. Data source: Maine Drought Task Force 10/6/2022 Report

Maine Wildfire Occurrences			
Year	**2020**	**2021**	**2022**
Annual total	1,154	650	624

In neighboring Biddeford, there were two large wildfires during the 2002 summer drought which destroyed about 10 acres.[51] More recently, in April 2020 a large wildfire burned about 20 acres of wooded area and took 3 hours to get under control.[52] Between 1992 and 2018, Biddeford and Saco were a hotspot of wildfire occurrences compared to the rest of the county (Map 20).[53] In the future, more frequent, prolonged, or intense droughts have the potential to increase the risk of wildfires, posing a threat to Saco's natural environment and public safety.

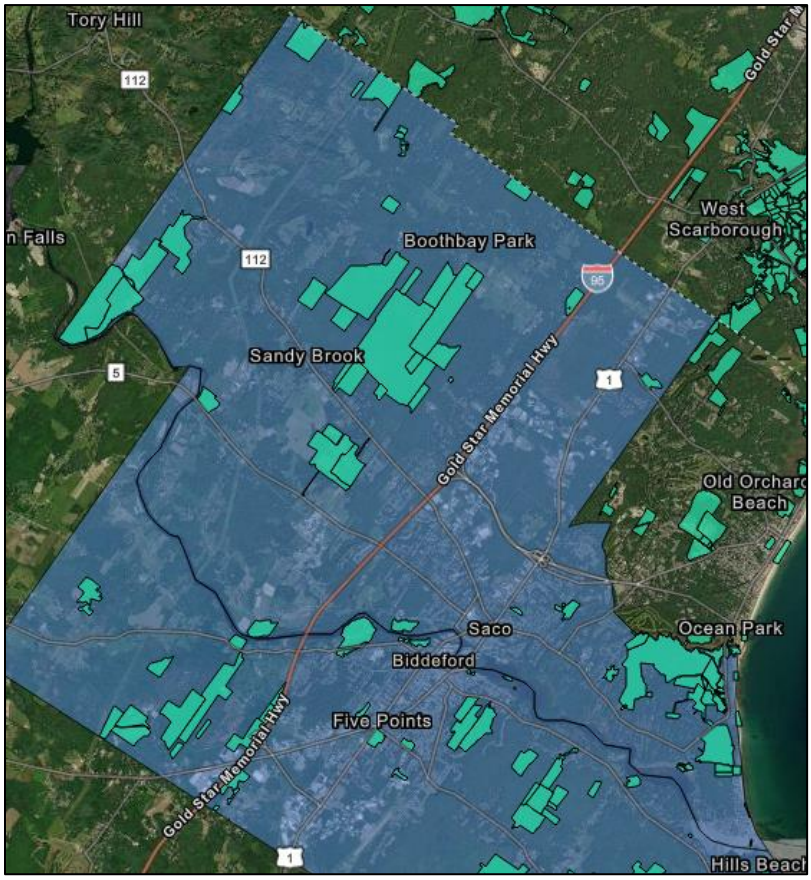
[49] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management
[50] ME Drought Task Force Report, 10/6/2022: https://www.maine.gov/mema/hazards/drought-task-force
[51] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management
[52] Portland Press Herald: https://www.pressherald.com/2020/04/06/wildfires-rage-across-maine-on-monday/
[53] York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management



Map 20 Wildfire occurrence in York County per square mile, 1992-2018. Data source: York County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.yorkcountymaine.gov/emergency-management

The Maine Natural Areas Program inventories land parcels owned by federal, state, municipal, and non-profit entities that have conservation easements protecting them from future development. The Saco Heath Preserve, located off Route 112, is the largest swath of conserved land in Saco and is held by the Nature Conservancy (Map 21). Other significant conserved lands include Horton Woods off Route 112, and an area held by Maine Farmland Trust around the Ecology School. The marsh at the mouth of Goosefare Brook is conserved by the USFWS Rachel Carson National Wildlife Refuge and Ferry Beach State Park is conserved by the State. There are several smaller pockets of conserved land throughout the community that are held either by the City of the Saco or the Saco Valley Land Trust.

The Saco Heath Preserve includes freshwater wetlands, freshwater aquifers, rare and endangered species habitat, and deer winter areas. Horton Woods and the area around the Ecology School have important river habitat, freshwater wetlands, and deer winter areas. Some of the richest habitat in Saco is located at the mouth of Goosefare Brook and is part of the National Wildlife Refuge. This area includes tidal marshes, freshwater wetlands, rare and endangered species habitat, important river habitat, tidal waterfowl and wading bird habitat, and deer wintering areas. Further south along the shore, Ferry Beach State Park and the banks of the Saco River have important habitat areas including tidal marshes, freshwater wetlands, rare and endangered species habitat, and tidal waterfowl and wading bird habitat. In the future, more frequent, prolonged, or intense droughts have the potential to degrade these critical habitat areas.



Map 21 Conserved lands in Saco are indicated by the green polygons. Data source: Maine Natural Areas Program. Map source: Climate Ready Coast Southern Maine

Agricultural Impacts

Drought can impact agricultural operations due to shifts in the growing season, crop losses, and increased costs associated with irrigation. During the 2022 drought, the Maine Drought Task Force reported that farmers had to irrigate their crops, increasing their operational costs.[54] In both 2020 and 2022, the Farm Services Administration issued emergency declarations for York County as a result of prolonged, severe drought conditions.[55] Even if farmers have irrigation systems, water supply can still be an issue. The Maine Department of Environmental Protection restricts irrigation withdrawals when stream and river levels fall below a certain threshold.[56]

Saco is known for its beautiful beaches and picturesque downtown, but the City has a strong agricultural heritage as well. There are several operating farms in Saco that grow fruits and vegetables and raise goats and horses. Every Saturday during the summer and fall a farmer's market is held at the Saco Valley Shopping Center. In the future, more frequent, prolonged, or intense droughts have the potential to reduce local farmer's production, increase their costs, and disrupt the local food system.

CHANGING MARINE CONDITIONS

Key Takeaways

- In the last 40 years, ocean temperatures have risen faster in the Gulf of Maine than almost anywhere else in the world. Ocean temperatures will likely rise 1.5°F by 2050, and Maine's marine ecosystem will resemble present day conditions in southern New England.
    - There is limited commercial fishing and aquaculture activity in Saco, however the individuals who rely on these commercial fishing for their livelihoods are vulnerable to the economic impacts of changing marine conditions.
- Ocean and coastal acidification are expected to worsen due to higher amounts of carbon dioxide in the atmosphere and more frequent precipitation events.
- The dynamics of harmful algal blooms (HABs) in Maine have shifted in recent years and could continue to change in the future, posing new threats to public health.
- Eelgrass is an important nursery habitat for commercially important species and is an indicator species for overall ecosystem health.
    - There is a small eelgrass bed offshore near Eagle Island and a large bed off Ferry Beach that emerged in the last decade.
    - Between 2010 and 2021, the extent and density of the Eagle Island eelgrass bed expanded and increased slightly and a low density, but large eelgrass bed off Ferry Beach emerged.
    - Improved water quality due to better stormwater and wastewater management practices or a lack of invasive European green crabs may have caused the eelgrass habitat gains.
    - In the future, more frequent and intense precipitation and increasing invasive species have the potential to decimate eelgrass habitat, reducing the carbon sink and coastal resilience benefits this habitat provides.

[54] ME Drought Task Force Report, 8/4/2022: https://www.maine.gov/mema/hazards/drought-task-force
[55] Cumberland County Emergency Management Agency, Hazard Mitigation Plan, 2022: https://www.cumberlandcounty.org/231/Hazard-Mitigation
[56] Maine DEP Press Release: https://www.maine.gov/dep/news/news.html?id=8535391

Background Info, Trends, & Projections

Southern Maine is located in the Gulf of Maine which stretches from Cape Cod to Nova Scotia. Since 1982, ocean temperatures in the Gulf of Maine have risen 96% faster than the rest of the world's oceans due to rising air temperatures and shifting ocean currents caused by climate change.[57] Marine species ranges are shifting northward following their habitats. Lobster stocks in Long Island Sound and southern New England have collapsed, and as ocean temperatures continue to warm, Maine's lobster resource could be headed in the same direction. Warming waters have also allowed invasive species like European green crabs, Asian shore crabs, and tunicates to proliferate. Future projections indicate that by 2050 ocean temperatures in Maine will likely rise 1.5°F, and the marine ecosystem will resemble present day conditions in southern New England.[58]

The oceans are also becoming more acidic. As carbon dioxide builds up in the atmosphere from the burning of fossil fuels, some of that carbon dioxide is absorbed into the ocean. Dissolved carbon dioxide changes the chemical conditions of the water, making it more acidic. In coastal areas, ocean acidification is exacerbated by nutrient rich runoff which can trigger agal blooms. As the blooms die off and decay, the water becomes more acidic. Ocean and coastal acidification primarily impact shellfish species like scallops, oysters, clams, and mussels, all of which are commercially harvested in Maine. Both ocean and coastal acidification are expected to worsen in the future with increasing fossil fuel emissions and increasing and intensifying rainfall events.[59]

It is hypothesized that warming waters and shifting currents due to climate change are changing the dynamics of harmful algal blooms (HABs) in Maine. Every summer Maine has a "red tide" when a toxin producing phytoplankton species blooms. Shellfish become contaminated with the toxin and when eaten can cause Paralytic Shellfish Poisoning. In recent years, Maine has experienced blooms of new HAB species that have different impacts on human health and the ecosystem. Currently it is unclear how HAB dynamics may shift with climate change, but coastal Maine communities face an uncertain future regarding the public health, economic, and ecosystem impacts of HABs.

Habitat Shifts and Carbon Sinks

Eelgrass beds are critical marine habitat for commercially important species such as fish and shellfish. It is also vital to estuarine ecosystem functioning because it provides nursery habitat for many species. Eelgrass is sensitive to sediment loading and pollutants often caused by poor stormwater and wastewater management. Invasive species including the European green crab and various tunicate species also destroy eelgrass habitat, uprooting plants and smothering growth. As a result, eelgrass habitat loss is generally indicative of poor watershed management practices and declining ecosystem health.[60]

Eelgrass habitat in southern Maine was most recently surveyed in 2021 by the Maine Department of Environmental Protection and was previously surveyed in 2010 by the Maine Department of Marine Resources. Based on these two surveys, there is a small eelgrass bed offshore near Eagle Island and a large bed off Ferry Beach that emerged in the last decade (Map 22). Between 2010 and 2021, the extent and density of the Eagle Island eelgrass bed expanded and increased slightly and the low density, but large eelgrass bed off Ferry Beach emerged. These habitat shifts suggest that water quality may have improved over this time period, possibly as a result of better stormwater and wastewater management practices.

In addition to poor water quality, invasive European green crabs can destroy eelgrass habitat. Substantial eelgrass habitat losses were observed in Casco Bay between 2012 and 2013 coinciding with a rapid increase in

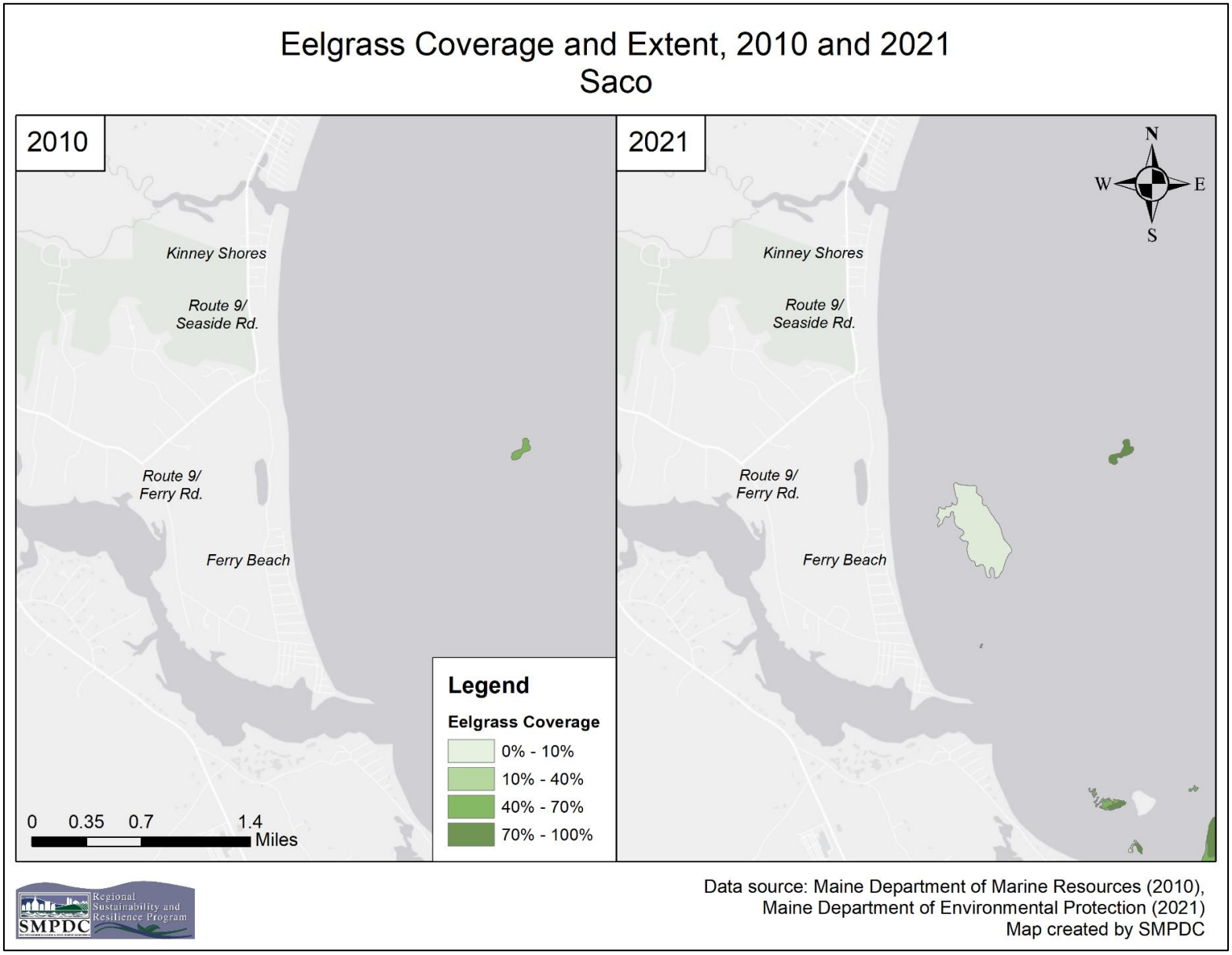
[57] https://www.gmri.org/stories/gulf-of-maine-warming-update-summer-2021/
[58] University of Maine, Maine's Climate Future, 2020: https://climatechange.umaine.edu/climate-matters/maines-climate-future/
[59] ME Climate Council, Scientific Assessment of Climate Change and Its Effects in Maine, 2020: http://climatecouncil.maine.gov/reports
[60] Piscataqua Region Estuaries Partnership: https://prepestuaries.org/eelgrass/

the green crab population.[61] The status of the green crab population in southern Maine is not as well understood but these data suggest that green crabs may not have been as much of a problem in Saco as they have been in Casco Bay.

In the future, extreme precipitation events are expected to become more frequent and intense which will likely present new and increasing stormwater and wastewater management challenges. The shorefront from Kinney Shores to Camp Ellis also has a high degree of impervious surfaces (see Extreme Storms & Precipitation Map 10), which increases runoff during heavy rainfall events and degrades coastal water quality. Additionally, warming ocean temperatures favor green crab population growth which may contribute to future eelgrass habitat loss.[62]

There is evidence that eelgrass beds can serve as carbon sinks, absorbing carbon dioxide from the water and locally reducing the influence of ocean and coastal acidification. The vegetation also stabilizes sediments and reduces wave action which has the potential to buffer coastlines from intense coastal storms. For these reasons, eelgrass habitat is not only important for its role in ecosystem functioning, but also for the climate mitigation and resilience benefits it provides. These ecosystem services emphasize the importance of protecting this vulnerable habitat.[63]

[61] Casco Bay Estuary Partnership, Eelgrass Beds Decline as Green Crab Numbers Explode, 2015: https://www.cascobayestuary.org/wp-content/uploads/2015/10/Indicator_Eelgrass.pdf
[62] ME Climate Council, Scientific Assessment of Climate Change and Its Effects in Maine, 2020: http://climatecouncil.maine.gov/reports
[63] ME Climate Council, Scientific Assessment of Climate Change and Its Effects in Maine, 2020: http://climatecouncil.maine.gov/reports



Map 22 Distribution and coverage of eelgrass habitat in Saco in 2010 and 2021 based on surveys conducted by the Maine Department of Marine Resources and the Maine Department of Environmental Protection. These data indicate the location of potential carbon sinks as well as marine ecosystem shifts over time.

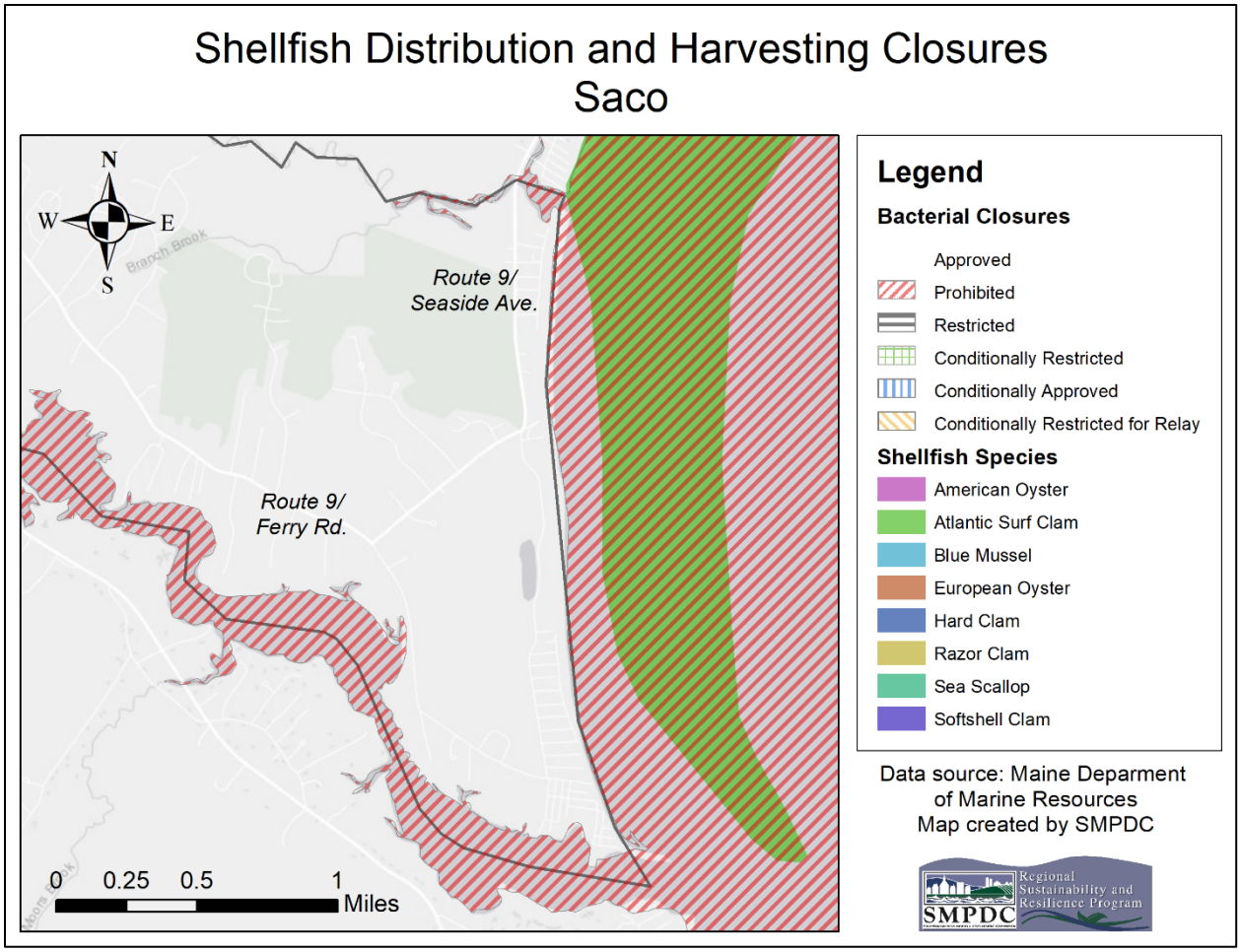
Economic Impacts

There are a total of 43 commercial fishing licenses held in Saco and 83 non-commercial licenses (Table 14). The majority of these licenses are for harvesting lobster and crab, or fish. Individuals who rely on these fisheries for their livelihoods, especially lobster, may experience economic impacts as species' ranges shift with climate change. Recreational fishing opportunities for non-commercial license holders may also be impacted, representing a significant cultural loss for the community.

Table 14 Commercial and non-commercial fishing licenses in Saco. Data source: Maine Department of Marine Resources.

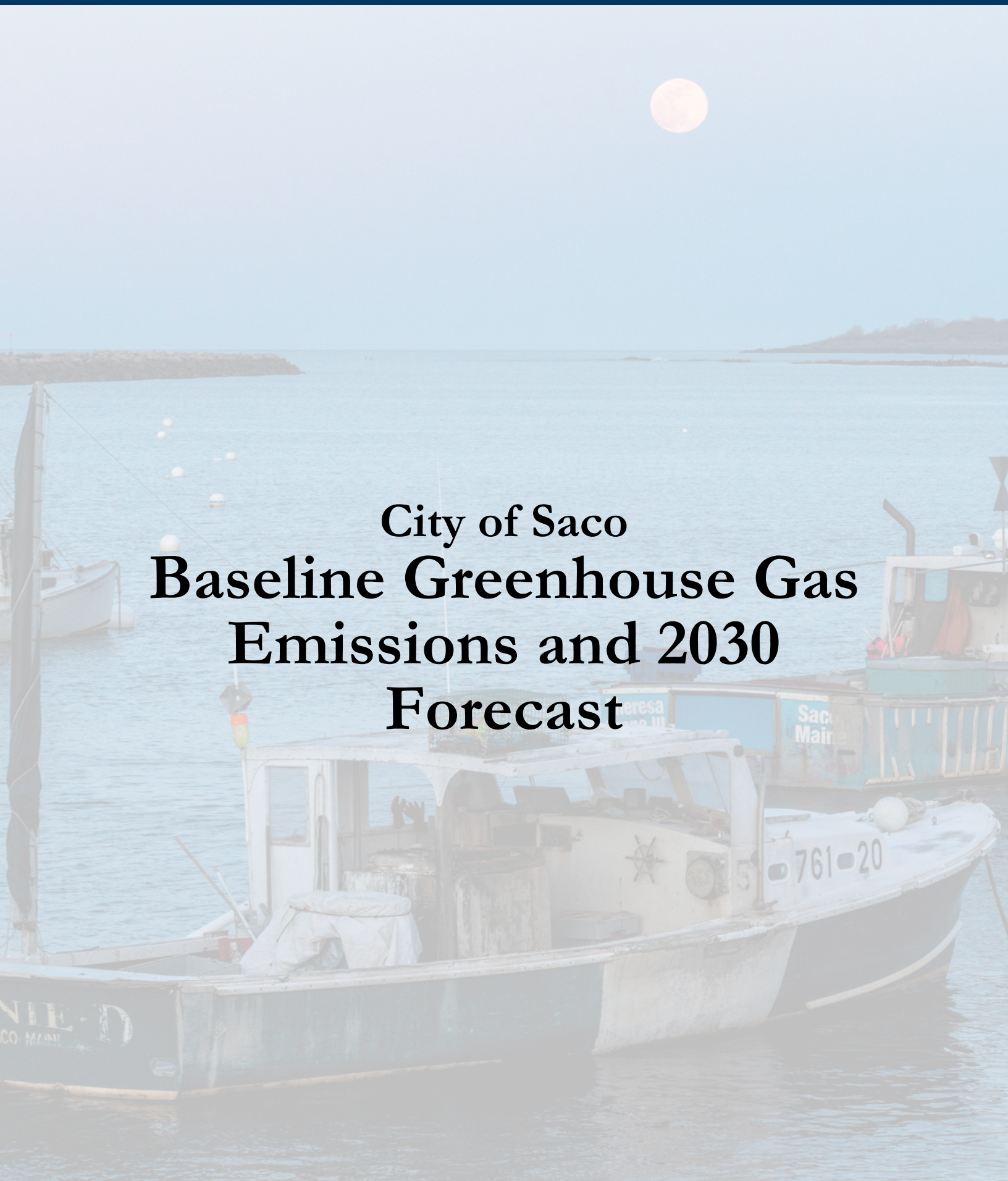
Commercial and Non-Commercial Fishing Licenses	
Commercial	**Number of Licenses**
Lobster/crab	19
Fishing	15
Menhaden	3
Shellfish	2
Scallop dragger	2
Green crab	1
Elver	1
Total	*43*
Non-Commercial	
Lobster/crab	42
Saltwater fishing	41
Total	*83*

In 2010, the Maine Department of Marine Resources (DMR) conducted a survey of shellfish habitat across the state. Based on that survey, there was a significant Atlantic surf clam bed along Saco's coastline (Map 23). However, shellfish harvesting is prohibited in Saco's coastal waters and the Saco River estuary. As a result, wild shellfish harvesting is limited in Saco and there are only 2 commercial shellfish harvesters in Saco. The community is therefore less economically vulnerable to the impacts of climate change on shellfish species. However, warmer waters, ocean acidification, and HABs have the potential to impact these species which are a critical part of the marine ecosystem.



Map 23 Distribution of shellfish species based on a survey conducted by the Maine Department of Marine Resources in 2010. Areas that are prohibited for shellfish harvesting based on poor water quality from bacterial contamination are indicated. Data source: Maine Department of Marine Resources.

In the last decade aquaculture has exploded in Maine, particularly in southern Maine where the impacts of the declining lobster fishery have been felt more acutely. Aquaculture is viewed as a climate resilient alternative to wild harvest fisheries like lobster. There are no shellfish farms in Saco, likely because coastal waters are closed to shellfish harvesting. The only aquaculture activity is an experimental lease site off Ram Island for growing sugar kelp held by the University of New England. Shifting marine conditions due to climate change have the potential to impact aquaculture operations, however based on limited aquaculture activity, Saco is not directly vulnerable to these economic impacts.



City of Saco
Baseline Greenhouse Gas Emissions and 2030 Forecast

CITY OF SACO

Baseline Greenhouse Gas Emissions and 2030 Forecast

INTRODUCTION

The City of Saco is already experiencing the effects of climate change and is beginning to take steps to address its causes and impacts. Saco's Comprehensive Plan Update recommends the city pursue a Climate Adaption Action Plan (CAAP). Saco's community has also identified climate action planning as a priority in its City Council's Resolution Endorsing the Declaration of a Climate Emergency and Emergency Mobilization Effort to Restore a Safe Climate and has enrolled in the Governor's Office of Policy Innovation and the Future's Community Resilience Partnership.

This greenhouse gas (GHG) inventory summarizes a baseline of GHG emissions in the City of Saco to be used in the city's CAAP. It identifies the activities and major sources of emissions, enabling the town to identify areas to focus emission reduction efforts, establish goals and track progress towards those goals, and facilitate decision-making about future policies and strategies.

Why Greenhouse Gas Inventories Matter

The City of Saco is already experiencing the impacts of climate change, including warmer air and ocean temperatures, shorter winters, and new pests and diseases.[1] These changes are primarily driven by an increase of carbon dioxide (CO_2) and other greenhouse gases (GHGs) in the atmosphere, largely due to the combustion and use of fossil fuels. These GHGs trap heat in the Earth's atmosphere. They let short-wave sunlight pass through the atmosphere but prevent some of the long-wave radiation emitted from the earth from leaving, thereby warming the atmosphere. As we burn more and more fossil fuels, GHGs continue to build up in the atmosphere, trapping an ever-greater amount of heat.

A greenhouse gas inventory is an account of all the GHG emissions from sources within a community. It is a tool to help communities:

- Understand ongoing activities and major sources of emissions
- Identify areas to focus emission reduction efforts
- Establish goals and track progress towards those goals

[1] MCC STS. 2020. *Scientific Assessment of Climate Change and Its Effects in Maine*. A Report by the Scientific and Technical Subcommittee (STS) of the Maine Climate Council (MCC). Augusta, Maine. 370 pp. http://climatecouncil.maine.gov/future/sites/maine.gov.future/files/inline-files/GOPIF_STS_REPORT_092320.pdf

- Facilitate decision-making about future policies and strategies

An inventory is usually calculated for a specific analysis year. Subsequent inventories every 3-5 years can aid local decision-makers and municipal staff in prioritizing and evaluating emission reduction strategies.

This report contains two inventories for the City of Saco: A *community-wide inventory* and a *municipal inventory*. A community-wide GHG inventory estimates the amount of GHG emissions associated with community sources and activities, meaning those of a municipality's residents, workforce, visitors, and economy. A municipal GHG inventory estimates only the emissions occurring because of local government operations, including those from government buildings and facilities, government fleet vehicles, wastewater treatment and potable water treatment facilities, landfill facilities, and other operations.

What Greenhouse Gases are Included

The primary GHGs included in a GHG inventory are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Each GHG contributes differently to warming in the atmosphere, where some are far more potent than others in the same quantities.[2] Because CH_4 and N_2O absorb far more energy than CO_2 in the atmosphere, global warming potentials (GWP) are needed to account for the warming impact of each gas. A GWP is a measure of how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of CO_2. To show the total emissions impact, emissions of CH_4 and N_2O are converted to metric tons of CO_2 equivalent (MT CO_2e) using each gas' GWP.

There are many other types of greenhouse gases, including perfluorocarbons, hydrofluorocarbons, sulfur hexafluoride, and nitrogen trifluoride. This protocol does not address these gases because they occur in much smaller quantities and are difficult to estimate for community-wide and municipal sources.

[2] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

COMMUNITY WIDE INVENTORY

Overview

The community-wide inventory estimates the GHG emissions due to Saco's sources and activities, including those of Saco's residents, workforce, visitors, and economy. This inventory was calculated for all emissions activities occurring in 2021. In the case where 2021 data was not available, 2018, 2019, or 2020 data were used as a substitute.

Methodology

This inventory was conducted using the methodology laid out in the SMPDC Greenhouse Gas Inventory Protocol for Southern Maine Cities and Towns. This is a standardized and simplified protocol for community-wide GHG inventories. The ICLEI ClearPath reporting platform was used for emissions calculations and accounting.

Community-wide GHG emissions may be either directly created (e.g., through household heating or vehicle fuel combustion) or indirectly created (e.g., through grid electricity use) by community members. For the inventory, emission types are divided into different sectors and subsectors. Table 1 shows the sectors and subsectors *included* in the Saco GHG inventory.

There are several sectors and subsectors of emission sources that were *excluded* from Saco's community-wide inventory (Table 2). In some cases, it is because these categories are not applicable to the Town of Saco. In others, it is because data for emissions in those categories are less readily available, are likely inaccurate given current methodologies, and/or have little relevance to municipal climate action planning.

Table 1 Sectors and Subsectors Included in the Saco Community-Wide GHG Inventory

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE/END USE
STATIONARY ENERGY	Residential	Energy used in buildings as well as losses from distribution systems	Electricity
		Energy used in buildings	Discrete Fuel and Natural Gas
	Commercial	Energy used in commercial, government, and institutional buildings as well as losses from distribution systems	Electricity
		Energy used in commercial, government, and institutional buildings	Discrete Fuel and Natural Gas
	Industrial	Energy used in manufacturing and industrial facilities as well as losses from distribution systems	Electricity
		Energy used in manufacturing and industrial facilities	Discrete Fuel and Natural Gas
TRANSPORTATION	Passenger Vehicles	Fuel combusted from all passenger vehicle trips that are attributable to the community	Gasoline, Diesel, Electricity
	Commercial Vehicles	Fuel combusted from all commercial vehicle trips that are attributable to the community	Gasoline, Diesel, Electricity
	Public Transit	Fuel combusted due to passenger miles travelled on public transit	Gasoline, Diesel, Electricity
	Marine Vessels	Fuel combusted by boats that are registered in Saco	Gasoline, Diesel
WASTE	Municipal Solid Waste - Incineration	GHG emissions resulting from the incineration of all trash generated by residential and commercial activity in the community that is sent to an incineration plant	Incineration Emissions
	Compost	GHG emissions resulting from the breakdown of all composted material generated by residential, commercial, and schools	Aerobic and Anaerobic Digestion
	Wastewater – Septic	Emissions from wastewater processed in Saco Septic Systems	Aerobic and Anaerobic Digestion
	Wastewater – Wastewater Treatment Plant	Emissions from wastewater treated at Saco WWTP	Aerobic and Anaerobic Digestion
	Wastewater-Effluent Discharge	Emissions from wastewater effluent from Saco WWTP	Aerobic and Anaerobic Digestion

*Table 2 Sectors and Subsectors **Excluded** From the Saco Community-Wide GHG Inventory*

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE/ END USE	REASON
TRANSPORTATION	Passenger Rail	Fuel combusted due to passenger miles travelled on passenger rail	Gasoline, Diesel, Electricity	Data availability
	Freight Rail	Emissions from the movement of freight on rail lines through a community	Gasoline, Diesel, Electricity	Data availability, not relevant for municipalities
	Off-Road Equipment	Emissions that result from airport equipment, agricultural tractors, chain saws, forklifts, snowmobiles, etc.	Gasoline, Diesel, Electricity	Data availability
	Aviation	Fuel combusted from passenger and commercial air travel	Jet Fuel	Data availability
WASTE	Municipal Solid Waste - Landfilling	Landfill gas emissions resulting from all trash generated by residential and commercial activity in the community and sent to landfill	Landfill Gas	Not applicable in Saco
INDUSTRIAL	Industrial Process Emissions	Process and fugitive emissions from industrial facilities	Combustion and other Chemical Emissions	Data availability
	Product Use	Emissions from the use of products such as refrigerants, foams, or aerosol cans	Combustion and other Chemical Emissions	Data availability
AGRICULTURE, FORESTRY, MARINE	Livestock	Emissions from manure management and enteric fermentation	Enteric fermentation and manure management	Data availability
	Land	Emissions and sequestration of GHGs from land use changes	Soil and Land Management Changes	Data availability, methodology

Community-Wide Inventory

Figure 1 summarizes Saco's 2021 community-wide GHG inventory. Community-wide emissions for 2021 were estimated as 206,545 Metric Tons CO_2 equivalent (MT CO_2e). This is equivalent to 9.99 MT CO_2e per capita based on the city's Census.gov 2021 population estimate. The largest category of these emissions (42.3%) is on-road transportation, including the emissions from passenger and commercial vehicles as well as public transit. The second largest category is residential buildings (29.6%), including emissions from

electricity and energy used for home heating. The third largest category is commercial/industrial buildings (18.2%), followed by solid waste disposal (9.3%).

For comparison, the city of Biddeford's 2019 GHG inventory estimates Biddeford's community-wide emissions to be 240,692 MT CO_2e, equivalent to 10.69 MT CO_2e per capita. On-road transportation is also Biddeford's largest category of emissions, followed by energy use in residential buildings.

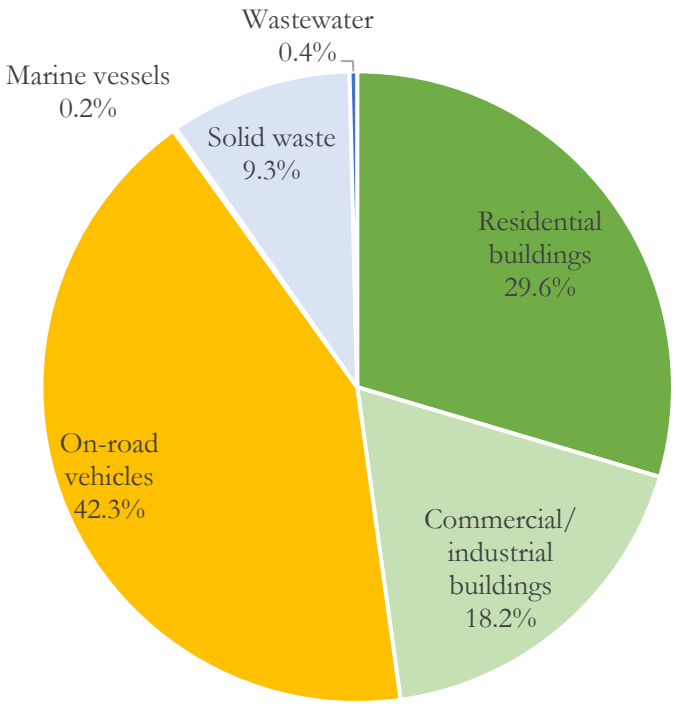


Figure 1: Summary of Saco's 2021 Community-Wide Emissions

Figure 2 shows emissions grouped by end use or emissions source. The largest single source of community-wide emissions is passenger vehicles (31.8%) from diesel and gasoline fuel combustion. Residential heating fuels, including fuel oil, propane, and kerosene, are the second largest source of emissions (20.5%). Together, these two emissions sources account for over half of the community-wide emissions. Overall, the categories that represent the energy Saco's residents, visitors and businesses use for transportation, electricity and heating make up over 90% of Saco's community-wide emissions.

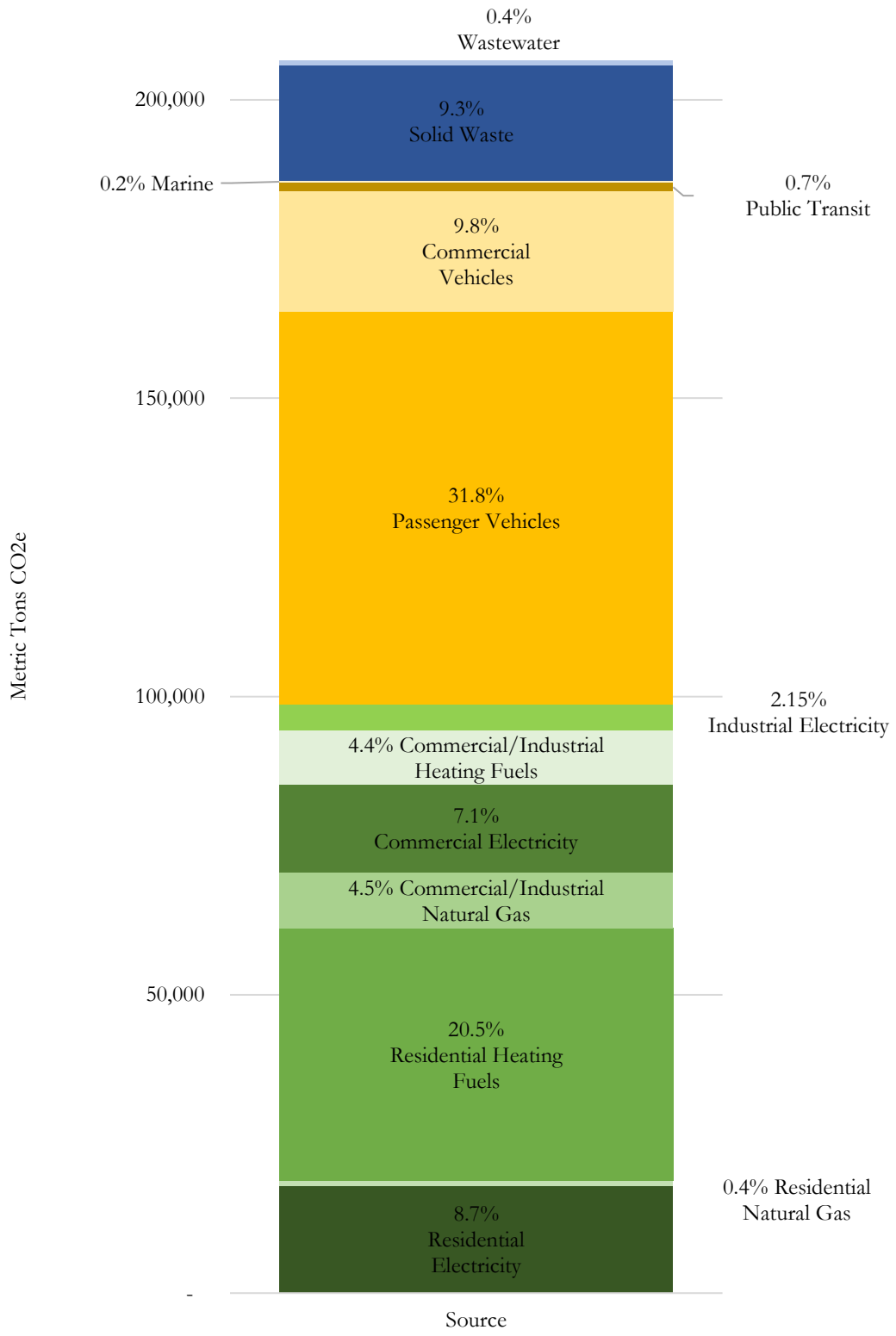


Figure 2. Saco's Community-Wide Emissions by End Use/Source

MUNICIPAL INVENTORY

Overview

The municipal inventory accounts for the GHG emissions due to the municipal operations of the City of Saco, including municipal buildings and vehicles. This inventory was calculated for all emissions activities occurring in 2021. In the case where 2021 data was not available, 2018, 2019, or 2020 data were used as a substitute. The boundary of this inventory is Saco's operational control boundary. This includes any emissions sources that the municipality has full authority over their operating policies. Emissions from non-municipal public buildings (such as the school district buildings and library) are excluded from the municipal emissions inventory.

Methodology

The inventory was prepared using the Local Government Operations Protocol for the quantification and reporting of greenhouse gas emissions inventories. Developed in partnership by the California Air Resources Board, California Climate Action Registry, and ICLEI – Local Governments for Sustainability, the protocol provides step-by-step guidance on developing a municipal GHG inventory.

Municipal GHG emissions may be either directly created (e.g., through building heating or vehicle fuel combustion) or indirectly created (e.g., through grid electricity use) by municipal operations. For the municipal inventory, emission types are divided into different sectors and subsectors. Table 3 shows the sectors and subsectors *included* in the Saco municipal GHG inventory.

There are several subsectors of emission sources that were *excluded* from Saco's municipal inventory (Table 4). Saco does not operate a transit fleet or a school bus fleet, and so these subsectors were excluded. Similarly, Saco is served by Maine Water, over which the City of Saco does not have operational control. Because of this, the water treatment subsector is excluded (although it's electricity use is captured in the community-wide inventory). Due to lack of municipally-generated waste data, the waste – municipal solid waste (MSW) subsector is also excluded. Table 5 shows the sectors excluded from Saco's municipal GHG inventory.

Collecting the Data

Municipal emissions were calculated by multiplying activity data (e.g., fuel consumption) by the corresponding emission factors (e.g., tons CO_2 emitted per gallon of fuel combusted) for each activity. This activity data was compiled from vendor invoices and utility data platforms.

*Table 2. Sectors and Subsectors **Included** in Saco's Municipal GHG Inventory*

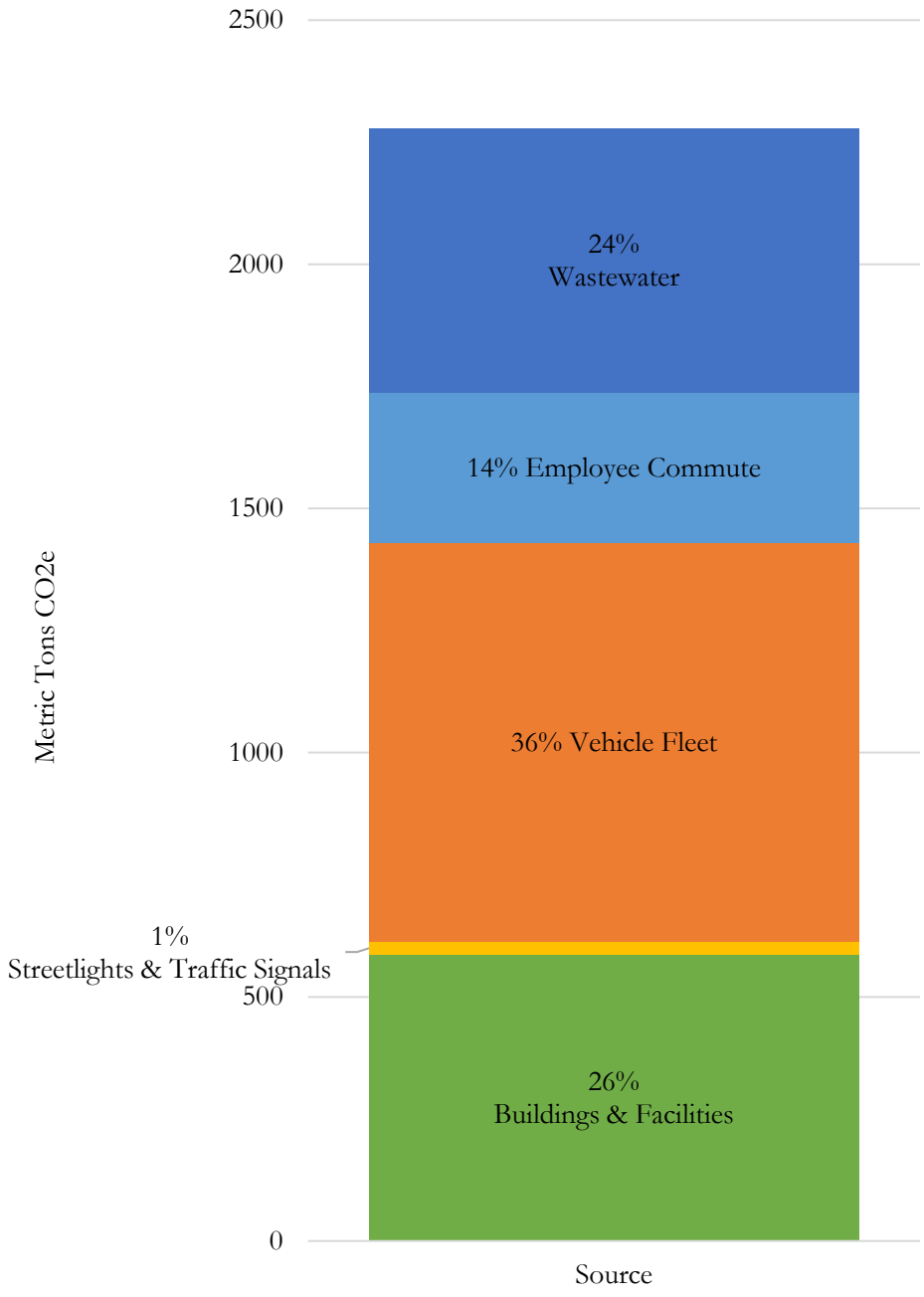
SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE/END USE
STATIONARY ENERGY	Buildings and Facilities	Energy used in town offices, fire stations, police stations, and parks and recreation facilities	Electricity
			Natural Gas
			Discrete Fuel
	Streetlights and Traffic Signals	Energy used in town street lighting and traffic signals	Electricity
TRANSPORTATION	Vehicle Fleet	Fuel combusted by municipally-owned vehicles	Gasoline, Diesel
	Employee Commute	Fuel combusted from vehicles used by municipal employees as they commute to and from work	Gasoline, Diesel
WASTE	Wastewater Treatment	Emissions from wastewater treated at the Saco WWTP	Aerobic and Anaerobic Digestion
		Emissions from wastewater treated in community septic systems	Aerobic and Anaerobic Digestion
		Energy used in wastewater processing at the WWTP and pump stations	Electricity
		Emissions from the recycling of wastewater sludge	Sludge Recycling

*Table 4. Sectors **Excluded** From Saco's Municipal GHG Inventory*

SECTOR	SUBSECTOR	EMISSIONS SOURCES	ENERGY TYPE/END USE	REASON
STATIONARY ENERGY	Water treatment	Emissions from energy used to treat drinking water	Electricity	Not applicable to Saco
TRANSPORTATION	Transit Fleet	Fuel combusted in transit vehicles.	Diesel	Not applicable to Saco
	School Buses	Fuel combusted in school buses	Diesel	Not applicable to Saco
WASTE AND WASTEWATER	Waste – MSW	Emissions from the incineration of municipal solid waste generated by municipal operations	Incineration Emissions	Data availability

Municipal Inventory

Figure 3 summarizes Saco's 2021 municipal GHG inventory. Municipal emissions for 2021 were estimated as 2,278 Metric Tons CO_2 equivalent (MT CO_2e). Municipal emissions are comparable to 1.1% of total community-wide emissions. The largest source of municipal emissions is the vehicle fleet (36%), followed by the emissions from heating and electrifying buildings and facilities (26%) and the energy, process, and waste disposal emissions from wastewater treatment (24%).



Figuree 3. Saco's Municipal Emissions by Source

Figure 4 shows the breakdown of Saco's municipal emissions by department. The Water Resource Recovery Department (WRRD) and Public Works each account for 26% of municipal GHG emissions. Emissions for the WWRD are primarily from electricity used at the wastewater treatment plant and at pump stations (57%). For Public Works, the largest source of emissions is diesel fuel used in public works vehicles (57%), followed by heating fuel used at buildings and facilities (23%).

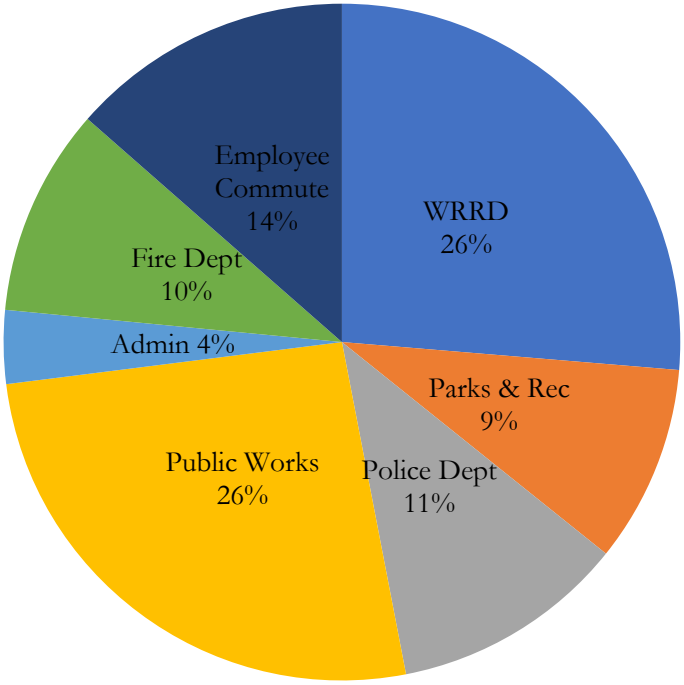


Figure 4. Saco's Municipal Emissions by Department

BUSINESS AS USUAL GHG EMISSIONS FORECAST

To understand future emissions in Saco, ICELI USA developed the Business as Usual (BAU) forecast by projecting community-wide emissions in 2030 based on the 2019 baseline inventory and anticipated demographic and economic changes (Appendix A). The BAU forecast provides the basis for developing goals, strategies, and targets addressing emissions reductions. The forecast was developed for the primary sectors in the GHG inventory which include heating and electricity from the residential, commercial, and industrial sectors as well as transportation.

Indicators for Greenhouse Gas Emissions Forecasting

For the purposes of ICLEI USA's initial analysis, 2030 community-wide and municipal emissions were estimated based on the following indicators. If Saco is interested and has access to more localized data sources, ICLEI USA can refine the forecast further.

- ICLEI USA used the projected ***annual population growth rate of 0.72% for Saco*** to estimate emissions trends in the residential, commercial and transportation sectors.
- Municipal GHG emissions will likely fall by 2030 due to more renewable energy on the electricity grid and more rigorous fuel efficiency standards for vehicles.
- GHG emissions from the New England electricity grid are expected to fall by 2030 because the states have adopted ambitious renewable energy targets and ***Renewable Portfolio Standards (RPS)***[3]. ICLEI USA used Maine's RPS requirements to estimate 2030 electricity emissions.
- Emissions from vehicle fuel use are projected to decline as a result of the ***Federal Corporate Average Fuel Economy (CAFE) standards*** adopted by the Biden Administration, which will increase fuel efficiency 8% annually for model years 2024-2025 and 10% for model year 2026.

Changes in Emissions Through 2030

Without taking any additional action at the community or municipal level, ***Saco's community-wide GHG emissions are expected to fall 22% by 2030*** driven by 1) increasing renewable energy sources on the electricity grid as a result of state targets and RPSs, and 2) decreasing transportation emissions due to CAFE fuel efficiency standards and electric vehicle expansion. Market forces are also expected to contribute to an overall decline in GHG emissions globally. Emissions from the burning of fossil fuels to heat buildings in the residential and commercial sectors will likely stay relatively flat, with some efficiency improvements keeping pace with population growth.

[3] **Renewable Portfolio Standard (RPS)** is a state legislative mandate to increase production of electricity from renewable sources such as wind, solar, biomass and other alternatives to fossil and nuclear electric generation. Maine, Massachusetts, Vermont, Rhode Island, and Connecticut have all made commitments requiring that electricity suppliers produce 60%-100% of electricity from renewable sources by 2030.

OVERVIEW OF CLIMATE GOALS AND EMISSIONS TARGETS

Having established baseline emissions and projected BAU 2030 emissions, the next step for Saco to identify specific goals and emissions reduction targets to include in the Climate Action and Adaptation Plan. Climate goals and emissions reduction targets provide a tangible objective to guide climate action and a benchmark to track progress. Goals and targets should have clear baseline and target dates. For example, the target could be a 60% reduction in emissions by 2030 compared to the 2019 baseline. Goals can reference carbon neutrality[4], climate neutrality[5], or net-zero[6]. Goals and targets can also specifically address the types of GHG gases (e.g. carbon dioxide, methane, etc.) or the sources of emissions (e.g. transportation or residential energy).

Globally, 195 countries, including the U.S., signed the Paris Agreement, committing to keep the rise in global temperatures below 2.7°F (1.5°C). The United Nations Intergovernmental Panel on Climate Change (IPCC) estimates that we must reduce global emissions by 50% by 2030 and achieve climate neutrality by 2050 to reach this goal. The U.S. and Maine have set national and state-wide climate goals and emissions reduction targets in an effort to uphold our Paris Agreement commitment.

National targets

- Paris Agreement commitment to keep the rise in global temperatures below 2.7°F (1.5°C)
- Reduce GHG emissions to 50% below 2005 levels by 2030

Maine targets

- 80% of electricity produced by renewables by 2030[7]
- 100% of electricity produced by renewables by 2050 (Maine RPS)
- Achieve carbon neutrality by 2045
- Reduce overall GHG emissions to 45% below 1990 levels by 2030 and 80% by 2050

Meeting national and state climate goals and reduction targets requires municipal and community action. Additionally, equitably reducing global emissions by 50% requires high-emitting, wealthy nations like the U.S. to reduce their emissions by more than 50%. ICLEI USA projects that U.S. industries, communities, and individuals need to reduce GHG emissions by 60-65% to equitably achieve the Paris Agreement goals. ICLEI USA analyzed 138 community GHG Inventories, demonstrating that it is possible for most U.S. communities to reduce per-capita emissions by 63% or more by 2030.

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[4] **Carbon neutrality** is the net balance between activities that emit carbon dioxide and carbon sinks that absorb carbon dioxide from the atmosphere (e.g. soil formation, forests, eelgrass beds, saltmarshes).

[5] **Climate neutrality** refers to the emission and mitigation of all greenhouse gases (GHGs) – not just carbon dioxide. Much like carbon neutrality, climate neutrality can be achieved by emitting GHGs at an equal rate to their removal from the atmosphere.

[6] **Net-zero** means cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions counterbalanced by carbon sinks such as soil formation, forests, and saltmarshes

[7] During her 2023 State of the Budget address, Gov. Mills set a new target for 100% of the electricity consumed in Maine to come from renewable energy sources by 2040, a decade sooner than previously planned.

To go above and beyond existing commitments, the City of Saco should consider setting their own GHG emissions targets. ICLEI USA performed a High Impact Action analysis for the City of Saco (Appendix A). **Based on this analysis, ICLEI suggests that Saco could reduce community-wide GHG emissions 62.6% by 2030 by implementing ambitious but realistic emissions reduction strategies.** Such an ambitious emissions reduction is achievable for Southern Maine communities. According to ICLEI USA's high-level analysis, a 62.6% reduction in emissions by 2030 could be met by:

- Reducing vehicle miles traveled (VMT) by 5%
- Increasing Electric Vehicle (EV) VMT to 22.5% of total VMT
- Increasing commercial and residential building energy efficiency for new and renovated buildings
- Increasing current residential and commercial building energy efficiency
- The electrification of current and new commercial and residential buildings

Other Southern Maine communities are setting ambitious emissions reduction targets and goals. On Dec. 6th, the Biddeford City Council passed a resolution committing to community-wide net-zero emissions by 2050, with a reduction of 62.6% below the 2019 emissions baseline by 2030.

As Saco takes the next steps to set GHG reduction targets and develop a Climate Action and Adaptation Plan, there are many strategies Saco can use to reduce GHG emissions. The challenge is not figuring out what to do, but rather accelerating the change already taking place globally, nationally, and regionally to bring benefits to Saco.

CLIMATE ACTIONS

Climate Actions

Climate Actions Overview

To make a difference on climate change, we're focusing on taking action in five focus areas:

1. Health, Safety, and Well-Being: Ensuring the health and safety of Saco's community members and increasing overall community resilience.

2. Buildings and Energy: Making buildings and energy systems resilient.

3. Natural Environment: Protecting and enhancing natural resources while directing development to protect vulnerable people and places.

4. Transportation and Land Use: Facilitating the transition to low and zero emissions transportation while supporting alternatives to single-occupancy vehicles and strengthening local infrastructure.

5. Leadership, Capacity and Support: Building support and cooperation for climate action among municipal staff, community members, and partner organizations.

Guiding Criteria

To assess and prioritize actions that align with Saco's values and priorities, we thought it critical to connect strategies to results of the climate survey, and to consider the following framework of guiding criteria.

Initial Criteria		
Effective	**Efficient**	**Equitable**
Does this action reduce GHG emissions, reduce vulnerability, or effectively support overarching goals?	Does this action maximize benefits relative to costs or use resources efficiently to enact it?	Are the costs and benefits of this action distributed fairly? Does this action minimize harm to the most vulnerable groups?

Saco-Specific Criteria			
Regionally Impactful	**Community Inspired**	**Actionable**	**Measurable**
What are our neighboring communities doing?	What have our community members said?	What can Saco do?	What can Saco measure?

HEALTH, SAFETY, AND WELL-BEING

ENSURING THE RESILIENCE OF OUR COMMUNITY TO CLIMATE-RELATED PUBLIC HEALTH HAZARDS WHILE INCREASING COMMUNITY WELL-BEING.

Connection to Climate

The impacts of climate change are heavily intertwined with public health and safety. Climate hazards like sea level rise, erosion, and increases in extreme heat will all affect our community, particularly our most vulnerable community members. We must strive to prepare Saco to respond to increasing public health hazards. We must also work to increase community resilience and create and maintain open lines of communication between community members and our City government.

Our Goal

Share the impacts of climate change with community members, neighborhoods, and future developers to empower more resilient decisions throughout the community. Support policy decision that help resilience for community members, neighborhoods, and future development become more resilient to the impacts of climate change through the use of education and outreach.

Where We Stand

Saco has adopted additional freeboard for coastal areas in the City floodplain ordinance and continues to prepare for future public health impacts and other climate change hazards. In addition, the City continues to support its community members by prioritizing equity in the distribution of City services and resources, and by performing outreach including a community-wide cleanup event, promotion of community gardens, and education on compost and waste reduction.

Our Strategies

How to Read the Strategy Tables

Category

- Priority - *Identified through public engagement*
- Associated goal/strategy in Comprehensive Plan
- Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
1A. Conduct education and outreach about climate change, including the impacts to public health, climate-related events, and actions community members can take to address climate change.					
i. Utilize existing lines of communication (website, social media, newsletter, direct mailings with tax bills, etc.) to publicize info about the impacts of climate change and what residents and businesses can do to address climate change. Example actions include composting, reuse, energy upgrades, and walking/biking.	● ●	Energy & Sustainability Committee	• Number of webpage hits • Number of mailings • Number of people engaged at in-person events • Number of educational materials developed • Number of 'likes' and/or shares of social media postings • Number of social media impressions	Near-term	$
ii. Conduct outreach at targeted community events.	● ●	Energy & Sustainability Committee	• Number of events attended • Number of people engaged at in-person events	Near-term	$
iii. Share information from the ME Dept. of Health & Human Services' ME Tracking Network and Climate Impact Dashboard.	● ●	Planning, Communications, and Energy & Sustainability Committee	• Information hosted on the City webpage	Near-term	$
iv. Conduct Ward-specific and/or topic-specific outreach events.	●	Planning and Energy & Sustainability Committee	• Number of events attended • Number of people engaged at in-person events	Near-term	$
1B. Incorporate climate resilience measures in land use policies and regulations and direct new development away from areas that have high exposure to climate hazards and toward appropriate areas of town with public services. ★					
i. Conduct a review of land use ordinances and policies to identify opportunities for enhanced inclusion of resilience and sustainability measures and standards.	●	Planning, Public Works, Code Enforcement and Conservation Commission	• Ordinance audit complete	Ongoing	$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
1B(Continued). Incorporate climate resilience measures in land use policies and regulations and direct new development away from areas that have high exposure to climate hazards and toward appropriate areas of town with public services.					
ii. Investigate use of regulatory and policy mechanisms to discourage development in areas at high risk of climate hazards and toward more suitable locations. Pursue appropriate density bonuses or other incentives to encourage development in areas that have low exposure to hazards and are appropriate for density.	●	Planning, City Council, Long Range Planning Committee (LRPC), Public Works, and Water Resource Recovery	• Ordinance amendments identified and amendments passed • Number of development applications for defined high versus low hazard areas over 10 years	Mid-term	$ - $$
iii. Require consideration of climate change resilience in development project applications.		Planning, Public Works, and Conservation Commission	• Percent of development applications that incorporate climate resilience measures	Ongoing	$ - $$
iv. Advance use of Low Impact Development Practices through incentives and regulatory mechanisms.	● ●	Planning, LRPC, Public Works, and Conservation Commission	• Adoption of LID incentives and requirements • Number and percent of projects permitted that incorporate LID measures	Ongoing	$
1C. Conduct neighborhood-specific assessments, similar to Camp Ellis Architectural Study, to evaluate climate impacts and vulnerabilities to areas of the city and develop locally-tailored strategies for enhancing the resilience and sustainability of those neighborhoods.					
i. Engage community members in efforts to develop hyper-local assessments of climate vulnerabilities and opportunities for enhancing resilience and sustainability at property- and neighborhood-scale.	●	Planning and Public Works	• Number and/or percent of community members engaged • Number of assessments completed (including property count of neighborhood) • Percent of neighborhoods for which assessments are completed	Mid-term	$ - $$
ii. Hold neighborhood meetings to discuss climate, sustainability, and resilience topics, local issues, and possible actions and/or solutions (target at least 1 neighborhood per year).	●	Planning and relevant City depts.	• Number of meetings held • Number of neighborhoods engaged • Number of people attending neighborhood outreach events	Mid-term	$

BUILDINGS AND ENERGY

MAKING BUILDINGS AND ENERGY SYSTEMS RESILIENT AND REDUCING THEIR EMISSIONS.

Connection to Climate Change

The electricity, natural gas, and/or oil that we use in our homes, businesses, institutions, and municipal facilities result in over half of greenhouse gas emissions in Saco. We will strive to increase energy efficiency, and where needed switch our building systems to alternative energy sources. At the same time, we need to ensure that our buildings and energy systems are resilient to increasing climate hazards like storms, sea level rise, and extreme precipitation.

Our Goal

Foster energy efficient and climate resilient commercial, residential, and public buildings.

Where We Stand

Saco has upgraded streetlight equipment in collaboration with utilities and other agencies and is planning for additional short- and long-term energy efficiency improvements, as well as conducting energy audits of municipal facilities and working toward participation in demand-response programs. The City also continues to perform community outreach on clean energy and energy use reduction.

Our Strategies

How to Read the Strategy Tables

Category

- ★ Priority - *Identified through public engagement*
- ● Associated goal/strategy in Comprehensive Plan
- ● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
2A. Create an incentive and educational program to improve energy efficiency of residential and commercial buildings (including solar generation) and continue to improve efficiency and use of renewable energy sources for public buildings. ★					
i. Support efforts by Efficiency Maine to transition single family homes and other buildings to heat pumps and other energy efficiency upgrades.	● ●	Energy and Sustainability Committee (ESC)	• Number of community members/households taking advantage of Efficiency ME rebates/programs • Number of energy efficiency and renewable permit entries	Ongoing	$
ii. Partner with YCCAC to create and publicize a weatherization incentive program for homes and businesses, including affordable housing developments.	● ●		• Number of energy efficiency and renewable permit entries	Near-term	$
iii. Conduct a municipal and school energy audit and implement energy efficiency measures.	●	Facilities, Schools, and ESC.	• Number of energy efficiency and renewable permit entries • Number of standards adopted	Near-term	$ - $$
iv. Install renewable energy at municipal and school buildings.	●	Facilities, Schools, and ESC.	• Number of energy efficiency and renewable permit entries • Tracking of savings.	Mid-term	$$-$$$
v. Promote solar-ready guidelines for new construction and standards for historic buildings.	● ●	Planning Department and Planning Board.	• Number of standards adopted • Number of applications reviewed.	Near-term	$ - $$
vi. Conduct education and outreach about installing solar on existing structures.	●	Communications, Code Enforcement, and ESC.	• Number of energy efficiency and renewable permit entries	Near-term	$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
2B. Incentivize for resilient building design.					
i. Work with state to adopt the most up-to-date energy codes and consider adopting the Maine "Stretch Code".		Code Enforcement, Planning Department, and City Council.	• Adopted codes are up-to-date • Performance standards adopted	Mid-term	$-$$
ii. Adopt sustainable and resilient design/performance standards.		Planning Department, Planning Board, City Council and Long Range Planning Committee (LRPC).	• Number of performance standards adopted	Near-term	$-$$
iii. Provide density bonuses and/or waive standards (e.g., parking), as permitted, for certain design elements.		Planning Department, Planning Board, City Council and LRPC.	• Number of applications requesting incentives • Number of incentives approved by the Planning Board and City	Near-term	$
iv. Re-write and incentivize use of the urban green space ordinance provision.		Planning Department, Planning Board, City Council and LRPC.	• Number of applications requesting incentives • Number of incentives approved by the Planning Board and City	Mid-term	$

NATURAL ENVIRONMENT

PROTECTING AND ENHANCING NATURAL RESOURCES WHILE DIRECTING DEVELOPMENT TO PROTECT VULNERABLE PEOPLE AND PLACES.

Connection to Climate Change

Land use is how the physical world is modified or put to use for human purposes, while the natural environment includes all aspects of healthy and functioning ecosystems. How we use the land directly relates to how the natural environment is able to withstand and adapt to climate change impacts. We will strive to have Saco's land use policies and regulations protect the natural environment and encourage sustainable, healthy relationships with the land. In doing so our community will gain many resilience benefits, including cooling (through shade and evapotranspiration), reduction and filtration of stormwater runoff, and carbon sequestration— the removal of GHGs from the atmosphere.

Our Goal

Protect Saco's natural environment and working lands to enhance resiliency and help combat cascading effects of climate change.

Where We Stand

Saco has partnered with land trusts both locally and regionally for strategic land conservation, and continues to work toward protecting open space, including managing community forests and open space for long term resilience and developing a strategic plan for community tree management. The City is also working toward establishing a minimum buffer requirement around waterways, encouraging sustainable management of cultivated landscapes, and adopting zoning standards for protecting surface and groundwater from runoff and contamination.

Our Strategies

How to Read the Strategy Tables

Category

- Priority - *Identified through public engagement*
- Associated goal/strategy in Comprehensive Plan
- Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k) = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
3A. Preserve and protect natural areas and local farms. ★					
i. Amend ordinance to require or incentivize conservation/open space subdivisions.	● ●	Parks and Recreation, Planning Department, Long Range Planning Committee (LRPC).	• Number of subdivision applications/approvals that incorporate open space or conserved lands • Creation and adoption of a green capital planning program	Near-term - Mid-term	$-$$
ii. Partner with Conservation Commission on an educational campaign about the values and benefits of preserved natural areas.	●	Communications, Planning Department, Conservation Commission.	• Number of subdivision applications/approvals that incorporate open space or conserved lands • Acreage of new conserved or protected lands by 2030	Ongoing	$
iii. Develop, adopt, and implement an Open Space Plan.	●	Parks and Recreation, Conservation Commission, Planning Department.	• Open space plan developed	Near-term	$$
iv. Incorporate 'Green Capital Planning' principles in City capital planning process.	● ●	Finance Committee	• Creation and adoption of a green capital planning program	Mid-term - Long-term	$$
v. Partner with land trusts and others to protect areas that are vulnerable to climate hazards and those that provide climate and hazard mitigation services, such as carbon sequestration, flood mitigation, water quality protection, and important habitats.	● ●	Parks and Recreations, Conservation Commission, City Council.	• Identification of key parcels that are essential to conserve for climate resilience • Acreage of new conserved or protected lands by 2030	Long-term and Ongoing	$$-$$$
vi. Support local food production.	●	City Council	• Local food production volume	Long-term	$$
3B. Maintain tree canopy cover.					
i. Provide education regarding shade trees and the importance of access to shade trees.	●	Conservation Commission, Parks and Recreation	• Metrics as required by the Tree City US program	Near-term	$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
3B. (Continued) Maintain tree canopy cover.					
ii. Maintain Tree City USA participation.	●	Parks and Recreation	• Metrics as required by the Tree City US program	Ongoing	$
iii. Partner with Conservation Commission and others to promote an 'adopt a tree'/'memorial tree' program to support care, maintenance, and new planting.	●	Parks and Recreation and Conservation Commission	• Number of 'adopt a trees'/'memorial trees' planted, or similar	Near-term	$
iv. Amend landscaping ordinance as necessary to support maintenance of existing tree cover and strategic planting of new trees.	● ●	Conservation Commission, Planning Department, Planning Board, and City Council	• Metrics as required by the Tree City US program • Number of 'adopt a trees'/'memorial trees' planted, or similar	Near-term	$
3C. Promote and enable restoration and/or enhancement of natural areas and 'nature-based solutions.' ★					
i. Ensure local ordinances and permitting processes enable implementation of nature-based solutions.	● ●	Planning Department, Public Works, Code Enforcement, Planning Board, and City Council	• Number of nature-based solution permits and projects • Number of partnerships created	Mid-term	$ - $$
ii. Work with relevant partners to support nature-based solution projects.	● ●	Conservation Commission and Planning Department	• Number of nature-based solution permits and projects	Mid-term	$
iii. Amend land use ordinances and zoning to protect areas that could support important habitat in the future, such as marsh migration areas.	●	Planning Department, Public Works, Planning Board, LRPC, City Council	• Ordinance amendments adopted • Marsh migration study completed	Mid-term	$ - $$
iv. Restore sand dunes or wetlands to protect shorelines, coastal property, and other important habitat from climate hazards such as flooding and erosion.	● ●	Public Works, Planning Department, and City Council.	• Adoption of beach management plan • Completion of resiliency studies of City infrastructure	Near-term - Mid-term	$$-$$$

TRANSPORTATION AND INFRASTRUCTURE

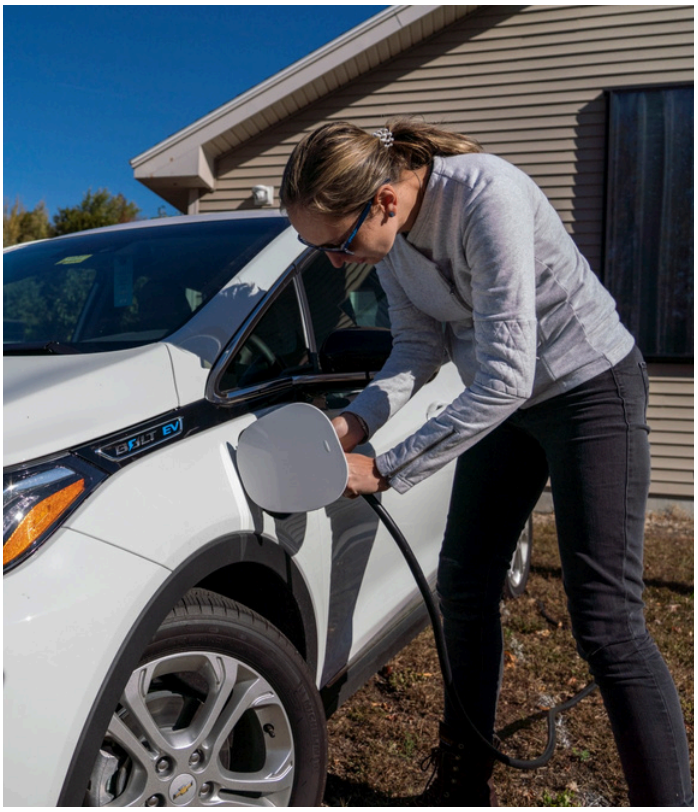
FACILITATING THE TRANSITION TO LOW AND ZERO EMISSIONS TRANSPORTATION WHILE SUPPORTING ALTERNATIVES TO SINGLE-OCCUPANCY VEHICLES AND STRENGTHENING LOCAL INFRASTRUCTURE.

Connection to Climate Change

Our travel choices have a big impact on climate change, especially when most of us drive alone in gas or diesel vehicles to commute. Transportation emissions make up over 40% of Saco's GHG emissions. We must create a sustainable transportation system that prioritizes safe, accessible, clean options for travel, including public transportation, bicycling, and walking. At the same time, we need to ensure that Saco's infrastructure, including roads, bridges, and wastewater systems, are resilient to increasing climate hazards like storms, sea level rise, and extreme precipitation.

Our Goal

Reduce transportation emissions by supporting active mobility, public transit, and electric and hybrid vehicles as alternatives to gas-powered single-occupancy vehicles.



Where We Stand

Saco has already made progress in ensuring that zoning and land use regulations allow for mixed-use development in appropriate areas. In addition, the City is working toward increasing pedestrian and bicycle connectivity by identifying existing gaps and collaborating with regional transportation agencies to maximize connectivity between existing networks. Saco is also working toward promoting local and regional transit options, partnering with agencies to maintain and expand transit services, and pursuing transit-oriented new development.

Our Strategies

How to Read the Strategy Tables

Category

- ★ Priority - *Identified through public engagement*
- ● Associated goal/strategy in Comprehensive Plan
- ● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k) = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
4A. Improve 'walkability' and 'bikeability' of city's roadways and alternative pathways ★					
i. Direct economic development to decrease needs for private vehicles and increase accessibility to services.	●	Economic Development Committee (EDC) and City Council	• Reduction in traffic count and/or car milage numbers	Long-term	$$ - $$$
ii. Identify gaps in pedestrian and the bicycle networks and barriers (such as safety concerns) to active modes of travel.	●	Public Works, Planning Department, Traffic Safety Committee (TSC)	• Total linear footage of paths • Completion of a transportation mater plan • Impact fee study	Near-term - Mid-term	$ - $$
iii. Develop and implement a bicycle and pedestrian plan to improve connectivity and safety in the community and beyond.	● ●	Public Works, Planning Department and TSC	• Total linear footage of paths • Update the bicycle and pedestrian plan	Near-term - Mid-term	$$ - $$$
iv. Collaborate with regional partners to connect on-and off-road bicycle facilities with existing and planned regional trail networks.	● ●	Eastern Trail, Parks and Recreation, Public Works, Planning Department	• Total linear footage of paths • Eastern Trail data	Ongoing	$$ - $$$
v. Build off completed bike share study and explore a bikeshare program in partnership with Biddeford.	● ●	Planning Department	• Reduction in traffic count and/or car milage numbers	Near-term	$ - $$
vi. Adopt a 'Complete Streets' policy, or similar.	●	TSC	• Complete Streets Policy adopted	Near-term	$
vii. Explore opportunities for shared parking agreements.	●	Planning Department, EDC	• Reduction in traffic count and/or car milage numbers	Ongoing	$
4B. Improve education about public transit services to expand use					
i. Partner with PACTS and BSOOB to conduct outreach to community members about existing transit services. One example is holding a 'come ride the bus' day.	● ●	Communications Department, PACTS, BSOOB	• Number of social media campaigns and interactions • Number of education materials developed	Near-term to Mid-term	$
ii. Partner with PACTS and BSOOB to support planning for expanded access to transit.	● ●	Public Works, Planning Department, PACTS, BSOOB, EDC	• Number of public transit users	Mid-term	$ - $$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
4C. Support the expansion of EVs					
i. Take advantage of Efficiency Maine incentives to install publicly accessible EV charging stations in municipal parking lots.	●	Energy and Sustainability Committee (ESC)	• Reduction in traffic count and/or car milage numbers	Near-term - Mid-term	$ $
ii. Increase awareness about tax rebates and other incentives for EV.		Communications Department and ESC	• Social media posts and impressions	Near-term	$
iii. Incorporate EV analysis into fleet replacement process.	●	Public Works and ESC	• Annual analysis results	Ongoing	$

LEADERSHIP AND SUPPORT

BUILDING THE RESOURCES AND SUPPORT TO IMPLEMENT CLIMATE ACTIONS.

Connection to Climate Change

Saco's City government will be instrumental in providing leadership, resources, and accountability to implement our CAAP. The City will work to ensure that departments and community members have the support and information to achieve the goals laid out in this plan.

Our Goal

Lead by example on climate change by providing capacity, education, and resources to municipal staff, elected officials, boards, committees, and the business community.

Where We Stand

Saco has led by example on climate change both locally and regionally by enrolling in the State's Community Resilience Partnership, participating in FEMA's Community Rating System for flood mitigation and planning, reporting environmental data to help advance national and international collaborative climate change efforts, and incorporating sustainability and resilience in the City's comprehensive plan. Saco also continues to incorporate considerations of flood risk and other climate hazards into City plans and policies.

Our Strategies

How to Read the Strategy Tables

Category

- ★ Priority - *Identified through public engagement*
- ● Associated goal/strategy in Comprehensive Plan
- ● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

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High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
5A. Dedicate more staff hours into future long-term planning initiatives aligned with the Climate Adaptation and Action Plan and the Comprehensive Plan.					
i. Continue City staff collaboration and coordination on efforts related to the CAAP and Comprehensive Plan.	●	City Administration, Long Range Planning Committee (LRPC), All Relevant City Departments	• Percent of departments actively participating on Energy and Sustainability Committee	Ongoing	$
ii. Evaluate staff capacity and needs for enabling more staff hours dedicated to climate resilience and sustainability efforts.	●	City Administration and City Council	• Number of staff hours/budget for resilience and sustainability work	Ongoing	$ - $$
iii. Pursue grants, such as Maine's Community Action Grants, to support climate actions.	●	Energy and Sustainability Committee(ESC) and Relevant City Departments	• Number of grants awarded for climate projects	Ongoing	$
iv. Provide annual updates to the community, staff, elected officials, and volunteers on the City's climate change efforts.	●	Planning Department and ESC	• Continue to track climate metrics in capital plan • Continue web presence at sacomaine.org/climate	Near-term	$
5B. Provide climate training for municipal boards, committees, and commissions. ★					
i. Work with partners like SMPDC and others to develop climate training, similar to MS4 or FOAA training.		City Administration, Communications Department, and Planning Department	• Development of training materials/curriculum	Near-term	$
ii. Deliver training to all municipal boards, committees, and commissions, making sure to train new members when they begin.		City Administration, Communications Department, and Planning Department	• Number of boards, committees, commissions trained annually	Near-term	$
iii. Maintain a tracking sheet of which board, committee, and commission members were trained and when.		City Clerk	• Number of active members trained annually	Near-term	$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost
5C. Foster a climate-resilient local economy and tourism industry.					
i. Partner with local chamber of commerce to support business resilience and continuity planning.	●	Economic Development Department	• Number of events held • Number of business outreach initiatives undertaken	Ongoing	$ - $$
ii. Encourage and/or assist businesses with evaluating climate vulnerabilities and energy audit opportunities.		Economic Development Department	• Number of businesses engaged • Opportunities for funding identified	Near-term - Mid-term	$ - $$
iii. Provide informational resources to businesses about programs and funding opportunities to support resilience action (weatherization, dry floodproofing, etc.).		Economic Development Department and Communications Department	• Number of businesses making operational or facility changes to increase resilience and/or energy efficiency/reduce emissions • Number of permits issued to businesses for upgrades	Ongoing	$
iv. Provide support for innovative sustainable businesses.		Economic Development Department, ESC, and City Council	• Number of innovative or entrepreneurial efforts with partnerships	Mid-term - Long-term	$ - $$

CONCLUSION

What's Next

The City of Saco is proud to present this Climate Adaptation and Action Plan which represents months of community engagement, staff and committee input, and consideration of regionally impactful initiatives. The plan envisions actionable steps and progress we can make today to enhance our community as climate-ready and to continue incorporating resiliency and adaptation measures into our policies and investments. This plan is one piece in the larger puzzle for Saco's climate future – a puzzle that includes major infrastructure upgrades, initiatives to improve resilience to sea level rise, and a future that respects our abundant natural resources now and for years to come. Saco is committed to implementing the actions outlined in this CAAP and is already undertaking climate adaptation efforts, including:

- Saco Water Resource Recovery Resiliency Project
- Camp Ellis Shoreline Erosion Mitigation Project
- Energy efficiency upgrades at municipal facilities
- Exploration of rooftop solar opportunities at the Public Works facility

We will also increase participation in regional action on climate change. Through the CAAP process, we have identified several strategies on which we might be able to collaborate with our neighbor communities and the broader southern Maine region. Several of these actions have been identified in other local climate action plans, including those of Biddeford, Kittery, Kennebunk, and Kennebunkport. One of our next steps will be exploring ways these actions and others can be implemented with regional coordination and support.

Potential Partner/Regional Actions:

Buildings and Energy

- **Create an incentive and educational program to improve energy efficiency and electrification of buildings** (Strategy 2a) - Supported through a regional incentive program.

Transportation and Infrastructure

- **Improve education about public transit services to expand use** (Strategy 4b) - Work regionally to expand transit connecting our communities.
- **Support the expansion of EVs** (Strategy 4c) - Coordinate regionally and with the state on the distribution of public EV charging stations.

Leadership and Support

- **Provide climate training for municipal boards, committees, and commissions** (Strategy 5b) - Work with SMPDC to develop and deliver climate change training that is applicable to throughout the region.
- **Foster a climate-resilient local economy and tourism industry** (Strategy 5c) - Work with regional partners to on sustainable economic development and resilience efforts.

Looking Ahead

Southern Maine is a rapidly changing region, and Saco is no exception. With the development of new technologies, shifting populations, and a changing climate, it is vital that the actions and timelines we have laid out in this CAAP are adaptable to future conditions. Our CAAP is a dynamic document that we will constantly refer to and revise when necessary and appropriate to determine the best path forward to make progress on our climate goals. We will also hold ourselves accountable to report on our progress in meeting our milestones and targets.

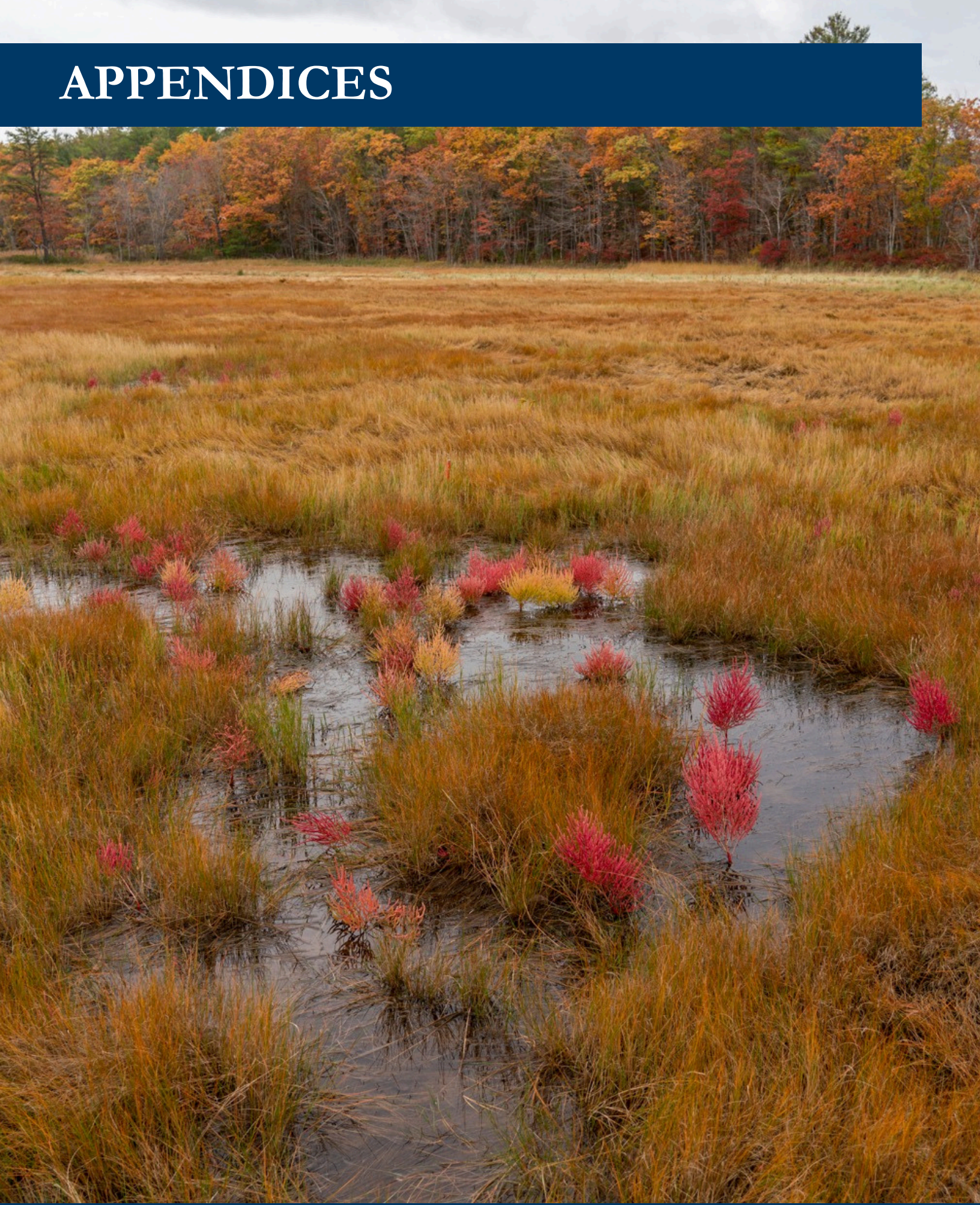
The Energy and Sustainability Committee will provide an annual update on the CAAP to City Council.

How To Stay Involved!

Follow along with Saco CAAP progress through our dedicated webpage: www.sacomaine.org/climate

If you have questions, comments, or concerns about this CAAP, please share them with the Saco Planning Department

APPENDICES



APPENDIX A - GLOSSARY

Aquaculture – Breeding, raising, and harvesting of aquatic animals such as fish and oysters and aquatic plants such as kelp.

Energy Efficiency – Describes measures taken to reduce energy use, such as improving building weatherization, installing more efficient heating and cooling systems, and LED lighting.

Electrification – The process of converting fossil fuel technologies and processes to electricity, for example vehicles that use gasoline and buildings heated with oil or gas.

Extreme heat – At least two to three days of heat and humidity with temperatures above 90 degrees.

Freeboard - An additional amount of height above the Base Flood Elevation used as a factor of safety (e.g., 2 feet above the Base Flood) in determining the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with community floodplain management regulations.

Greenhouse gas emissions (GHG) – Gases released during combustion of fossil fuels, the majority of which are carbon dioxide, with smaller amounts of methane and nitrous oxide. These emissions trap heat in the atmosphere and warm the planet.

Groundwater rise – The movement upward of the groundwater table due to fluctuations in rainfall recharge rates and/or river, ocean, or tidal levels.

Heat island – An area that is denser with buildings, roads and sidewalks which absorb and re-emit the sun's heat at higher rates than less developed areas which tend to have more trees and vegetation.

Heat-related illness – A serious medical condition resulting from the body's inability to cope with a particular heat load, resulting in heat cramps, heat exhaustion, and heat stroke.

Heat pump – An appliance that uses electricity to provide both heating and cooling to a building. To warm a building, it extracts heat from outside the building and moves it inside. To cool a building, it moves heat from inside the building to outside.

Impervious surface – A non-vegetated, hard surface such as pavement, roads, sidewalks, gravel driveways, stone paths or roofs, which causes rainwater to run off rather than soak into the soil.

Infrastructure – The city's physical structures and facilities such as public roads, stormwater management systems, wastewater management plants and systems, and drinking water systems.

Land Use – Describes the human use of lands. In the city, land use planning is the process of regulating the use of land by the City.

Low Impact Development (LID) – The process of developing land while minimizing the effects of development on water resources and the natural environment.

Nature-Based Solutions (NBS) – Planning, design and engineering practices that weave natural features or processes into the built environment to promote adaptation and resilience.

Resilience – Refers to climate resilience which means the ability to prepare for, recover from, and adapt to the impacts of climate change.

Saltwater intrusion – Occurs when saltwater infiltrates freshwater sources either underground or by overtopping lower land areas near the coast. Sea level rise and storm surge are among the causes of saltwater intrusion into freshwater drinking sources.

Stormwater – Water, generated by rain, hail and snowmelt events that flows over land or impervious surfaces such as roads, parking lots and roofs.

Sustainability – As defined by the United Nations in their publication Our Common Future: "meeting the needs of the present without compromising the ability of future generations to meet their own needs". There are three pillars of sustainability as described in the UN publication: environmental, social and economic.

Vector-borne disease – Disease, such as Lyme, resulting from an infection transmitted to humans by blood-feeding mosquitoes, ticks or fleas.

Vulnerable populations – Individuals or groups of people who, due to socioeconomic and demographic factors like income, education, health care access and housing, are at greater risk to the impacts of climate change.

APPENDIX B - REFERENCES

Saco and Southern Maine Planning Development Commission (SMPDC) Documents

These reports can be accessed online at:
https://www.sacomaine.org/departments/administration/climate_adaptation_and_action_plan.php

SMPDC (2023) Climate Ready Coast - Southern Maine: A Regional Coastal Resilience Plan for Southern Maine.

SMPDC (2023) Summary of Baseline Greenhouse Gas Emissions and 2030 Forecast: Saco.

SMPDC (2023) Climate Change Vulnerability Assessment Summary: Saco.

Climate Action Planning in other Southern Maine Communities

City of Biddeford Climate Task Force and Climate Action Plan (2023). https://www.biddefordmaine.org/3131/Biddeford-Climate-Task-Force.

Town of Kittery Climate Adaptation Committee and Climate Action Plan (2024). https://kitteryme.gov/climate-action-planning-kittery.

Town of Kennebunk Climate Action Plan Task Force and Climate Action Plan (2024). https://kennebunkmaine.us/captf.

Town of Kennebunkport Climate Action Plan Task Force and Climate Action Plan (2024).
https://www.kennebunkportme.gov/climate-action-plan-task-force

Additional Reports and Online Tools

Fernandez, I, R Marvinney, C Rose (2020) Scientific Assessment of Climate Change and Its Effects in Maine. Maine Climate Council Report. https://www.maine.gov/future/climate/reports

Maine Climate Council (2020) Maine Won't Wait: A Four Year Plan for Climate Action.
https://www.maine.gov/climateplan/

IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate. https://www.ipcc.ch/report/sixth-assessment-report-cycle/

USGCRP (2023) Fifth National Climate Assessment: Report-in-Brief. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA.
https://nca2023.globalchange.gov/downloads/NCA5_Report-In-Brief.pdf

ICLEI (Local Governments for Sustainability) (2024) Clearpath Online Software Platform. https://icleiusa.org/clearpath/

APPENDIX C - SURVEY RESULTS

Summary

In preparation for a new Climate Adaptation and Action Plan (CAAP), the City of Saco developed a Climate Survey to get community input into the process. The CAAP project is timed to coincide with Climate Plans in Kennebunk, Kennebunkport, and Biddeford. This survey was designed to ensure that the CAAP would reflect the unique needs and wants of the Saco community. The survey went live online on August 29th, 2023, and was open until November 27th. **Over the course of these three months, the survey garnered an impressive 672 responses.** Overall, respondents were glad to have the ability to participate in this survey and to have an opportunity to provide input to the city as they work on their CAAP.

Respondents suggested a mixture of strategies that would make it easier and more affordable for individual citizens to be more sustainable in their everyday lives and strategies that hold the City responsible for sustainable development. The most common emergent themes include protecting and preserving natural resources, stakeholder engagement in the CAAP, and the scale of the overall issue of climate change.

81.4% of respondents want the city to preserve, protect, and restore natural areas. This number was reflected in the passionate and varied answers of respondents when asked about further thoughts that should be taken into consideration during the drafting of the CAAP. Perspectives on protecting the natural environment varied from investing in at-risk coastal areas, preventing housing and other types of development on green spaces, and transparency from the City's planning department on its goals. When it came to the theme of ongoing public engagement, one respondent had the following advice to the City: "Do drafts and get public input. It's a hassle but means ownership at the end." Respondents felt strongly that engagement like this survey was a valuable and necessary part of this process, and they would like to see this outreach continued throughout the drafting and adoption of the plan. Lastly, many respondents mentioned in different ways that a key consideration should be the scale of the global issue that is climate change. Some respondents felt that such a large-scale, ongoing issue demands City action rather than focusing on individual changes. Others felt that it was time to move from mitigation to planning to adapt to the already-encroaching impacts of climate change.

The issue of protecting and preserving natural resources, which was the most popular action for the city to take, came up in the open-ended responses in multiple forms. People talked about the need to protect green spaces and limit new development that would take these wooded areas away. There was also discussion of the value that greenery has along transportation corridors. This was described as both a needed intervention for noise pollution and along sidewalks for shade trees and protection from hot weather. Respondents also mentioned the coastal areas of Saco, saying that erosion has been and will continue to be a large issue that the City should act on. The Camp Ellis neighborhood was mentioned by name fifteen times. Most people discussing Camp Ellis believe this should be a priority, although a few voices wonder if the money spent on the area in the past has been effective, and if not, how the City will change its approach.

Summary Continued

Many respondents voiced concern over continued clearing and cutting of trees, and the associated lack of green spaces as areas of Saco are developed. Both supporters and those more critical of the CAAP process said that the City's CAAP project feels disingenuous given how much development and/or clear cutting of trees has occurred in recent years. One respondent said "[We] can't call Saco 'Friendly by Nature' when every massive housing project is approved and hundreds of acres have been cleared so that more people move here ultimately impacting the environment and create more pollution and traffic." Addressing this dichotomy in public communication and project implementation for development would be a good step to building trust, especially with those who are unsure whether they trust the plan for a CAAP.

Respondents want Saco to continue to do outreach and education. Some people say that though they have been frustrated with a lack of ability to give input for City decisions in the past, this survey work feels like a step in the right direction. **People would like to see a continuation of this with public outreach events and engagement** in the process throughout the drafting of the plan and especially through the eventual implementation of the strategies.

The last large theme that came out of the open-ended responses was the issue of the scale of climate change. People were reluctant to totally focus on individual action, and wanted to be sure that the City would acknowledge that in many cases the impacts of climate change are already on their way, and changes made by the City in the near future will not be able to totally prevent these impacts. One community member said, "It is imperative to emphasize that our efforts in the Climate Adaptation and Action Plan should not be solely about taking action to prevent the effects of global warming; it is equally about addressing the damage it has already caused, particularly to our cherished coastline and beaches." Therefore, respondents said, **at least part of the strategies employed by this plan should be preparing the City, especially the coastal areas, for impacts like flooding, erosion, and more that we know are coming.**

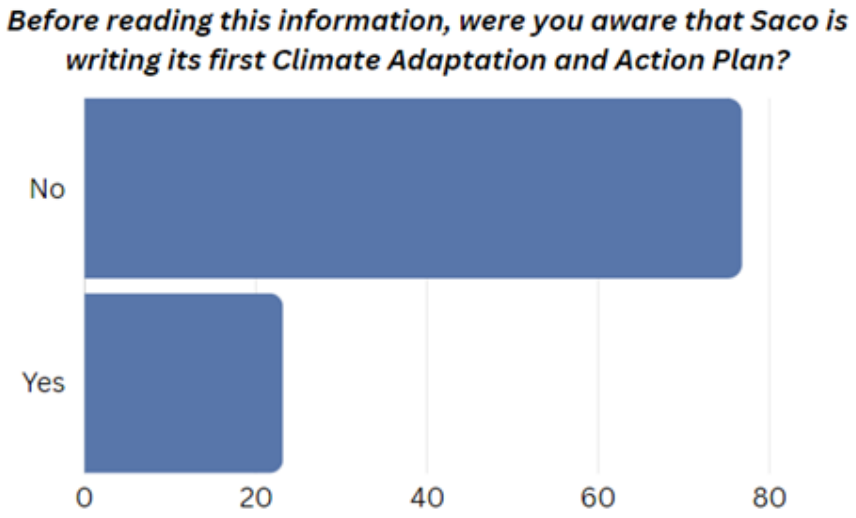
Multiple respondents mentioned that they would have liked to have had a little more flexibility with the way the questions are set up. For the question on actions people would like to see the city take, multiple people noted that all these actions are things the city should aim to do, but some are more realistic than others, there are cost issues, etc. People would have liked to see an option to rank the different responses.

Throughout the open-ended responses there was a common concern that the CAAP would become a plan that never becomes implemented. One respondent said, "Things need to change at a systemic level, and I wouldn't want Saco's climate plan to be an "in name only" plan that tries to shift the burden to individuals." This sentiment was shared between both supporters and dissenters of the CAAP. A common concern was that this CAAP would either not be able to be implemented or be too overly focused on individual action without municipal accountability.

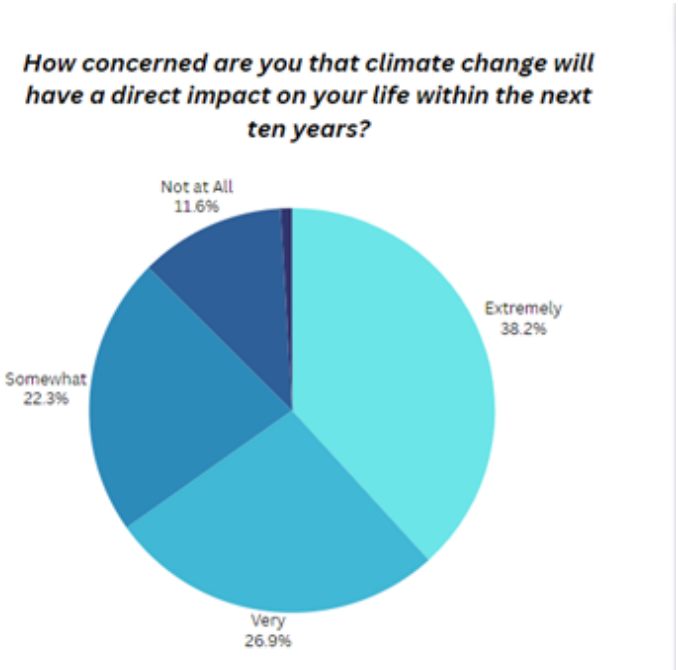
APPENDIX C - SURVEY RESULTS

Specific Question Results

1. Before reading this information, were you aware that Saco is writing its first CAAP?
76.8% of respondents said no, 23.2% yes.



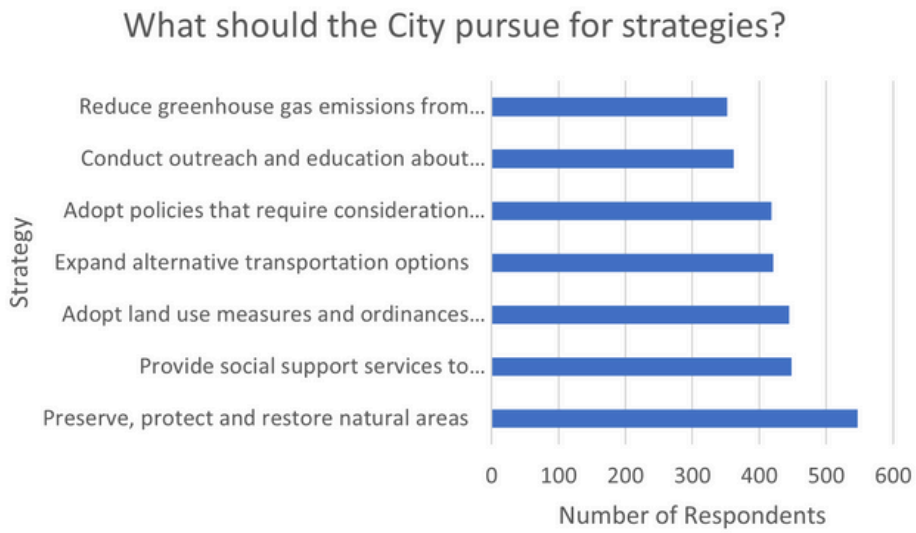
2. How concerned are you that climate change will directly impact your life in the next ten years?
38.2% of respondents were 'extremely' concerned, and 26.9% were 'very' concerned. Only 11.6% were not at all concerned that climate change will directly impact their lives in the next decade.



APPENDIX C - SURVEY RESULTS

3. What do you recommend the city pursue for strategies to reduce climate change impacts?
81.4% of respondents want the city to preserve, protect, and restore natural areas. The next four responses all got at least 60% of respondent votes: social support to residents during extreme weather events, land use measures put in place for sustainable development, alternative transportation options, and policies that consider climate change for municipal decisions and investments. This last category was voted on by 62.2% of respondents.

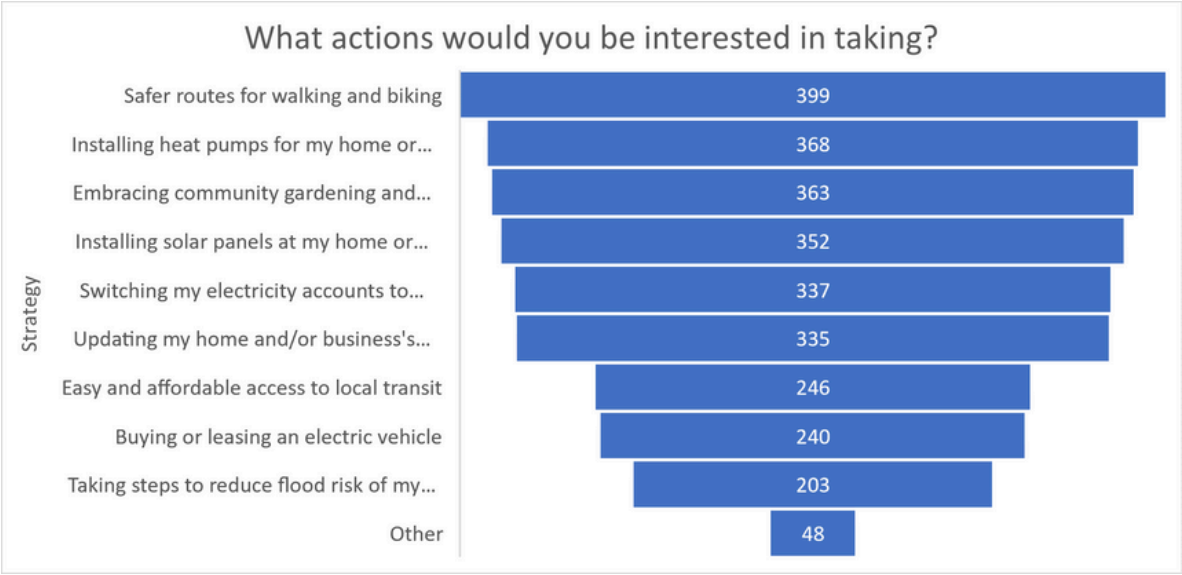
Respondents backed up their support of the last strategy – considering climate change in municipal decisions – in their responses to the open-ended questions. There were many responses that mentioned an interest in backing up individual calls to action with municipal policy. Some of these responses include: "I would like Climate Action applied to zoning restrictions," "[Saco should] align our building codes and ordinances with our Climate Adaptation Plan and Comp Plan goals for sustainability. We must mandate land preservation, incentivize energy reduction, and educate our Saco students and public via municipal & regional outreach on tangible and achievable acts to address climate change and global warming. But all of this fails if our development and growth march forward unaffected and unencumbered by sustainability goals.," and "When it comes to zoning & ordinance regulations, make it less restrictive for climate-forward residential and commercial modifications/construction to take place".



4. What actions would you be interested in taking to support climate action?
Walking and biking rose to the top of this question about individual action. 59.4% of respondents identified this as something they would be willing to do or interested in having the city invest in. The next most popular response was heat pump installation for either homes or business, with 54.8% of respondents selecting this option. Community gardening closely followed with 54%.

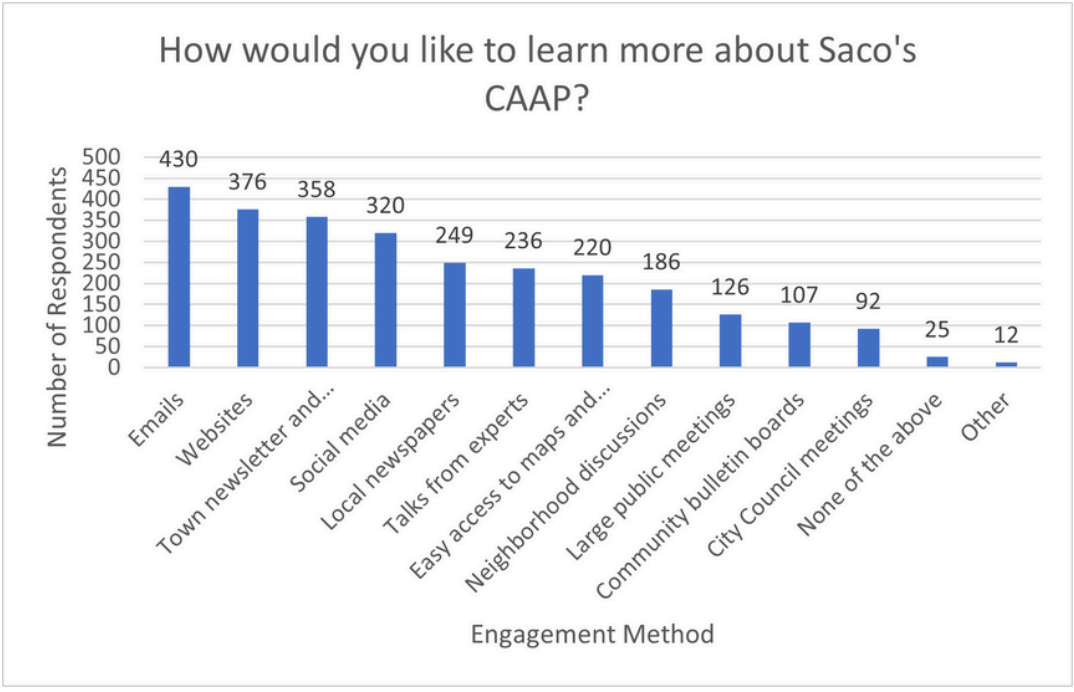
The lowest response was 30.2% for taking steps to reduce flood risk at one's home or business. It is important to note here that none of these options were unpopular. There was a wide range of things people were both willing to do and excited about. One response said that Saco should focus on preparation rather than trying to prevent impacts of climate change- this respondent felt that this response would be the best or most effective for community members. People who responded in the 'other' category seem to fall into one of two groups. Either they are already taking action- for example, they have heat pumps, walk their children to school, etc.- or they do not believe in climate change.

APPENDIX C - SURVEY RESULTS



5. How would you like to learn more about Saco's Climate Action and Adaptation Plan?
Most respondents (64%) would like to receive email communications regarding Saco's CAAP.

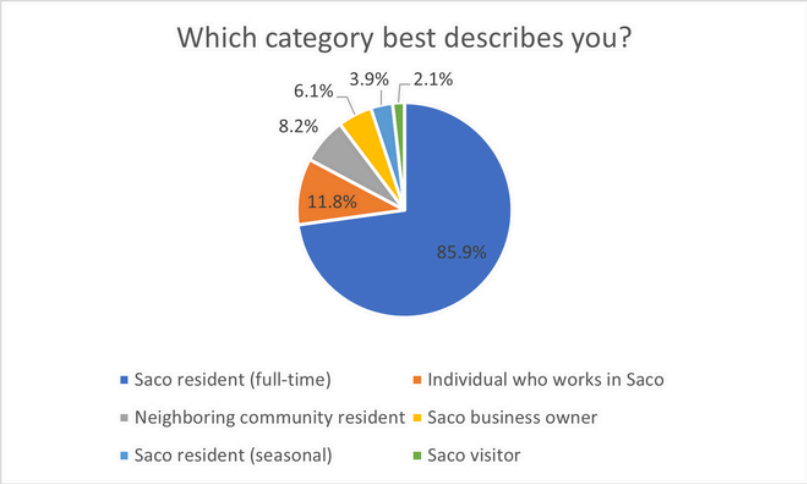
In the open-ended question at the end of the survey, many people said that they appreciated the survey effort because it allowed them to feel like they have a part in the decision making around the CAAP. There was a real appetite expressed for a continuation of this community engagement from the city throughout the process. People mentioned that they would like to have continued engagement and education. There was an expressed desire for a draft of the CAAP to be put out to the public before adoption for feedback/input/questions.



APPENDIX C - SURVEY RESULTS

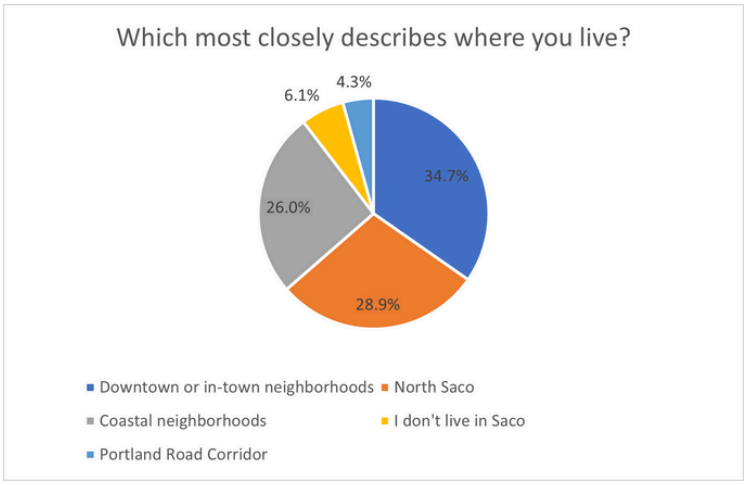
6. Select the category that best describes you. (Residency)

This survey largely reached full-time residents of Saco. 85.9% of respondents identified themselves as full-time residents of the City of Saco. The next highest response, 11.8%, were individuals who work in Saco.

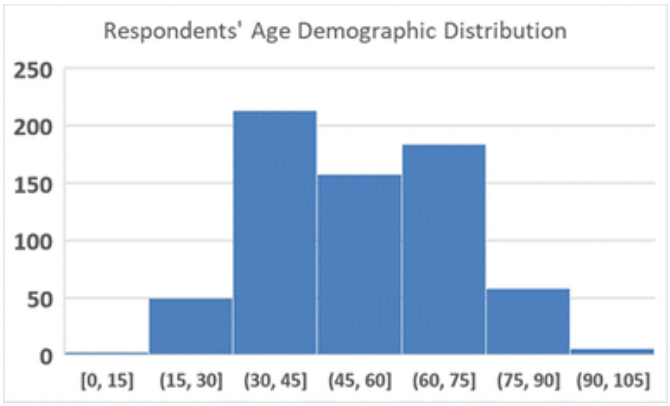


7. Which best describes the area of Saco where you live?

Downtown of in-town neighborhoods was the most popular response, with 34.7% of respondents. After that, North Saco received 28.9%, coastal neighborhoods 26%, non-residents 6.1%, and the Portland Road Corridor area 4.3%.



8. Age distribution of survey respondents.



APPENDIX D - COMPLETE STRATEGY MATRIX

How to Read the Strategy Tables

Category

- ★ Priority - *Identified through public engagement*
- ● Associated goal/strategy in Comprehensive Plan
- ● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
1. HEALTH, SAFETY, AND WELL-BEING						
1A. Conduct education and outreach about climate change, including the impacts to public health, climate-related events, and actions community members can take to address climate change.						
i. Utilize existing lines of communication (website, social media, newsletter, direct mailings with tax bills, etc.) to publicize info about the impacts of climate change and what residents and businesses can do to address climate change. Example actions include composting, reuse, energy upgrades, and walking/biking.	● ●	Energy & Sustainability Committee	• Number of webpage hits • Number of mailings • Number of people engaged at in-person events • Number of educational materials developed • Number of 'likes' and/or shares of social media postings • Number of social media impressions	Near-term	$	7.5, 7.7
ii. Conduct outreach at targeted community events.	● ●	Energy & Sustainability Committee	• Number of events attended • Number of people engaged at in-person events	Near-term	$	
iii. Share information from the ME Dept. of Health & Human Services' ME Tracking Network and Climate Impact Dashboard.	● ●	Planning, Communications, and Energy & Sustainability Committee	• Information hosted on the City webpage	Near-term	$	
iv. Conduct Ward-specific and/or topic-specific outreach events.	●	Planning and Energy & Sustainability Committee	• Number of events attended • Number of people engaged at in-person events	Near-term	$	
1B. Incorporate climate resilience measures in land use policies and regulations and direct new development away from areas that have high exposure to climate hazards and toward appropriate areas of town with public services. ★						
i. Conduct a review of land use ordinances and policies to identify opportunities for enhanced inclusion of resilience and sustainability measures and standards.	●	Planning, Public Works, Code Enforcement and Conservation Commission	• Ordinance audit complete	Ongoing	$$	5.1a, 7.1c

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
1B (Continued). Incorporate climate resilience measures in land use policies and regulations and direct new development away from areas that have high exposure to climate hazards and toward appropriate areas of town with public services.						
ii. Investigate use of regulatory and policy mechanisms to discourage development in areas at high risk of climate hazards and toward more suitable locations. Pursue appropriate density bonuses or other incentives to encourage development in areas that have low exposure to hazards and are appropriate for density.	●	Planning, City Council, Long Range Planning Committee (LRPC), Public Works, and Water Resource Recovery	• Ordinance amendments identified and amendments passed • Number of development applications for defined high versus low hazard areas over 10 years	Mid-term	$ - $$	5.1a, 7.1c
iii. Require consideration of climate change resilience in development project applications.		Planning, Public Works, and Conservation Commission	• Percent of development applications that incorporate climate resilience measures	Ongoing	$ - $$	
iv. Advance use of Low Impact Development Practices through incentives and regulatory mechanisms.	● ●	Planning, LRPC, Public Works, and Conservation Commission	• Adoption of LID incentives and requirements • Number and percent of projects permitted that incorporate LID measures	Ongoing	$	
1C. Conduct neighborhood-specific assessments, similar to Camp Ellis Architectural Study, to evaluate climate impacts and vulnerabilities to areas of the city and develop locally-tailored strategies for enhancing the resilience and sustainability of those neighborhoods.						
i. Engage community members in efforts to develop hyper-local assessments of climate vulnerabilities and opportunities for enhancing resilience and sustainability at property- and neighborhood-scale.	●	Planning and Public Works	• Number and/or percent of community members engaged • Number of assessments completed (including property count of neighborhood) • Percent of neighborhoods for which assessments are completed	Mid-term	$ - $$	7.1c
ii. Hold neighborhood meetings to discuss climate, sustainability, and resilience topics, local issues, and possible actions and/or solutions (target at least 1 neighborhood per year).	●	Planning and relevant City depts.	• Number of meetings held • Number of neighborhoods engaged • Number of people attending neighborhood outreach events	Mid-term	$	

Category

★ Priority - *Identified through public engagement*

● Associated goal/strategy in Comprehensive Plan

● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
2. BUILDINGS AND ENERGY						
2A. Create an incentive and educational program to improve energy efficiency of residential and commercial buildings (including solar generation) and continue to improve efficiency and use of renewable energy sources for public buildings. ★						
i. Support efforts by Efficiency Maine to transition single family homes and other buildings to heat pumps and other energy efficiency upgrades.	● ●	Energy and Sustainability Committee (ESC)	• Number of community members/households taking advantage of Efficiency ME rebates/programs • Number of energy efficiency and renewable permit entries	Ongoing	$	8.2, 7.4c, 3.4, 7.7, 7.2
ii. Partner with YCCAC to create and publicize a weatherization incentive program for homes and businesses, including affordable housing developments.	● ●		• Number of energy efficiency and renewable permit entries	Near-term	$	
iii. Conduct a municipal and school energy audit and implement energy efficiency measures.	●	Facilities, Schools, and ESC.	• Percent of development applications that incorporate climate resilience measures	Ongoing	$ - $$	
iv. Install renewable energy at municipal and school buildings.	●	Facilities, Schools, and ESC.	• Number of energy efficiency and renewable permit entries • Tracking of savings.	Mid-term	$$ - $$$	
v. Promote solar-ready guidelines for new construction and standards for historic buildings.	● ●	Planning Department and Planning Board.	• Number of standards adopted • Number of applications reviewed.	Near-term	$ - $$	
vi. Conduct education and outreach about installing solar on existing structures.	●	Communications, Code Enforcement, and ESC.	• Number of energy efficiency and renewable permit entries	Near-term	$	
2B. Incentivize for resilient building design.						
i. Work with state to adopt the most up-to-date energy codes and consider adopting the Maine "Stretch Code".	● ●	Code Enforcement, Planning Department, and City Council.	• Adopted codes are up-to-date • Performance standards adopted	Mid-term	$ - $$	5.1a
ii. Adopt sustainable and resilient design/performance standards		Planning Department, Planning Board, City Council and Long Range Planning Committee (LRPC).	• Number of performance standards adopted	Near-term	$ - $$	

Category

★ Priority - *Identified through public engagement*

● Associated goal/strategy in Comprehensive Plan

● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
2B. (Continued) Incentivize for resilient building design.						
iii. Provide density bonuses and/or waive standards (e.g., parking), as permitted, for certain design elements.		Planning Department, Planning Board, City Council and LRPC.	• Number of applications requesting incentives • Number of incentives approved by the Planning Board and City	Near-term	$	5.1a
iv. Re-write and incentivize use of the urban green space ordinance provision.		Planning Department, Planning Board, City Council and LRPC.	• Number of applications requesting incentives • Number of incentives approved by the Planning Board and City	Mid-term	$	
3. NATURAL ENVIRONMENT						
3A. Preserve and protect natural areas and local farms. ★						
i. Amend ordinance to require or incentivize conservation/open space subdivisions.	● ●	Parks and Recreation, Planning Department, Long Range Planning Committee (LRPC).	• Number of subdivision applications/approvals that incorporate open space or conserved lands • Creation and adoption of a green capital planning program	Near-term - Mid-term	$ - $$	3.2, 3.2d, 5.1, 5.2, 5.2b, 5.2d, 5.3, 5.5, 6.1, 10.4
ii. Partner with Conservation Commission on an educational campaign about the values and benefits of preserved natural areas.	●	Communications, Planning Department, Conservation Commission.	• Number of subdivision applications/approvals that incorporate open space or conserved lands • Acreage of new conserved or protected lands by 2030	Ongoing	$	
iii. Develop, adopt, and implement an Open Space Plan.	●	Parks and Recreation, Conservation Commission, Planning Department.	• Open space plan developed	Near-term	$$	
iv. Incorporate 'Green Capital Planning' principles in City capital planning process.	● ●	Finance Committee	• Creation and adoption of a green capital planning program	Mid-term - Long-term	$$	
v. Partner with land trusts and others to protect areas that are vulnerable to climate hazards and those that provide climate and hazard mitigation services, such as carbon sequestration, flood mitigation, water quality protection, and important habitats.	● ●	Parks and Recreations, Conservation Commission, City Council.	• Identification of key parcels that are essential to conserve for climate resilience • Acreage of new conserved or protected lands by 2030	Long-term and Ongoing	$$ - $$$	

Category

★ Priority - *Identified through public engagement*

● Associated goal/strategy in Comprehensive Plan

● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
3A. (Continued) Preserve and protect natural areas and local farms. ★						
vi. Support local food production.	●	City Council	• Local food production volume	Long-term	$$	3.2, 3.2d, 5.1, 5.2, 5.2b, 5.2d, 5.3, 5.5, 6.1, 10.4
3B. Maintain tree canopy cover.						
i. Provide education regarding shade trees and the importance of access to shade trees.	●	Conservation Commission, Parks and Recreation	• Metrics as required by the Tree City US program	Near-term	$	5.2c
ii. Maintain Tree City USA participation.	●	Parks and Recreation	• Metrics as required by the Tree City US program	Ongoing	$	
iii. Partner with Conservation Commission and others to promote an 'adopt a tree'/'memorial tree' program to support care, maintenance, and new planting.	●	Parks and Recreation and Conservation Commission	• Number of 'adopt a trees'/'memorial trees' planted, or similar	Near-term	$	
iv. Amend landscaping ordinance as necessary to support maintenance of existing tree cover and strategic planting of new trees.	● ●	Conservation Commission, Planning Department, Planning Board, and City Council	• Metrics as required by the Tree City US program • Number of 'adopt a trees'/'memorial trees' planted, or similar	Near-term	$	
3C. Promote and enable restoration and/or enhancement of natural areas and 'nature-based solutions.' ★						
i. Ensure local ordinances and permitting processes enable implementation of nature-based solutions.	● ●	Planning Department, Public Works, Code Enforcement, Planning Board, and City Council	• Number of nature-based solution permits and projects • Number of partnerships created	Mid-term	$ - $$	5.1, 5.1c, 5.2
ii. Work with relevant partners to support nature-based solution projects.	● ●	Conservation Commission and Planning Department	• Number of nature-based solution permits and projects	Mid-term	$	
iii. Amend land use ordinances and zoning to protect areas that could support important habitat in the future, such as marsh migration areas.	●	Planning Department, Public Works, Planning Board, LRPC, City Council	• Ordinance amendments adopted • Marsh migration study completed	Mid-term	$ - $$	

Category

★ Priority - *Identified through public engagement*

● Associated goal/strategy in Comprehensive Plan

● Potential Regional Action

Timeframe to Implement

Near-term = 1-3 years
Mid-term = 4-6 years
Long-term = 7 or more years
Ongoing = regular, sustained efforts

Cost

Low ($50k) = $
Medium ($50 - $500k = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
3C. (Continued) Promote and enable restoration and/or enhancement of natural areas and 'nature-based solutions.' ★						
iv. Restore sand dunes or wetlands to protect shorelines, coastal property, and other important habitat from climate hazards such as flooding and erosion.	● ●	Public Works, Planning Department, and City Council.	• Adoption of beach management plan • Completion of resiliency studies of City infrastructure	Near-term - Mid-term	$$-$$$	5.1, 5.1c, 5.2
4. TRANSPORTATION AND LAND USE						
4A. Improve 'walkability' and 'bikeability' of city's roadways and alternative pathways. ★						
i. Direct economic development to decrease needs for private vehicles and increase accessibility to services.	●	Economic Development Committee (EDC) and City Council	• Reduction in traffic count and/or car milage numbers	Long-term	$$-$$$	1.3a, 1.3b, 1.3c, 1.5, 1.5b, 1.8, 2.7a, 2.7d, 3.3g, 4.1a, 4.1d, 4.1b, 4.4e, 4.4, 4.5a, 4.6
ii. Identify gaps in pedestrian and the bicycle networks and barriers (such as safety concerns) to active modes of travel.	●	Public Works, Planning Department, Traffic Safety Committee (TSC)	• Total linear footage of paths • Completion of a transportation mater plan • Impact fee study	Near-term - Mid-term	$-$$	
iii. Develop and implement a bicycle and pedestrian plan to improve connectivity and safety in the community and beyond.	● ●	Public Works, Planning Department and TSC	• Total linear footage of paths • Update the bicycle and pedestrian plan	Near-term - Mid-term	$$-$$$	
iv. Collaborate with regional partners to connect on- and off-road bicycle facilities with existing and planned regional trail networks.	● ●	Eastern Trail, Parks and Recreation, Public Works, Planning Department	• Total linear footage of paths • Eastern Trail data	Ongoing	$$-$$$	
v. Build off completed bike share study and explore a bikeshare program in partnership with Biddeford.	● ●	Planning Department	• Reduction in traffic count and/or car milage numbers	Near-term	$-$$	
vi. Adopt a 'Complete Streets' policy, or similar.	●	TSC	• Complete Streets Policy adopted	Near-term	$	
vii. Explore opportunities for shared parking agreements.	●	Planning Department, EDC	• Reduction in traffic count and/or car milage numbers	Ongoing	$	
4B. Improve education about public transit services to expand use.						
i. Partner with PACTS and BSOOB to conduct outreach to community members about existing transit services. One example is holding a 'come ride the bus' day.	● ●	Communications Department, PACTS, BSOOB	• Number of social media campaigns and interactions • Number of education materials developed	Near-term - Mid-term	$	2.7d, 2.7d, 4.2, 4.2a, 4.2b, 4.2c, 4.2d, 4.2f, 4.3

Category

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Ongoing = regular, sustained efforts

Cost

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Medium ($50 - $500k = $$
High ($500k +) = $$$

Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
4B. (Continued) Improve education about public transit services to expand use.						
ii. Partner with PACTS and BSOOB to support planning for expanded access to transit.	● ●	Public Works, Planning Department, PACTS, BSOOB, EDC	• Number of public transit users	Mid-term	$ - $$	2.7d, 2.7d, 4.2, 4.2a, 4.2b, 4.2c, 4.2d, 4.2f, 4.3
4C. Support the expansion of EVs.						
i. Take advantage of Efficiency Maine incentives to install publicly accessible EV charging stations in municipal parking lots.	●	Energy and Sustainability Committee (ESC)	• Reduction in traffic count and/or car milage numbers	Near-term - Mid-term	$$	4.8 a-d
ii. Increase awareness about tax rebates and other incentives for EV.		Communications Department and ESC	• Social media posts and impressions	Near-term	$	
iii. Incorporate EV analysis into fleet replacement process.	●	Public Works and ESC	• Annual analysis results	Ongoing	$	
5. LEADERSHIP AND CAPACITY						
5A. Dedicate more staff hours into future long-term planning initiatives aligned with the Climate Adaptation and Action Plan and the Comprehensive Plan.						
i. Continue City staff collaboration and coordination on efforts related to the CAAP and Comprehensive Plan.	●	City Administration, Long Range Planning Committee (LRPC), All Relevant City Departments	• Percent of departments actively participating on Energy and Sustainability Committee	Ongoing	$	7.1, 7.7b, 8.1, 8.2
ii. Evaluate staff capacity and needs for enabling more staff hours dedicated to climate resilience and sustainability efforts.	●	City Administration and City Council	• Number of staff hours/budget for resilience and sustainability work	Ongoing	$ - $$	
iii. Pursue grants, such as Maine's Community Action Grants, to support climate actions.	●	Energy and Sustainability Committee (ESC) and Relevant City Departments	• Number of grants awarded for climate projects	Ongoing	$	
iv. Provide annual updates to the community, staff, elected officials, and volunteers on the City's climate change efforts.	●	Planning Department and ESC	• Continue to track climate metrics in capital plan • Continue web presence at sacomaine.org/climate	Near-term	$	

Category

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Strategy and Sub-Strategy	Category	Lead	Metrics	Timeframe to Implement	Cost	Comprehensive Plan Cross-Reference
5B. Provide climate training for municipal boards, committees, and commissions. ★						
i. Work with partners like SMPDC and others to develop climate training, similar to MS4 or FOAA training.		City Administration, Communications Department, and Planning Department	• Development of training materials/curriculum	Near-term	$	
ii. Deliver training to all municipal boards, committees, and commissions, making sure to train new members when they begin.		City Administration, Communications Department, and Planning Department	• Number of boards, committees, commissions trained annually	Near-term	$	
iii. Maintain a tracking sheet of which board, committee, and commission members were trained and when.		City Clerk	• Number of active members trained annually	Near-term	$	
5C. Foster a climate-resilient local economy and tourism industry.						
i. Partner with local chamber of commerce to support business resilience and continuity planning.	●	Economic Development Department	• Number of events held • Number of business outreach initiatives undertaken	Ongoing	$ - $$	2.7c, 5.4a, 6.2
ii. Encourage and/or assist businesses with evaluating climate vulnerabilities and energy audit opportunities.		Economic Development Department	• Number of businesses engaged • Opportunities for funding identified	Near-term - Mid-term	$ - $$	
iii. Provide informational resources to businesses about programs and funding opportunities to support resilience action (weatherization, dry floodproofing, etc.).		Economic Development Department and Communications Department	• Number of businesses making operational or facility changes to increase resilience and/or energy efficiency/reduce emissions • Number of permits issued to businesses for upgrades	Ongoing	$	
iv. Provide support for innovative sustainable businesses.		Economic Development Department, ESC, and City Council	• Number of innovative or entrepreneurial efforts with partnerships	Mid-term - Long-term	$ - $$	

Category

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APPENDIX E - COMMUNITY COMMENTS ON CAAP

This appendix summarizes community feedback submitted during comment periods throughout development of the Climate Adaptation and Action Plan (CAAP). It is dived into two sections: feedback received during the CAAP Development process and feedback received on the final draft CAAP during a two-week public comment period held in August 2024.

Feedback Received During CAAP Development Process (Summarized)

- Support for the City's initiative to create the CAAP. A comment that many coastal homeowners are away (*i.e.* seasonal) and so they may not be as aware of the planning process that is happening.
- Statement that Maine is the 'tailpipe of the US' and if states to the west and south reduce their per capita greenhouse gas (GHG) emissions by 63% by 2030, they will still emit GHGs that will travel to Maine's atmosphere. Question of whether Saco has to reduce GHG emissions even more than 63% to compensate for the amount of emissions Maine receives from other states. Suggestion to investigate funding for measurement equipment to position around southern Maine in order to detect with specificity the amount of GHG emissions Saco is encountering, ultimately improving the targets laid out in the CAAP.
- Concern that Efficiency Maine's rebate amounts for electric vehicles (EVs), which are based on income level, are relatively low in relation to the cost of an EV, which could be a significant barrier for most people to purchase EVs, thus making the CAAP's draft goal related to the portion of 'vehicle miles traveled' coming from EVs in Saco difficult to achieve. Suggestion that Efficiency Manie expanding eligibility for the largest rebate amount would help Saco achieve the draft goal.
- Statement that there is a need to address the Camp Ellis and Saco River jetty situation and the impact of remediating that situation, as well as the effect of not taking any action, should be considered.
- Suggestion to incorporate food system security, sustainable food systems, and impacts of climate change on food system infrastructure and design in the CAAP, including in the vulnerability assessment.

Feedback Received on the Final Draft CAAP During August 2024 Public Comment Period

- Though the document is very thorough in identifying beach erosion issues, I would expect to see more in the way of specific solutions and associated actions. For example see the section on 'Saco - Camp Ellis, Ferry Beach' in the "Climate Ready Coast - Southern Maine" by the Southern Maine Planning & Development Commission. (https://storymaps.arcgis.com/stories/4b1a578fa6f84e8b83593c17d9c824aa?).
- This is extremely thorough and does an excellent job identifying the many issues we face. I look forward to supporting it. My comments... To quote: "It is imperative to emphasize that our efforts in the Climate Adaptation and Action Plan should not be solely about taking action to prevent the effects of global warming; it is equally about addressing the damage it has already caused…" Perfectly stated. Most climate plans are only concerned with what is envisioned 10, 25, 50 years from now. This really demonstrates we need to address the dilemma we currently face. Primarily concerned with the coast, I was disappointed in the fact that I could not find specific action. For example, there is no mention of dredging, wave revetment, living shorelines, or stressing that we need to develop a comprehensive beach management plan. Yes, I see adoption the beach management plan, but we do not have one yet. What will that plan cover? I see nature-based solution projects, but we need to identify them. If it was stated we need to establish a wave revetment solution, perhaps utilizing wave attenuators; or a dune protection system using living shorelines (oyster bags, rock sills, etc.), it might be easier to apply for funding and grants. Just saying we will explore nature-based solutions and

identifying it as mid-term solution seems to make is less of a priority than it should be. All this goes to addressing the damage already caused. There were some suggested solutions in SMPDC's Climate Ready Coast and it seems that if there was more specificity in this plan, we could act quicker. I was hoping to see some of those. Another Example: Goal: Protect Saco's natural environment and working lands to enhance resiliency and help combat cascading effects of climate change helping natural areas to be resilient to climate change and to help sequester carbon. 10-year Target: 10% Increase in acreage of protected lands. This is something we are all behind, but the question remains … how do we get there? Is this all part of comprehensive beach management? If that is case, it should be clearly defined in the CAAP. In sum, a Climate Action Plan is something a long time coming. It is very comprehensive and detailed. It should act as the basis for everything we do going forward. Well done!

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Saco
friendly by nature