

CITY OF FREDERICTON

CLIMATE CHANGE

ADAPTATION PLAN

ADAPT
Fredericton



ACKNOWLEDGEMENTS

Although climate change is a global issue, the impacts are felt at a local level. Action must be place-based and tailored to the local context. For this reason, the City of Fredericton (CoF) has relied heavily on local stakeholders to provide input into its Climate Change Adaptation Plan. The City would like to thank everyone who has contributed to the development of this plan. We appreciate the time, effort and knowledge contributed to building a more resilient city.

ADAPTATION COMMITTEE

An Adaptation Committee was formed to help guide the development of the Adaptation Plan. The committee included members of City staff from a number of departments along with outside stakeholders. This core group provided strategic advice and direction during the development of the plan. This committee, along with City Directors and Council provided final endorsement of the plan.

GOVERNMENT OF NEW BRUNSWICK

The City of Fredericton thanks the New Brunswick Climate Change Secretariat for sharing the climate change projection data used in this report and the Government of New Brunswick – Environment and Local Government for funding a portion of Fredericton’s Climate Change Adaptation Plan.

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GLOSSARY

Adapted from “City of Barrie Climate Change Adaptation Strategy” and New Brunswick Climate Change Secretariat’s “A Guide to Climate Change Adaptation Planning for New Brunswick Communities”

Adaptation: Includes any initiatives or actions in response to actual or projected climate change impacts which reduce the effects of climate change on built, natural and social systems.

Adaptive Capacity: The ability of built, natural and social systems to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Baseline: A climatological baseline is a reference period, typically 30 years, that is used to compare changes in climate between one period and another.

Climate: The weather of a place averaged over a period of time, typically 30 years.

Climate Change: Changes in long-term weather patterns caused by natural phenomena and human activities that alter the chemical composition of the atmosphere through the build-up of greenhouse gases which trap heat and reflect it back to the earth’s surface.

Climate Change Scenario: A simplified representation of a plausible future climate based on comprehensive scientific analyses of the potential consequences of natural and human-driven climate change and compared to current or historical climatic conditions.

Extreme Weather Event: A meteorological event that is rare at a place and time of year, such as an intense storm, flood or heat wave that is beyond the normal range of activity.

Global Climate Models: Computer-based models based on physical laws and empirical evidence and using mathematical representations of atmospheric conditions to describe climatic behaviour.

Greenhouse gas (GHG) emissions: The release of any gaseous compound in the atmosphere that is capable of absorbing infrared radiation, thereby trapping and holding heat in the atmosphere.

Heatwave: A period of excessively hot weather; In Canada, typically a period of three days or more reaching more than 32° C.

Impact: The effects of existing or forecast changes in climate on built, natural, and human systems.

Mitigation: The promotion of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere.

Resilience: The capacity of a system, community or society exposed to hazards to minimize damages by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.

Risk: A combination of the likelihood (probability of occurrence) and the consequences of an adverse event occurring.

Weather: The day-to-day state of the atmosphere, and its short-term variation in minutes to weeks.

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EXECUTIVE SUMMARY

The City of Fredericton recognizes the threat that climate change poses to our community and City operations. The Climate Change Adaptation Plan (CCAP) aids in addressing this threat by identifying impacts and potential actions to minimize risk and build resilience. The plan builds on 20 years of City climate action including adaptations to infrastructure, operations, and policies and by-laws.

This plan was guided by ICLEI Canada's Building Adaptive and Resilient Communities five-milestone program for municipal adaptation. It takes additional direction from Government of New Brunswick (GNB) guidelines for developing a municipal adaptation plan. Datasets pertaining to climate change projections for the Fredericton area were also obtained from GNB. These projections guided the discussions with stakeholders and helped determine potential impacts and actions in the plan.

In a series of workshops, City staff identified 84 climate change impacts. Members of the public and other stakeholders identified an additional 76. This initial list of impacts was filtered by the Adaptation Committee for overlap, and then for impacts the City could address according to its mandate set out in the *Local Governance Act*. Risk and vulnerability assessments were conducted for the remaining impacts to determine which to prioritize. The prioritized impacts have been summarized into a list of 19 to be addressed in this plan.

Potential actions were identified during two in-person public engagement opportunities, an online survey, staff workshops and a number of Adaptation Committee meetings. Best practices and adaptation plans across the country and internationally were reviewed as well. As a result of these activities the Adaptation Committee selected 68 priority actions to be included in this plan.

The identified actions fall under six goal areas. These goals emerged during the planning process. A cross-cutting action area was also identified for actions that will help achieve each of the other goals and the overall mission of the plan. The identified goals represent the areas where the City has the authority and ability to enact change to minimize climate risks and build resilience. They include:

**MAINTAINING HEALTH
AND SAFETY**

**MINIMIZING DISRUPTIONS TO
MUNICIPAL SERVICES AND PROGRAMS
OFFERED TO THE COMMUNITY**

**MINIMIZING RISKS TO BUILDINGS
AND PROPERTIES**

**STRENGTHENING RESILIENCE OF
NATURAL INFRASTRUCTURE AND ASSETS**

**STRENGTHENING RESILIENCE OF CORE
MUNICIPAL INFRASTRUCTURE**

**CREATING PARTNERSHIPS AND
EMPOWERING THE COMMUNITY**

A preliminary implementation schedule is included in this plan. The implementation schedule considers level of planning and effort, capacity and costs. The implementation timeline will be flexible but will assist the City in planning action over the next five years.

The plan ensures the City of Fredericton continues to take proactive steps towards adapting for climate change. Throughout the implementation of the plan, the City will continue to adapt its actions as necessary and communicate with the community on its progress.



MESSAGE FROM THE MAYOR

Climate change is the defining issue of our time, and as a municipality we have a role to play in addressing this issue.

The City of Fredericton's Climate Change Adaptation Plan (CCAP) provides a strategy and a framework to decrease the climate change related impacts, risks and vulnerabilities our community faces. Fredericton has worked hard to ensure that this plan is well-researched, scientifically based and validated by a wide variety of stakeholders. It is a practical tool to help us understand the climate-related impacts our City may face over the coming years and how we can adapt City operations, assets, infrastructure, operations and service delivery to build climate resilience that will have a positive impact on residents and businesses in our community. The plan includes an implementation timeline and provides a more strategic framework for decision-making moving forward.

The City of Fredericton has been a national leader in climate change adaptation for more than 20 years. Adaptation measures have been integrated into our infrastructure renewal, including oversizing stormwater systems, raising roads, and by expanding our active transportation network. We have long viewed our day-to-day operations, public communications and policies through a climate change lens by introducing measures such as modifying the salting and sanding techniques being used on our streets and roads, reminding people how they can be prepared for an emergency, sharing heat alert messages and crafting by-laws to mitigate household-level flooding.

We must continue to move forward with new actions aimed at helping our community withstand the impacts of climate change. A proactive approach will allow us to be climate-ready and to minimize the negative effects of changing climate.



INTRODUCTION

The City of Fredericton recognizes the wide-reaching implications of climate change that will be experienced locally. These impacts will pose challenges to City operations, infrastructure, assets and services delivery that must be addressed to help our community continue to thrive.

The Climate Change Adaptation Plan offers another tool in the City's proactive approach to addressing the impacts of climate change. This plan looks ahead to climate change projections to the end of the century. It identifies the impacts we are most vulnerable to and which are most likely to occur in the near future that will carry significant risk and/or burden. The plan identifies City-led actions that can be taken to minimize these risks in a way that will allow our community to continue to thrive.

ADDRESSING CLIMATE CHANGE

Climate change can be addressed using two distinct sets of strategies. One set of strategies minimizes future changes to the climate; the other helps us prepare for the inevitable changes that are to come.

Climate change mitigation refers to a group of strategies that can be employed to limit the effects of climate change. These strategies help avoid the release of carbon and other greenhouse gas emissions into the atmosphere, delaying or reducing future changes to climate and the associated impacts. Mitigation strategies include conserving energy, increasing use of energy efficient and renewable energy technologies, capturing and using landfill gas, and increasing active transportation options.

As a result of our past emissions, there will be changes in climatic conditions that we are no longer able to stop through future reduced emissions. Adaptation refers to a set of strategies used to manage the unavoidable consequences of climate change to reduce the impact on our social, physical, economic and ecological systems. Adaptation strategies may include those that increase resilience in our built environment, such as upgrades or changes to infrastructure, changing building designs and increasing flood resilience through built features. It also includes other strategies such as creating emergency response plans, educating the public about preparedness, protecting the economy through business continuity planning and protecting people and the environment through by-laws and policies.

Implementing both climate change mitigation and adaptation actions is important for a robust climate change strategy that addresses both the causes and effects of climate change. The City has been working on mitigation and adaptation efforts for the past two decades. This plan addresses future adaptation strategies.

MITIGATION ACTIVITIES

-  Milestone 5 of Partners for Climate Protection Program for Community and Corporate complete
-  34% reduction in corporate GHG emissions in 2018, over 2004 levels
-  20% reduction in community GHG emissions in 2017, over 2000 levels
-  Renewed corporate and community energy plans and targets set to be developed in 2020-2021

For more information on individual mitigation actions, visit the [Environmental Leadership page at Fredericton.ca](#)

CITY OF FREDERICTON'S PAST CLIMATE CHANGE ADAPTATION ACTIONS

The City of Fredericton has taken a number of actions to adapt to climate change. Each action has decreased climate-related risk and contributed to a more resilient City. Actions have been taken to respond to increases in temperature, changes in precipitation patterns, intense storm events and flooding. The actions to date relate to infrastructure and asset upgrades, changes to operations and staff policies and procedures and planning for future events.

RESPONSES TO CHANGES IN TEMPERATURES	RESPONSES TO CHANGES IN PRECIPITATION PATTERNS	RESPONSES TO INCREASE IN EXTREME WEATHER EVENTS (INCLUDING FLOODING)
Heat Alert Response System (HARS) info-sharing	Adjusted salting techniques	Active Emergency Measures Organization
Accommodations for outdoor City staff	Upgraded City vehicles/ apparatus for icy conditions	Back-up generators at pump and lift station
Staff gear/PPE modifications	Transit policy for icy conditions	Changes to water line placement
Outdoor pools free to the public	Staff gear/PPE modifications	Generator for Salvation Army emergency warming centre
Asphalt design modifications	Tree watering	Road raising (3 projects)
Artificial turf installation	Attenuation ponds on City properties	Daytime comfort stations - Grant Harvey Centre/Willie O'Ree Place
Changes to tree species planted	Stormwater guidelines updated in 2009	Key major culverts upgraded to increase capacity
Enhanced winter trail maintenance		Minor culvert system upgraded to increase capacity
Outdoor winter ice surfaces rationalized		Free transit, shuttle, park & rides during 2018 & 2019 flooding

CLIMATE CHANGE INFRASTRUCTURE PROJECTS: 2000 – 2013

CLIMATE CHANGE ADAPTATION INFRASTRUCTURE ENHANCEMENTS

ROAD UPGRADES

Arterial Roads raised to minimize closures

- 1.** Union Street Under Walking Bridge
2000
Raised 1m and trail bridge also raised.

- 2.** Lincoln and Wilsey
2005
Intersection raised 1.3m

DRAINAGE MANAGEMENT

- 17.** Bliss Carman Area Attenuation Pond
2005
Attenuation Pond

- 18.** McLeod Hill Road
2006
Drainage diversion

- 19.** Rainsford Lane Area
2009
Attenuation Pond

MAJOR CULVERT UPGRADES: Culvert capacity increased to 1.2x1:100 year event and fish passage introduced

- 3.** Lincoln Road
2004
Twin culvert upgrade

- 7.** Royal Road
2006
Twin culvert upgrade

- 11.** Crocket Street
2009
Twin culvert upgrade

- 4.** Forest Acres Court
2005
Single culvert upgrade

- 8.** Wilsey near Hilton
2007
Twin culvert upgrade

- 12.** Hanwell Road
2009
Single culvert upgrade

- 5.** Wilsey Road
2006
Twins culvert upgrade

- 9.** Forest Hill Road
2008
Twin culvert upgrade

- 13.** St. Mary's
2010
Single culvert upgrade

- 6.** McLeod Hill Road
2006
Twin culvert upgrade

- 10.** Colonial Heights
2009
Twin culvert upgrade

- 14.** MacLaren Avenue
2011
Twin culvert upgrade

- 15.** River Street
2011
Culvert upgrade and road raised

TRAIL CULVERT UPGRADE

- 20.** Killarney Brook Trail Bridge
2003

- 21.** Northside Trail
2009

- 22.** Lincoln Trail
2010

- 23.** Valley Trail
2013

LEGEND

- Culvert Upgrade
- Drainage Management
- Road Upgrade

Additional Climate Change Infrastructure Projects 2014 – 2019

- 19 single culvert upgrades
- Five twin culvert upgrades

- One culvert removal at McIntosh Brook

- Five ditching upgrades
- Duck bill valving additions

ROLE OF LOCAL GOVERNMENT IN ADAPTATION

Climate change is a place-based issue. Although climate change is occurring at a global scale, the impacts are felt at a local level. This means local stakeholders, including municipal governments are key actors in responding to climate change.

In New Brunswick, the *Local Governance Act* defines the mandate for municipalities. This act helps municipalities in New Brunswick determine their activities and responsibilities. Within this mandate, there are five key action mechanisms the City of Fredericton can leverage to adapt to climate change:

INFRASTRUCTURE RENEWAL AND ASSET MANAGEMENT

Local governments own and/or maintain over sixty percent of core public infrastructure across Canada. Therefore, it is important that municipalities account for changes in climate when renewing infrastructure and assets. Adapting proactively whenever possible is key because it decreases risks to safety and saves money in the long run.

BY-LAWS, LAND-USE PLANNING AND POLICIES

By-laws, land-use planning, policies and development guidelines determine where and how properties can and cannot be developed within a municipality. These can be amended with climate change projections and impacts in mind to minimize risk and build resilience.

OPERATIONS AND SERVICE DELIVERY

Understanding likely impacts and the risk of those impacts allows us to adapt how we deliver services in order to maintain a high level of service.

PARTNERSHIP

Working closely with our provincial and federal counterparts and with the residents, businesses and organizations whom we provide services for in our community provides the opportunity to share information about what is happening in our community.

LEADERSHIP

As an organization that accepts and understands climate change science and the projections for our region, it is imperative that we take action, lead by example and educate others.

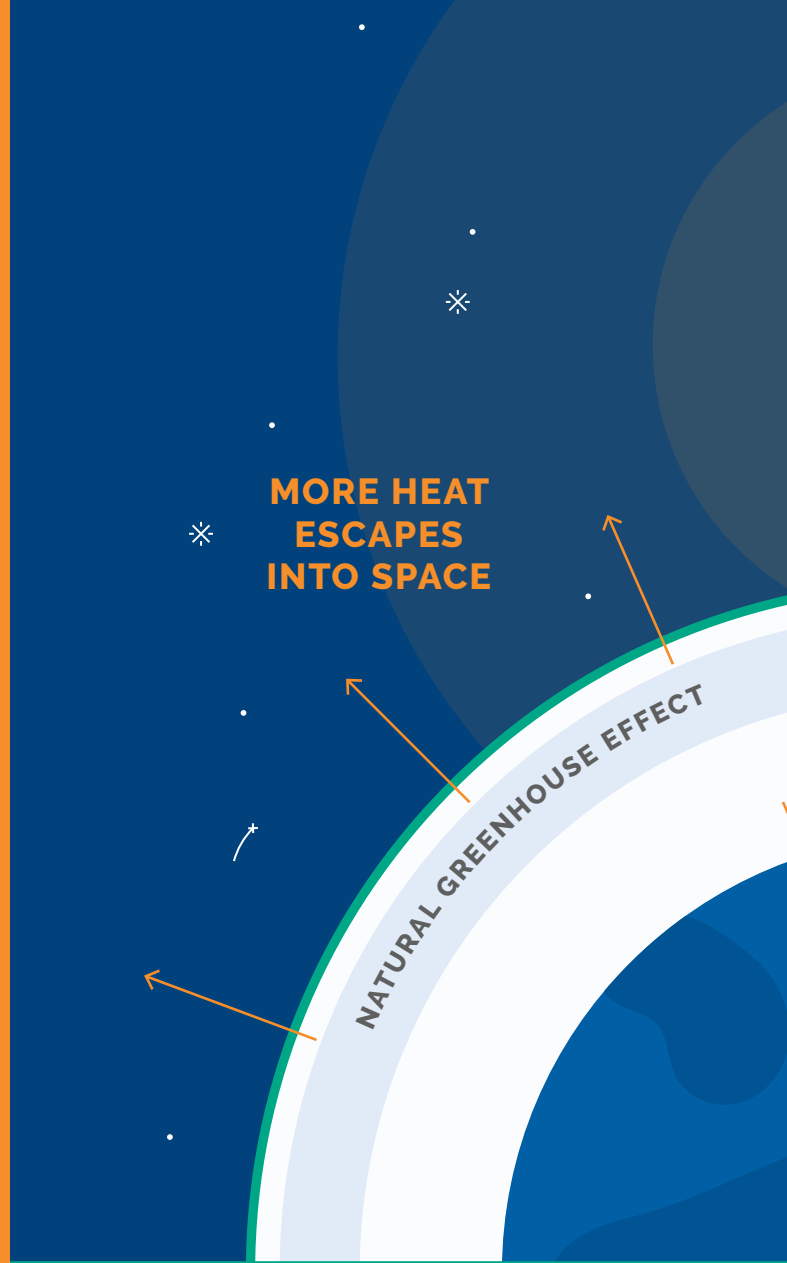
CLIMATE CHANGE IN CONTEXT

THE SCIENCE

Scientists around the world agree that the global climate is changing at a rate that is unprecedented and to a large degree, these changes can be linked directly to human activity.

While the Earth's climate has naturally changed and fluctuated for millennia, the changes in climate observed from the 1950s to the present have happened at an accelerated pace. These recent changes can be attributed to the burning of fossil fuels, which have increased levels of atmospheric gases including carbon dioxide. An increase in atmospheric gases causes more heat to be trapped, warming our earth, and setting off a chain-action of effects, including sea ice melt, more frequent and intense storm events, and changes in precipitation patterns.

Climate change differs from weather and from variability in weather patterns. Weather describes the short-term condition of the atmosphere and is measured in hours, days and weeks. Climate variability describes the variations from expected weather patterns over seasons, years and decades, for example, a milder winter. This differs from climate change, which shows an overall shift in climate patterns over a longer timeframe.



CLIMATE

WHAT YOU EXPECT

The pattern of weather conditions such as temperature and precipitation, amounts of sun and fog, and frequency and intensity of severe events measured over years, decades and centuries.



30 YEAR AVERAGE TEMPERATURE

WEATHER

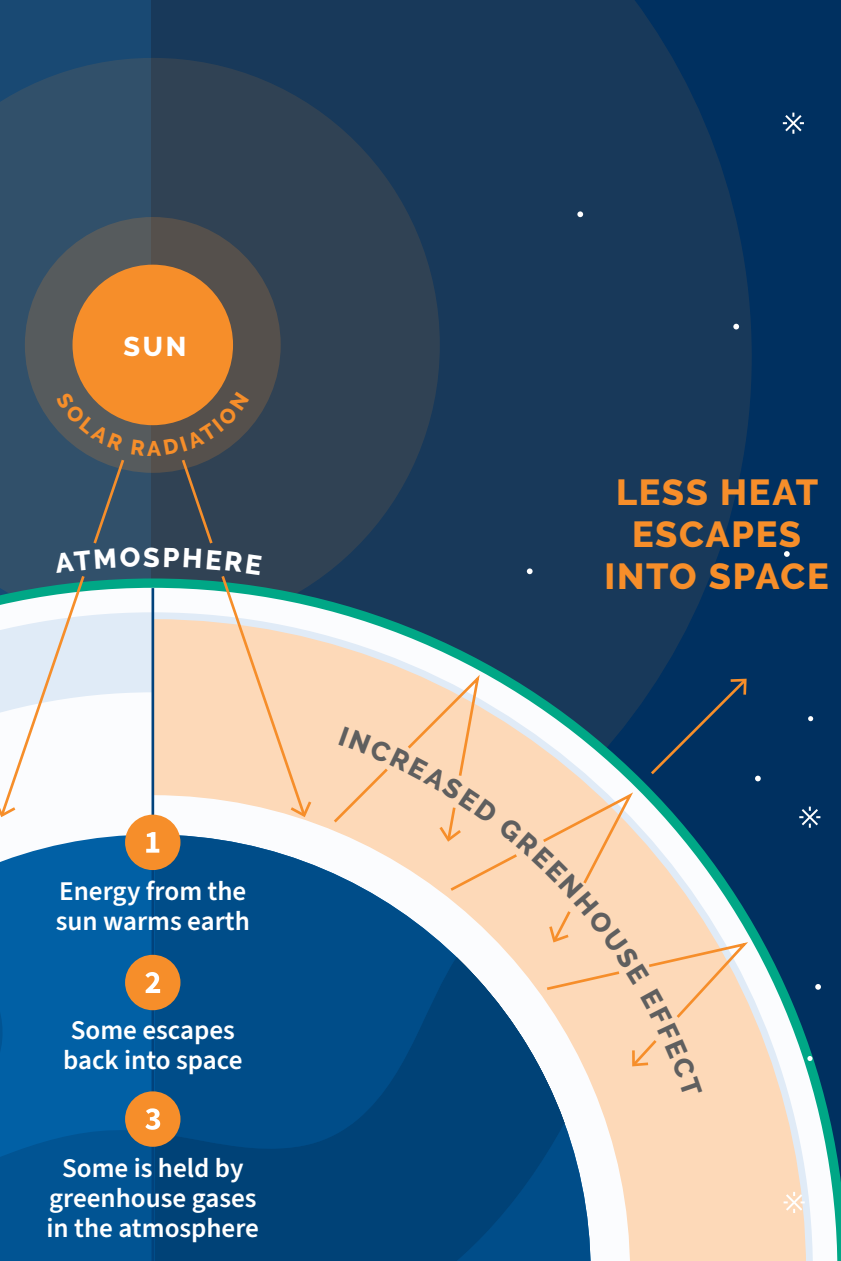
WHAT YOU CURRENTLY EXPERIENCE

The current conditions of the atmosphere. It is measured in minutes, hours, days, weeks, months and seasons.

VS



SATURDAY



HOW DO WE KNOW? GREENHOUSE EFFECT

Earth's atmosphere is like a thin blanket, made up of **carbon and other gases**, that **traps some of the heat provided by the sun**. This keeps our planet at **just the right temperature** for life as we know it. This is known as the greenhouse effect.

Through industrial activities, humans have released a lot of greenhouse gases over a short period. This has caused the blanket of atmosphere around our Earth to become thicker, trapping more heat, and disrupting our usual climate patterns.

WEATHER

GET

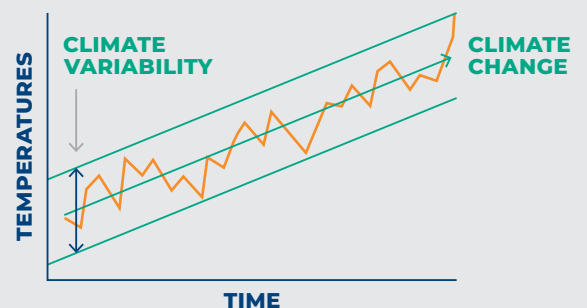
Condition of the atmosphere is measured in terms of temperature, humidity, wind, clouds, days, weeks, months, and seasons.



MONDAY


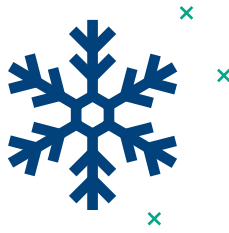

CLIMATE VARIABILITY

The climate is not constant. Long-term climate data will show variations over seasons, years, decades and centuries (e.g. warmer winter, more precipitation). Some appear unpredictable while others are explained by phenomena we are aware of (solar cycles, ocean circulation patterns).



CLIMATE CHANGE PROJECTIONS FOR FREDERICTON










Fredericton has already been impacted by climate change, with a 1.5 °C increase in mean annual temperature over the past century, with 1.1 °C of that change occurring over the past three decades.

INCREASES IN SUMMER TEMPERATURES	INCREASES IN WINTER TEMPERATURES	CHANGES IN PRECIPITATION PATTERNS
<p>↘ HIGHER MEAN TEMPERATURES: 1.1°C by 2020s 2.2°C to 3.0°C by 2050s and:</p> <p>2.8°C TO 5.1°C by 2080s</p>	<p>↘ 1.5°C INCREASE IN MEAN SEASONAL TEMPERATURE by 2020s, 2.7°C to 3.7°C by 2050s and:</p> <p>3.4°C TO 6.1°C by 2080s</p>	<p>↘ INCREASE IN ANNUAL PRECIPITATION: 3.6% - 4.5% by 2020s, 6.3% - 8.5% by 2050s,</p>
<p>↘ INCREASE IN HOT NIGHTS that don't go below</p> <p>20°C</p> 	<p>↘ AS FEW AS 2 DAYS with a maximum below -10°C by 2080s, compared to 12.</p> 	<p>↘ FEWER RAIN AND SNOW DAYS per year with heavier precipitation events.</p>
<p>↘ INCREASE IN LENGTH, FREQUENCY and intensity of heat waves.</p> 	<p>↘ MORE RAIN AND FREEZING RAIN in the winter, with less snow days.</p>	

CONSEQUENCES Climate change will impact City infrastructure, assets, service levels and operations. Without action and plan will be more intense.

ALREADY **NEW BRUNSWICK'S ANNUAL TEMPERATURE** has already increased 1.5 °C in the last 100 years, with **1.1 °C of that increase occurring over the past three decades.**

This change has been implicated as a contributing factor in heat waves, extreme weather events and changes in precipitation patterns over the last number of years. It is expected that these changes are just the beginning. Projections for our region show greater increases in temperature, changes in precipitation patterns and an increase in the number and severity of extreme weather events. The combination of these factors will also lead to greater fluctuations in local freshwater levels. See Appendix A for a more detailed breakdown of projections to 2100.

ON	INCREASE IN FREQUENCY AND SEVERITY OF EXTREME WEATHER EVENTS	FLUCTUATIONS IN FRESHWATER LEVELS
	<p>∨ POTENTIAL INCREASE in number of winter ice storms, post-tropical storms and hurricanes.</p> 	<p>∨ POTENTIAL INCREASE in incidence and severity of flood events.</p> 
	<p>∨ POTENTIAL INCREASE in chance for and severity of drought, early or late season frost, and winter rain and thaw.</p> 	<p>∨ POTENTIAL INCREASE in long-lasting flood events.</p> 
	<p>∨ POTENTIAL INCREASE in flood and heavy rainfall events.</p> 	<p>∨ POTENTIAL INCREASE in incidence of reduced stream and river water levels.</p> 

nning impacts

Addressing impacts and thinking proactively will help minimize impacts.

This creates a safer, more resilient community.

century, with
the past 30 years.

IN THE PAST 11 YEARS

Fredericton has experienced **three one in one-hundred-year flood events** during the annual spring freshet.

OUR APPROACH

The City of Fredericton has followed ICLEI Canada's Building Adaptive and Resilient Communities (BARC) methodology for developing a CCAP.

This plan captures milestones 1-3 of the five-milestone program. Although the City did not consult directly with ICLEI Canada, the process provided in their guide, *Changing Climate, Changing Communities: Workbook for Municipal Climate Adaptation* was followed.

The City of Fredericton has also adhered to the recommendations laid out in GNB's *A Guide to Climate Change Adaptation Planning for New Brunswick Communities: Version 2.0*. This document outlines how to define the scope of the adaptation plan, climate history and projections for New Brunswick, how to develop a vulnerability assessment, and how to identify adaptation priorities and actions.

Note: The City worked with ICLEI through the BARC program previously. The City achieved Milestones 1 & 2 through that process. This plan reflects updates to that previous work.



- Identify stakeholders
- Build climate change adaptation team
- Identify and adaptation champion
- Take a first look at climate change impacts and existing adaptation actions
- Pass council resolution and community charter

- Initiate research on climatic changes
- Refine impacts and consider service areas for each
- Vulnerability assessment (study of sensitivity and adaptive capacity)
- Risk assessment (consequence and likelihood of impacts and prioritization)

- Establish adaptation vision and objectives
- Set goals
- Identify options and actions
- Identify possible drivers and constraints
- Evaluate actions against drivers and constraints
- Determine appropriate baseline and indicator data
- Examine financing and budget
- Establish implementation schedule
- Create action plan
- Launch plan

- Begin implementation
- Solidify support from Council and community
- Use appropriate implementation tools
- Follow terms of action plan
- Report on successes regulatory to maintain momentum

- Assess new information and review drivers
- Track implementation progress
- Evaluate effectiveness of actions using baseline data and indicators
- Communicate accomplishments
- Investigate future adaptation options and actions
- Revise adaptation plan
- Launch next round of adaptation plan

Stakeholder engagement was an important part of the process in developing the plan. Projections were presented to internal and external stakeholders who helped determine potential impacts and actions later refined by the City-led Adaptation Committee.



Following the identification of impacts, the Adaptation committee conducted vulnerability and risk assessments for each to determine which are currently high in priority and should be included in this initial plan.

VULNERABILITY ASSESSMENT

Vulnerability refers to susceptibility to adverse climate change effects. It is a measure of a City's sensitivity to climate change impacts in its current state and its ability to adapt effectively to those impacts, given the capacity and funds required to mitigate sensitivity. Impacts with a vulnerability ranking of (V3) or higher on a scale of 1-5 were carried forward for a risk assessment for this plan.

$$\text{VULNERABILITY} = \text{SENSITIVITY} \times \text{ADAPTIVE CAPACITY}$$

RISK ASSESSMENT

Risk is a measure of the expected outcome of an unexpected event. A risk assessment helps decision-makers make sense of the uncertainties associated with climate change in order to prioritize adaptation activities. Risk is estimated in this process by measuring the combined likelihood of hazardous impact occurring with the expected consequences to social economic and environmental systems in Fredericton.

$$\text{RISK} = \text{LIKELIHOOD} \times \text{EXPECTED CONSEQUENCES}$$

Risk categories (ICLEI *Canada Building Adaptive and Resilient Communities* framework):

SOCIAL FACTORS	ECONOMIC FACTORS	ENVIRONMENTAL FACTORS
Public Health & Safety	Property Damage	Air
Displacement	Local Economy & Growth	Water
Loss of Likelihood	Community Livability	Soil & Vegetation
Cultural Aspects	Public Administration	Ecosystem Function

For a more detailed understanding of climate projections in Fredericton, our consultations during the planning process, and our vulnerability and risk assessments, visit adaptfredericton.ca or request a copy of the CCAP Background Report from environmental.leadership@fredericton.ca or (506) 460-2020.

VISION

FREDERICTON IS A COMMUNITY RESILIENT TO THE FORESEEABLE IMPACTS OF CLIMATE CHANGE.

MISSION

The City of Fredericton will continue to adapt to climate change through the implementation of the Climate Change Adaptation Plan and by taking action in the six defined goal areas. The City will employ innovation and progressive action in achieving the plan goals.

We will follow best practices to adapt proactively, focusing on City infrastructure, assets, operations and service levels to minimize risk for residents, businesses and City staff.

GUIDING PRINCIPLES

Leadership

The City of Fredericton will demonstrate leadership by continuing to build on the adaptation efforts it has already taken over the past two decades.

Collaboration

The City of Fredericton will work with a variety of internal and external stakeholders to develop and implement the Climate Change Adaptation Plan.

Integration

Climate change adaptation will continue to be integrated into City plans and policies and will be considered as a factor in future municipal decisions and ways of doing business.

Partnership

The City will build networks and partnerships to work on common goals and mandates as they relate to climate change adaptation.

Integrity

The City of Fredericton will continue to maintain a high level of services to residents, businesses and institutions while adapting to climate change.

Flexibility

The City of Fredericton will remain open to adjusting its Adaptation Plan as conditions change and new science, data and adaptive measures become available.

Innovation

The City of Fredericton will employ innovative approaches to adaptation when appropriate.

Transparency

The City of Fredericton will be transparent in its progress towards completing the actions outlined in the plan.

Education

The City of Fredericton will play a role in educating Frederictonians and City staff about climate change and its impacts.

SUMMARY

OF IMPACTS

This list captures the potential impacts identified throughout the planning process that scored above a V2 on ICLEI's vulnerability scale and above a Low on ICLEI's risk scale (combined score for social, economic and environmental risks).

CROSS CUTTING IMPACTS

Includes impacts that will occur in multiple circumstances pertaining to shifts in weather patterns

- Extreme weather, freezing rain and heat will cause decreased lifecycle for building envelopes and some building components and render design parameters for buildings insufficient
- An increase in public health and safety issues stemming from climatic events will increase the need to communicate with and educate the public on impacts, risks, the City's role and the public's role

INCREASES IN SUMMER TEMPERATURES

Includes extreme heat, heat waves and longer summer-like season

- Increase in cancellations of recreation and tourism programming including special events and regular programming and closure of outdoor facilities
- Increase in the demand for indoor recreation facilities and outdoor aquatic facilities and decrease the demand for many other outdoor recreation facilities
- Increase in risks for outdoor workers, decrease in productivity and performance
- Increase in the demand for cooling centres within and outside of normal business hours
- More frequent and rapid spread of invasive species posing a threat to native and intentional species
- Extreme heat will render current asphalt design insufficient

INCREASES IN WINTER TEMPERATURES

Includes milder winters, and temperature variability and weather changes in shoulder seasons

- Increase in pest survival rates, leading to increased maintenance requirements for trees and vegetation and an increase in asset losses

CHANGES IN PRECIPITATION PATTERNS AND RIVER FLOODING

Includes drought, river flooding and flooding associated with heavy rain events

- Disruption and/or damage to City-owned assets
- Increase in incidences in of wintertime overland flooding
- Decrease in the quality of sidewalk and trail maintenance
- Increase in road damage and delayed road repairs (winter rain /change in freeze-thaw cycles)
- Increase in heavy rainfall events will cause an overwhelming of the stormwater system, resulting in overland flooding
- More risk of forest fire at urban wildland interfaces (drought/high heat)

EXTREME WEATHER

Includes hurricanes, tornadoes, high wind events, ice storms and other events

- Increase in public emergencies and evacuations
- Increase incidence of people being isolated or trapped in homes
- Increase in strain on municipal staff and financial resources from more overall, overlapping and back-to-back events

IMPACTS THAT SCORED LOW OR VERY LOW ON THE MATRIX BUT WILL BE MONITORED OR ADDRESSED AS PART OF THIS STRATEGY:

- Delay of maintenance and construction projects
- Compromised telecommunications systems making emergency response inefficient and increasing public safety risks
- Increase in potential for downed wires, live wires and fires
- Increase in the number of calls for service causing more triaging of fire & police response
- An extended period of drought could impact the aquifer, especially if the river gets very low
- Increase incidence of motor vehicle accidents and river-related incidents causing risks for public safety and primary responders
- Extreme heat and periods of drought will cause a reduction in river water quality, increase the risk of bacteria and may decrease aquatic recreation and tourism opportunities and/or interest
- Extreme weather, extreme heat and freezing rain increase the risk of staff injury, illness and MVAs while at work
- Issues with condensation and mildew in buildings, lift and booster stations and parking garages
- Increase in difficulty of fire operations in the rural areas Fredericton Fire is contracted for (drought)
- Increases in incidences of the wastewater system going into bypass
- Increase in energy use and cost to cool City-owned facilities

GOALS AND ACTIONS

Consultations with City staff and the public led to the generation of many ideas for actions, both big and small, to mitigate our risk and vulnerability to climate change and to build resilience in City infrastructure, assets, operations and service levels and ultimately, our community.

The Climate Change Adaptation Committee organized this input into six overarching goals that represent a response to potential impacts currently identified as having the highest risk to the community and City operations and assets. In addition to the six goals, cross-cutting actions were identified that will help to achieve each of the other goals and aid in the implementation of the plan itself.

CROSS CUTTING ACTIONS

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- GOAL 1 Maintain Health and Safety

 - GOAL 2 Minimize Risk to Buildings and Properties

 - GOAL 3 Strengthen Resilience of Core Built Municipal Infrastructure

 - GOAL 4 Strengthen Resilience of Natural Infrastructure and Assets

 - GOAL 5 Minimize Disruption to Municipal Services and Programs Offered

 - GOAL 6 Create Partnerships and Empower the Community

CROSS CUTTING ACTIONS

There are a number of actions that are cross-cutting across all or many of the goals in this plan.

These actions allow the City of Fredericton to integrate a climate perspective into plans, policies and decision-making and follow through with the implementation of the Adaptation Plan. They ensure that staff are well-informed and are able to make every effort to consider the impacts of climate change in workplans

CROSS CUTTING ACTIONS

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| CC.1. | Incorporate climate change adaptation into the City's new Municipal Plan |
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| CC.2. | Continue to integrate climate change adaptation considerations into Fredericton's future and existing plans, policies and bylaws |
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| CC.3. | Integrate reporting about climate change considerations into administrative reports |
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| CC.4. | Integrate information about climate change impacts and adaptation into regular communications |
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| CC.5. | Develop initiatives to educate City staff, local residents and businesses about climate change impacts and adaptation |
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| CC.6. | Develop a governance structure and schedule to regularly review the Climate Change Adaptation Plan, the related actions, costs and funding, and the implementation plan/schedule to reassess priorities, best practices and solutions |
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| CC.7. | Ensure appropriate City staff are up to date on climate change projections, best practices and relevant examples of adaptation work being carried out in other regions. |
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GOAL 1:

MAINTAIN HEALTH AND SAFETY

Climate change creates and heightens health and safety concerns for the public and for City staff and contractors.

The changes in weather and climate patterns Fredericton will experience over the next several decades are likely to cause disruption to our usual ways of life. Unexpected and unfamiliar events inherently create risk because we don't necessarily have the right tools or knowledge to protect ourselves. Taking steps, collectively and as individuals, to plan ahead and minimize impacts will be key to our wellbeing.

The City of Fredericton will do its part to maintain health and safety for its staff and for the public in the roles it plays, such as providing access to emergency services and providing updates on safety risks associated with flooding and extreme weather events. The City will work to enhance its services in these areas, including increasing communications and helping citizens to prepare themselves.

ACTIONS

Community Health and Safety

- 1.1** Continue to improve real-time communications to the public to provide information and directives associated with impacts and issues relating to weather-related events and conditions such as: road conditions, safety during storms and extreme weather events, water quality and swimming advisories, fire bans and heat advisories
- 1.2** Continue to improve proactive communications to the public on climate and weather-related safety measures such as being prepared for extreme weather events and minimizing their safety risks during and after an event
- 1.3** Provide clear and up-to-date information on emergency shelters and heating and cooling stations and work with partners to promote access to these services
- 1.4** Whenever possible, maintain and continue to incorporate natural and constructed shade and/or cooling structures into public infrastructure and public spaces
- 1.5** Complete the development of the Vulnerable Persons registry and continue to complete wellness checks during times of emergency, prioritizing registered persons whenever possible.
- 1.6** Continue to offer free access to outdoor City pools during summers months and consider modified schedules and/or expanded programming during periods of extreme heat.
- 1.7** Continue to offer bulk water and charging stations to individuals living outside City limits in times of emergency and coordinate with outlying communities to share this information.

City Staff Health and Safety

- 1.8** Develop policies and procedures, where possible, to allow Management of outdoor workers to modify hours and/or tasks during extreme heat and other extreme weather conditions
- 1.9** Regularly assess needs for new and/or modified equipment, gear and uniforms to keep staff comfortable and safe in extreme heat and other extreme weather conditions
- 1.10** Investigate changes in policies and procedures for alternative work arrangements for non-essential staff during extreme weather events and when road conditions are hazardous
- 1.11** Offer opportunities for staff to learn about being prepared for events at both home and work, so they are able to be at work to maintain essential services

GOAL 2:

MINIMIZE RISKS TO BUILDINGS AND PROPERTIES

In recent years, Frederictonians and the City of Fredericton have experienced increased incidences of weather-related damages to buildings and properties.

This includes basements flooding, cracked building foundations, and damaged landscapes. These damages, caused by overland flooding, high winds, ice events, and changes to freeze thaw cycles, are expected to increase. This requires changes to building and property designs, construction, management and maintenance.

For its own buildings, the City is able to modify specifications for renovations and new builds and review current operational and maintenance practices and policies to minimize risks and damage. For private property owners, the City can provide support through educational resources and updates to by-laws and guidelines. The City can also make infrastructure investments, such as valving, to mitigate flooding risk at the neighbourhood scale in some cases.

ACTIONS

City-owned Buildings and Properties:

- 2.1 Identify new and modified preventative maintenance schedules and procedures
- 2.2 Continue to track data on building utility use and use the data to make decisions about modifications in equipment and controls to maintain comfort in buildings and minimize cost increases
- 2.3 Identify and implement changes to building specifications when renovating or building to decrease future impacts and associated costs from climate change
- 2.4 Identify opportunities to make City buildings and properties more resilient to climate change impacts, while realizing co-benefits such as GHG emissions mitigation (e.g. green roofs, rain gardens)
- 2.5 Make climate change adaptation a consideration when replacing building components
- 2.6 Ensure impacts on lifecycles of building components is considered when managing assets
- 2.7 Identify learning opportunities for integrating climate resilience into buildings

Non-City-Owned Buildings and Properties:

- 2.8 Update by-laws, development guidelines and zoning regulations as required to reflect the most up-to-date climate projections. This may include stormwater guidelines and modified by-laws for building in known flood plains
- 2.9 Implement changes to storm sewer and sanitary sewer by-laws to improve the resilience of residential and commercial properties to climatic impacts.
- 2.10 Support and promote the installation and maintenance of backwater valves in individual residences, and take a role in educating the public and developers about these devices
- 2.11 Continue to undertake infrastructure projects that mitigate neighbourhood-level flooding in key areas of the City, as per projects outlined in association with the Disaster Mitigations Adaptation Fund.

The city of Fredericton is finalizing a number of projects relating to Flood Resilience. The projects will take place over the next eight years and include over \$28M in work. The projects will be funded by the City of Fredericton and Infrastructure Canada's Disaster Mitigation and Adaptation Fund.



GOAL 3:

STRENGTHEN RESILIENCE OF CORE BUILT MUNICIPAL INFRASTRUCTURE

Climate change puts an additional stress on core municipal infrastructure that must continue to be considered moving forward.

These stressors may come from changes in the climate over time. For example, impacts from changes in freeze-thaw patterns and the increase in number of high intensity rain events, require future infrastructure renewal to be planned with these factors considered. Stressors may alternatively come in the form of extreme weather events of higher intensity than previously seen, that can cause direct physical damage to infrastructure. This requires an understanding of potential risks and outcomes and finding ways to minimize those risks whenever possible.

ACTIONS

- 3.1** Continue with focused infrastructure renewal and improvements to the transportation network to minimize disruptions due to flooding
- 3.2** Seek expertise to develop resilient road design standards that will minimize multiple impacts from a changing climate, including extreme heat and changes to freeze-thaw cycles
- 3.3** Expand the Active Transportation Network to mitigate transportation disruptions due to climate change impacts
- 3.4** Continue with focused renewal of water and sewer infrastructure with attention to minimizing impacts from climate stressors
- 3.5** Seek out reliable data and expertise to improve stormwater management guidelines with attention to minimizing impacts from climate stressors
- 3.6** Continue to review and manage stormwater systems to mitigate impacts relating to flooding
- 3.7** Continue to upgrade culverts and bridges to mitigate service interruptions during flooding
- 3.8** Continue to upgrade back-up/emergency power generation to operate core infrastructure and deliver core services
- 3.9** Engage with utilities and other levels of government to stay up to date on their infrastructure and climate change adaptation plans to understand how the City of Fredericton and its residents may be impacted

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GOAL 4:

BUILD RESILIENCE OF NATURAL INFRASTRUCTURE AND ASSETS

Fredericton's trees and natural places are a source of pride for the City and its residents. They are sources of biodiversity and green infrastructure. These features can unfortunately be impacted greatly by climate change.

Conditions may become favourable for the introduction and spread of invasive species; extreme weather events may cause damage to trees and other natural features; warmer weather can cause stress in the summer; and drought and changes in winter precipitation will take their toll as well. These changing conditions require that the City continue to plan and adapt for our natural spaces and features to thrive. This includes making decisions about how these spaces and features may need to change or be replaced for long-term resilience.

ACTIONS

- 4.1** Continue to explore options to protect, improve and expand wetlands and areas in the upper watersheds to protect habitat and biodiversity and mitigate flooding during periods of heavy rainfall, as per projects outlined in association with the Disaster Mitigation Adaptation Fund
- 4.2** Collect data on the urban forest canopy to capture a snapshot and determine a future direction for urban tree canopy management in a changing climate
- 4.3** Continue to run trials and experiments to identify new tree species that will thrive in a changing climate, working collaboratively whenever possible
- 4.4** Update by-laws, development guidelines, policies and permitting processes to enhance green space, ecosystem corridors and tree canopy on public and private properties
- 4.5** Support the identification, mapping and monitoring of new invasive species that may arrive due to a changing climate
- 4.6** Work collaboratively to develop and enhance current management plans and strategies to manage invasive species
- 4.7** Increase education and communication with the public about invasive species in a changing climate and how people can monitor, report and minimize impact
- 4.8** Continue to integrate climate change adaptation considerations into City park plans and practices, including preserving biodiversity and ecology, the use of native species, water and shade features, adequate tree canopy and natural drainage features
- 4.9** Encourage and promote the planting of native vegetation along waterways to decrease risk of erosion
- 4.10** Encourage residents to plant gardens with native species and drought and water-tolerant plants to protect biodiversity and minimize habitat loss
- 4.11** Continue and/or increase preventative maintenance and inspection of trees on public property to reduce damage and hazards
- 4.12** Increase education and communication with the public about forest fire risk, especially at residences and businesses adjacent to forested areas

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GOAL 5:

MINIMIZE DISRUPTION TO MUNICIPAL SERVICES AND PROGRAMS OFFERED

Increasingly frequent and severe weather events may disrupt municipal services and the usual day-to-day routines and schedules in our community.

Where safe and possible, the City is committed to finding solutions to minimize disruption to core services. When services and programs need to be cancelled or delayed, the City strives to communicate efficiently and effectively to individuals impacted.

ACTIONS

- 5.1 Assess opportunities for different forms of tourism and recreation as a result of the changing climate.
- 5.2 Assess the need for new infrastructure and assets to maintain the comfort and safety of the public and staff during events and to minimize the cancellation of events.
- 5.3 Ensure there is a cohesive cross-departmental communications plan to notify the public of any disruptions or cancellations to services and programs, as well as post-event clean-up and safety risks
- 5.4 Develop an app and/or other communications tools to inform residents about the status of services and programs
- 5.5 Continue to assess the effectiveness of the new Transit Policy for storms based on changing weather patterns and conditions
- 5.6 Investigate the need and desire for expanded winter trail maintenance for use during milder weather
- 5.7 Investigate the need for new tools, equipment and assets allow staff to continue to safely deliver services in adverse weather conditions
- 5.8 Develop additional online / electronic tools for residents to access municipal services when access to physical services centres is limited
- 5.9 Assemble a cross-departmental team to address changing service and program needs/wants due to a changing climate, such as access to tourism and recreation services outside of their traditional seasons
- 5.10 Continue to encourage water conservation amongst residential and commercial consumers, and create a plan for mandatory restrictions in the event it is necessary



GOAL 6:

CREATE PARTNERSHIPS AND EMPOWER THE COMMUNITY

Climate change poses a wide array of potential risks and disruptions for residents and individuals, organizations and businesses in Fredericton. Where it has the ability to do so, the City of Fredericton is continuing to minimize climate change risks and vulnerabilities, as outlined throughout this plan.

Planning for climate change, however, is bigger than the City of Fredericton, even within our community. There is important work that is happening and needs to continue at the individual and community level, as well as within the business community and among local researchers. The Provincial and Federal governments play a role in ensuring climate change is addressed across our province and country. Of course, the decisions we and our neighbouring communities make or don't make about climate change will impact one another. With this in mind, the City of Fredericton plans to stay engaged in the work being done by others by others and will collaborate and create partnerships where beneficial.

ACTIONS

- 6.1 Stay engaged with climate change work happening at Provincial and Federal levels to understand outcomes for municipalities in general, and infrastructure and assets in our community in particular
- 6.2 Stay engaged with climate change work happening through the actions of individuals, groups and businesses in our community
- 6.3 Create and/or participate in partnerships and networks addressing climate change adaptation when beneficial to all parties involved
- 6.4 Work collaboratively with local businesses to identify solutions for attracting people to the business and shopping districts after large-scale storms events and during flooding, when safe to do so
- 6.5 Share and amplify important messages about climate change in our community, including those about emergency preparedness, household level adaptations, and others
- 6.6 Seek funding opportunities that will allow us to do more to implement the actions outlined in the plan
- 6.7 Seek out options to build capacity within our organization to adapt to climate change
- 6.8 Seek funding opportunities that will allow the City to support community-based actions

IMPLEMENTATION

A preliminary implementation schedule has been developed to identify the timeline required to access the resources (staff, partnerships, financial) required to carry out the actions. The implementation of the actions is highly dependent on staff capacity and financial considerations; additionally actions that address higher risk impacts often require more resources. Therefore, actions identified as priority may not always be completed first. The schedule also takes into account projects and programs that are already underway or planned. In addition, the implementation schedule is a living document that is subject to changes due to new information, new adaptation priorities being identified, and new funding sources becoming available. The Implementation Schedule can be found in Appendix B.

MONITORING AND REVIEW

Monitoring and review are such important parts of the adaptation process that they have been included as an action in this plan. Monitoring and review will include regularly reviewing the Climate Change Adaptation Plan, the related actions, costs and funding, and the implementation plan/schedule to reassess priorities and actions. This will take into account new projections, best practices, new technologies and lived experience of the impacts of climate change.

Quantitative and qualitative indicators will be employed to track the implementation of the Climate Change Adaptation Plan. Initially these indicators will largely be quantitative and process-based to identify the number of actions completed or the progress made on action items. As results are seen from implementation, outcome-based indicators will be added. Potential initial indicators can be found in Appendix C.

NEXT STEPS

The City of Fredericton plans to move forward with the implementation of some of the actions right away, beginning in 2020. Planning for many of the longer-term actions will also begin in 2020.



APPENDICES

APPENDIX A: SUMMARY OF CLIMATE CHANGE PROJECTIONS

The following table shows the future expected changes in climate in Fredericton from the historical baseline (1980-2010) during three periods – 2020's (2010-2039), 2050's (2040-2059) and 2080's (2060-2099) – according to two different scenarios – RCP 4.5 (rapid decrease in global emissions post 2050) and RCP 8.5 (global emissions on current trajectory). For a more detailed breakdown of projections, contact the City of Fredericton for a copy of the Climate Change Adaptation Plan Background Report.

VARIABLE	1980-2010	2020	2050	2080	2020	2050	2080
	Historical	RCP 4.5	RCP 4.5	RCP 4.5	RCP 8.5	RCP 8.5	RCP 8.5
Annual Mean Temp.	5.69	6.88	7.95	8.56	6.97	8.85	11.02
Winter Mean Temp.	-7.21	-5.72	-4.53	-3.78	-5.65	-3.5	-1.11
Spring Mean Temp.	4.9	5.99	7	7.57	6.02	7.8	9.8
Summer Mean Temp.	17.76	18.9	19.96	20.49	18.99	20.79	22.96
Autumn Mean Temp.	6.99	8.09	9.11	9.69	8.24	10.04	12.14
Cooling Degree Days	143.38	213.51	294.42	341	220.87	368.66	597.54
Heating Degree Days	4667.91	4301.47	3992.55	3818.39	4276.67	3737.88	3176.65
Annual Max Temp >25 °C	49	62.14	74.48	80.34	63.43	83.74	106.64
Annual Max Temp >30 °C	8.83	15.34	23.76	28.41	15.89	31.2	53.33
Annual Max Temp >35 °C	0.1	0.79	2.34	3.42	0.86	4.11	12.51
Annual Min Temp <0 °C	70.07	58.88	51.08	46.58	58.66	44.45	31.7
Annual Min Temp <-10 °C	11.59	8.09	6.17	5.14	8.06	4.7	2.24

VARIABLE	1980-2010	2020	2050	2080	2020	2050	2080
	Historical	RCP 4.5	RCP 4.5	RCP 4.5	RCP 8.5	RCP 8.5	RCP 8.5
Annual Min Temp <-20°C	0.14	0.09	0.05	0.03	0.09	0.02	0
Annual Total Precipitation	1058.32	1096.3	1125.6	1149.5	1106.1	1148.7	1190.4
Winter Total Precipitation	254.11	274.78	281.17	290.39	276.27	296.32	313.44
Spring Total Precipitation	266.54	275.42	288.52	292.08	281.94	293.21	312.61
Summer Total Precipitation	250.95	255.27	258.72	267.76	260.3	263.57	267.13
Autumn Total Precipitation	288.95	296.95	303.76	306.02	293.75	302.18	304.02
Annual Freeze-Thaw (F/T) Days	103.25	97.17	89.64	85.69	96.1	84.03	72.83
Spring F/T Days	30.5	33.96	36.06	37.31	33.9	37.93	40.58
Autumn F/T Days	39.43	34.29	29.06	26.13	33.97	25.11	17.92
Winter F/T Days	32.59	27.71	23.33	21.07	27.03	19.77	13.26
Growing Season Length	191.86	201.65	213.02	220.44	202.35	223.88	255.65
Annual Total Rain Days	146.75	144.02	144.53	144.99	144.19	144.93	145.06
Annual Total Snow Days	48.85	45.03	43.04	41.05	44.53	40.2	33.5

All projections provided via Government of New Brunswick – Environment and Local Government, Climate Change Secretariat from Roy, P. and Huard D. (2016). Future Climate Scenarios - Province of New Brunswick. Montreal: Ouranos. 46 p. + Appendixes.

APPENDIX B: PRELIMINARY IMPLEMENTATION SCHEDULE

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
CC.1	Incorporate climate change adaptation into the City's new Municipal Plan	Planning	Official Plan
CC.2	Continue to integrate climate change adaptation considerations into Fredericton's future and existing and future plans, policies and bylaws	All	All (e.g. Growth Strategy, Active Transportation Connection Plan, Emergency Management Plan)
CC.3	Integrate reporting about climate change considerations into administrative reports	City Clerk	Administrative reports
CC.4	Integrate information about climate change impacts and adaptation into regular communications	Communications	
CC.5	Develop initiatives to educate City staff, local residents and businesses about climate change impacts and adaptation	Engineering (Environmental) Communications	Climate Change Adaptation Plan, Energy Plans; Emergency Management Plan
CC.6	Develop a governance structure and schedule to regularly review the Climate Change Adaptation Plan, the related actions, costs and funding, and the implementation plan/schedule to reassess priorities, best practices and solutions	Engineering (Environmental), CAO	Climate Change Adaptation Plan

COST LEGEND

\$ = < \$25,000

\$\$\$ = \$100,000 - \$300,000

\$\$\$\$\$ = > \$500,000

\$\$ = \$25,000 - \$100,000

\$\$\$\$ = \$300,000 - \$500,000

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
N/A	Low	2019-2020	Short-term	\$
N/A	Medium	2020 onwards	Short to medium-term	\$
N/A	Low	2020-2021	Short-term	\$
N/A	Medium	2020 onwards	Short to medium-term	\$
Red Cross, Public Health, Public Safety, NB DELG, UNB	Medium	2021-2024	Short to medium-term	\$\$
N/A	Low	2020-2021	Short to medium-term	\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
CC.7	Ensure appropriate City staff are up to date on climate change projections, best practices and relevant examples of adaptation work being carried out in other regions	Engineering (Environmental)	Climate Change Adaptation Plan, Emergency Management Plan
1.1	Continue to improve real-time communications to the public to provide information and directives associated with impacts and issues relating to weather-related events and conditions such as: road conditions, safety during storms and extreme weather events, water quality and swimming advisories, fire bans and heat advisories	Communications, EMO, Engineering, Recreation, Police	Emergency Management Plan, Transit Policy
1.2	Continue to improve proactive communications to the public on climate and weather-related safety measures such as being prepared for extreme weather events and minimizing their safety risks during and after an event	Communications, EMO, Police, Engineering	Emergency Management Plan
1.3	Provide clear and up-to-date information on emergency shelters and heating and cooling stations and work with partners to promote access to these services	EMO, Communications	Emergency Management Plan
1.4	Whenever possible, maintain and continue to incorporate natural and constructed shade and/or cooling structures into public infrastructure and public spaces	Engineering, Parks & Trees, Recreation	Tree Management Plan

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
NB DELG	Low-medium	2021 onwards	Short to medium-term	\$\$-\$
Media	Low - Medium	2020 onwards	Short to medium-term	\$\$-\$\$\$
Media, Red Cross	Low-medium	2020 onwards	Short to medium-term	\$\$
Red Cross, Public Health, NB EMO, Salvation Army	Low-medium	2020-2021	Short to medium-term	\$
UNB, MCFT	Medium	2020+ (nat) 2022+ (cons)	Medium-term	\$\$\$-\$\$\$\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
1.5	Complete the development of the Vulnerable Persons Registry and continue to complete wellness checks during times of emergency, prioritizing registered persons whenever possible	Police, EMO	Emergency Management Plan
1.6	Continue to offer access to outdoor aquatic facilities during summer months and consider modified schedules and/or expanded programming during periods of extreme heat	Recreation, Engineering (Building Services)	N/A
1.7	Continue to offer bulk water and charging stations to individuals living outside City limits in times of emergency and coordinate with outlying communities to share this information	Water & Sewer	N/A
1.8	Develop policies and procedures, where possible, to allow Management of outdoor workers to modify hours and/or tasks during extreme heat and other extreme weather conditions	Engineering, Recreation, Tourism	Corporate Policy
1.9	Regularly assess needs for new and/or modified equipment, gear and uniforms to keep staff comfortable and safe in extreme heat and other extreme weather conditions	All, Fleet	Corporate Policy
1.10	Investigate changes in policies and procedures for alternative work arrangements for non-essential staff during extreme weather events and when road conditions are hazardous	HR (lead) / All	Corporate Policy

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
TBD	Medium	2021-2022	Short to medium-term	\$\$-\$\$\$
N/A	Low-medium	2021-2022	Short to medium-term	\$\$-\$
RSC 11	Low	2020 onwards	Short-term	\$
WorkSafe	Low-medium	2020-2022	Short-medium term	\$
N/A	Low	2021 onwards	Short-medium term	\$\$
N/A	Low-Medium	2021-2022	Short-medium term	\$\$-\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
1.11	Offer opportunities for staff to learn about being prepared for events at both home and work, so they are able to be at work to maintain essential services	HR / Environmental Coordinator	N/A
2.1	Identify new and modified preventative maintenance schedules and procedures for building systems	Engineering	Capital Replacement Policy; Corporate Energy Plan
2.2	Continue to track data on building utility use and use the data to make decisions about modifications in equipment and controls to maintain comfort in buildings and minimize cost increases	Engineering (Building Services)	Corporate Energy Plan
2.3	Identify and implement changes to building specifications when renovating or building to decrease future impacts and associated costs from climate change	Engineering (Building Services)	Capital Replacement Policy
2.4	Identify opportunities to make City buildings and properties more resilient to climate change impacts, while realizing co-benefits such as GHG emissions mitigation (e.g. green roofs, rain gardens)	Engineering (Buildings Services)	Capital Replacement Policy
2.5	Make climate change adaptation a consideration when replacing building components	Engineering (Building Services)	Capital Replacement Policy
2.6	Ensure impacts on lifecycles of building components is considered when managing assets	Engineering (Building Services)	Capital Replacement Policy

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
COF E4E Group	Low	2020 onwards	Short-term	\$
N/A	Medium	2022-2025	Medium-term	\$\$-\$\$\$
MCW	Medium	2021 onwards	Medium-long term	\$
N/A	Medium-high	2022-2024	Medium-long term	\$\$-\$\$\$
FCM	Medium-high	2022-2024	Medium-long term	\$\$-\$\$\$
FCM	Medium-High	2022-2024	Medium-long term	\$\$-\$\$\$
N/A	Medium	2022-2024	Medium-term	\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
2.7	Identify learning opportunities for integrating climate resilience into buildings	Engineering (Building Services)	Capital Replacement Policy
2.8	Update by-laws, development guidelines and zoning regulations as required to reflect the most up-to-date climate projections. This may include stormwater guidelines and modified by-laws for building in known flood plains	Planning & by-law services	By-laws, zoning
2.9	Implement changes to storm sewer and sanitary sewer by-laws to improve the resilience of residential and commercial properties to climatic impacts	Planning, Engineering, EMO, Communications	By-laws, zoning
2.10	Support and promote the installation and maintenance of backwater valves in individual residences, and take a role in educating the public and developers about these devices.	Engineering, EMO, Communications	N/A
2.11	Continue to undertake infrastructure projects that mitigate neighbourhood-level flooding in key areas of the City, as per projects outlined in association with the Disaster Mitigation Adaptation Fund	Engineering	Flood Resilience
3.1	Continue with focused infrastructure renewal and improvements to the transportation network to minimize disruptions due to flooding	Engineering	Flood Resilience

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
N/A	Low	2020-2023	Short to medium-term	\$
N/A	Medium	2021-2025	Short-long-term	\$\$-\$
Community groups TBD	Low	2021-2023	Short-medium term	\$\$-\$
Community groups TBD	Low	2021-2023	Short-medium term	\$\$-\$
N/A	Medium-high	As per DMAF project schedule	Short-medium term	\$\$\$\$\$
FCM, NB-DTI	High	As per DMAF project schedule	Short-medium term	\$\$\$\$\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
3.2	Seek expertise to develop resilient road design standards that will minimize multiple impacts from a changing climate, including extreme heat and changes to freeze-thaw cycles	Engineering	Flood Resilience
3.3	Expand the Active Transportation Network to mitigate transportation disruptions due to climate change impacts	Engineering	Active Transportation Connection Plan
3.4	Continue with focused renewal of water and sewer infrastructure with attention to minimizing impacts from climate stressors	Engineering, Water & Sewer	Capital Renewal Policy
3.5	Seek out reliable data and expertise to improve stormwater management guidelines with attention to minimizing impacts from climate stressors	Engineering	Stormwater Design Guidelines
3.6	Continue to review and manage stormwater systems to mitigate impacts relating to flooding	Engineering	Stormwater Design Guidelines
3.7	Continue to upgrade culverts and bridges to mitigate service interruptions during flooding	Engineering	Flood Resilience
3.8	Continue to upgrade back-up/emergency power generation to operate core infrastructure and deliver core services	Water & Sewer	Capital Renewal Policy

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
NB-DTI	Medium-High	2022-2025	Mediu to long-term	\$\$\$-\$\$\$\$
FCM	Medium-High	2021-2025	Short-medium term	\$\$\$\$
N/A	High	As per renewal	Sort-long term	\$\$\$\$
N/A	Low	2022-2023	Medium-term	\$\$-
Ducks Unlimited, NB-DTI	Medium-high	As per renewal	Medium-term	\$\$\$\$
NB-DTI, Infrastructure Canada	High	As per renewal	Medium term	\$\$\$\$
N/A	Low-medium	2021 -2025	Short-medium term	\$\$\$-\$\$\$\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
3.9	Engage with utilities and other levels of government to stay up to date on their infrastructure and climate change adaptation plans to understand how the City of Fredericton and its residents may be impacted	Engineering	N/A
3.10	Continue to upgrade back-up/emergency power generation to operate core infrastructure and deliver core services	Water & Sewer	Capital Renewal Policy
4.1	Continue to explore options to protect, improve and expand wetlands and areas in the upper watersheds to protect habitat and biodiversity and to mitigate flooding during periods of heavy rainfall, as per projects outlined in association with the Disaster Mitigation Adaptation Fund	Engineering	Municipal Plan
4.2	Collect data on the urban forest canopy to capture a snapshot and determine a future direction for urban tree canopy management in a changing climate.	Engineering (Parks & Trees)	Tree Management Plan
4.3	Continue to run trials and experiments to identify new tree species that will thrive in a changing climate, working collaboratively whenever possible.	Engineering (Parks & Trees)	Tree Management Plan
4.4	Update by-laws, development guidelines, policies and permitting processes to enhance green space, ecosystem corridors and tree canopy on public and private properties.	Planning	Growth strategy, park plans

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
NB Power, Liberty Utilities	Low	2020 onwards	Short-term	\$
N/A	Low-medium	2021 -2025	Short-medium term	\$\$\$-\$\$\$\$
Community groups TBD	Medium-high	As per DMAF project schedule	Medium-long-term	\$\$\$\$-\$\$\$\$\$
Researchers, UNB students	Low-medium	2021-2024	Short-medium-term	\$\$
Researchers, UNB students	Low-medium	2020-ongoing	Short-long-term	\$\$-\$\$\$
Community groups TBD	Medium-high	2023-2025	Medium-long-term	\$-\$\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
4.5	Support the identification, mapping and monitoring of new invasive species that may arrive due to a changing climate.	Engineering (Parks & Trees)	Tree Management Plan
4.6	Work collaboratively to develop and enhance current management plans and strategies to manage invasive species.	Engineering (Parks & Trees)	Tree Management Plan
4.7	Increase education and communication with the public about invasive species in a changing climate and share information on how people can monitor, report and minimize impact.	Planning, Engineering (Parks & Trees)	Tree Management Plan
4.8	Continue to integrate climate change adaptation considerations into City park plans and practices, including preserving biodiversity and ecology, the use of native species, water and shade features, adequate tree canopy and natural drainage features.	Engineering (Parks & Trees), Communications	Park plans
4.9	Encourage and promote the planting of native vegetation along waterways to decrease risk of erosion.	Planning, Engineering (Parks & Trees), Communications	Municipal Plan
4.10	Encourage residents to plant gardens with native species and drought and water-tolerant plants to protect biodiversity and minimize habitat loss.	Engineering, Planning, Communications	N/A

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
Researchers, community groups TBD	Medium-Low	2022-2025	Short-long-term	\$\$
Researchers, community groups TBD	Medium	2021-2025	Short-long-term	\$\$
Researchers, community groups TBD	Medium	As needed	Medium-term	\$\$
Community groups TBD	Low-medium	2021-ongoing	Short-long-term	\$\$-\$\$\$
Community groups TBD	Low	2021-2023	Short-medium term	\$
Community groups TBD	Low	2021-2023	Short-medium term	\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
4.11	Continue and/or increase preventative maintenance and inspection of trees on public property to reduce damage and hazards.	Engineering (Parks & Trees)	Tree Management Plan
4.12	Increase education and communication with the public about forest fire risk, especially at residences and businesses adjacent to forested areas.	Fire, EMO, Communications	N/A
5.1	Assess opportunities for different forms of tourism and recreation as a result of the changing climate	Tourism, Recreation	N/A
5.2	Assess the need for new infrastructure and assets to maintain the comfort and safety of staff and the public during events and to minimize the cancellation of events	Tourism, Recreation, Engineering	Asset Management Plan
5.3	Ensure there is a cohesive cross-departmental communications plan to notify the public of any disruptions or cancellations to services and programs, as well as post-event clean-up and safety risks	Communications, All	N/A
5.4	Develop an app and/or other communications tools to inform residents about the status of services and programs	Corporate Communications	Emergency Management Plan
5.5	Continue to assess the effectiveness of the new Transit Policy for storms based on changing weather patterns and conditions	Engineering (Transit)	Transit Policy

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
N/A	Medium	2020-ongoing	Medium-term	\$\$\$
TBD	Low-medium	2021-2023	Short-medium term	\$\$
User groups	Medium	2023-2025	Medium-term	\$\$\$-\$\$\$\$\$
User groups	Medium	2021-2023	Medium-term	\$\$-\$\$\$\$
TBD	Medium	2021-2023	Medium-term	\$\$
N/A	Low	2020-2021	Short-term	\$\$
N/A	Low	2020-2022	Short-medium term	\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
5.6	Investigate the need and desire for expanded winter trail maintenance for use during milder weather	Engineering (Parks & Trees)	Active Transportation Connection Plan
5.7	Investigate the need for new tools, equipment and assets that allow staff to continue to safely deliver services in adverse weather conditions	All	Corporate Policy
5.8	Develop additional online / electronic tools for residents to access municipal services when access to physical services centres is limited	Corporate Services, I&I	Digital Fredericton
5.9	Assemble a cross-departmental team to address changing service and program needs/wants due to a changing climate, such as access to tourism and recreation services outside of their traditional seasons	Recreation, Tourism and Community Engagement	N/A

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
N/A	Medium-High	2023-2025	Short-long term	\$\$-\$\$\$
N/A	Medium	2021-2024	Short-medium term	\$\$\$
N/A	Medium-High	2022-2025	Medium-long term	\$\$\$\$\$
TBD	Low-medium	2022-2025	Medium-term	\$-\$\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
5.10	Continue to encourage water conservation amongst residential and commercial consumers, and create a plan for mandatory restrictions in the event it is necessary	Water & Sewer	
6.1	Stay engaged with climate change work happening at a provincial and federal level to understand outcomes for municipalities in general, and infrastructure and assets in our community in particular.	Planning, Engineering (Environmental), Growth & Community Services	N/A
6.2	Stay engaged with climate change work happening within our community by individuals, groups and businesses	Planning, Engineering (Environmental)	N/A
6.3	Create and/or participate in partnerships and networks addressing climate change adaptation when beneficial to all parties involved	Engineering (Environmental), All	N/A
6.4	Work collaboratively with local businesses to identify solutions for attracting people to the business and shopping districts after large-scale storm events and during flooding, when safe to do so	Recreation, Tourism and Community Engagement	N/A

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
N/A	Low	2020 onwards	Short-term	\$\$
Provincial and federal governments	Low-medium	2020 onwards		\$
TBD	Low-medium	2020 onwards		\$
TBD	Low-medium	2020 onwards	Short-medium term	\$\$\$
Downtown Fredericton Inc, Business Fredericton North	Low-medium	2022-2024	Medium-term	\$\$

ACTION ID	ACTION	IMPLEMENTATION LEAD	ASSOCIATED MUNICIPAL PLANS/POLICIES/ STRATEGIES
6.5	Share and amplify important messages about climate change in our community, including those about emergency preparedness, household level adaptations, and others	Communications	N/A
6.6	Seek funding opportunities that will allow us to do more to implement the actions outlined in this plan	Engineering (Environmental)	Climate Change Adaptation Plan; All (e.g. Growth Strategy, Active Transportation Connection Plan, Emergency Management Plan)
6.7	Seek out options to build capacity within our organization to adapt to climate change	All	All (e.g. Growth Strategy, Active Transportation Connection Plan, Emergency Management Plan)
6.8	Seek funding opportunities that will allow the City to support community-based actions	Engineering (Environment)	N/A

POTENTIAL PARTNERS	LEVEL OF EFFORT	ANTICIPATED TIMING	DURATION	ESTIMATED RESOURCES
TBD	Low	2020 onwards	Short-term	\$\$
TBD	Low	2020 onwards	Short-Long term	\$
TBD	Low-medium	2020 onwards	Short-Long term	\$
N/A	Low	2020 onwards		\$

APPENDIX C: POTENTIAL INDICATORS

GOAL 1: MAINTAIN HEALTH AND SAFETY

RECOMMENDED INDICATOR	POTENTIAL SOURCE
# of deaths relating to extreme heat & weather events	Public Health
# of hospitalizations relating to extreme heat & weather events	Public Health
# of vulnerable persons registrations	Fredericton Police / Red Cross
# of vulnerable persons checks	Fredericton Police / Red Cross
# of times freshwater tests are above maximum contaminant level	Internal reporting
# of beach closures per year	Internal reporting
Proportion of shade coverage in public spaces	Internal reporting
# of employee injuries and absences due to heat/weather related illness/stress	Internal reporting
# of employees trained in basic emergency preparedness	Internal reporting

GOAL 2: MINIMIZE RISK TO BUILDINGS AND PROPERTIES

RECOMMENDED INDICATOR	POTENTIAL SOURCE
Number of reported properties experiencing flooding	Government of New Brunswick/internal reporting
Number and/or cost of insurance claims from extreme weather events in the community	Government of New Brunswick/internal reporting
Total losses (dollar value) due to weather related events incurred by the City	Internal reporting
% of total housing and development permitted in flood plain	Internal reporting
% of population living in 100-year flood plain	Internal reporting

GOAL 3: STRENGTHEN RESILIENCE OF CORE MUNICIPAL INFRASTRUCTURE

RECOMMENDED INDICATOR	POTENTIAL SOURCE
# of rain events that exceed design standards/year	Internal reporting - Engineering
Annual cost of road maintenance	Internal reporting - Roadway Operations, Finance
# of potholes per km of road (indicator of freeze-thaw cycles)	Internal reporting - Roadway Operations
# of sanitary sewer overflows per year	Internal reporting - Pollution Control
Annual cost of sewer infrastructure maintenance, repairs and new construction	Internal reporting - Wastewater Operations, Finance
# of implemented green infrastructure projects	Internal reporting - Engineering
Total losses (dollar value) due to weather related events incurred by the City	Internal reporting - Finance
# of road washouts	Internal reporting - Engineering
# of actions from Flood Resilience Plan completed	Internal reporting - Engineering
#/% of infrastructure projects implemented with climate change factors considered	Internal reporting - Engineering

GOAL 4: MINIMIZE DAMAGE TO PARKS, TREES AND NATURAL SPACES & FEATURES

RECOMMENDED INDICATOR	POTENTIAL SOURCE
Mortality rate of trees in public inventory	Internal reporting – Parks & Trees
Mortality rate of trees, by species	Internal reporting – Parks & Trees
Tree canopy coverage	Internal reporting – Parks & Trees
Number of species exceeding 10% of total tree inventory (to measure risk)	Internal reporting – Parks & Trees
Total number of tree species and genii in the public tree inventory	Internal reporting – Parks & Trees
Dollars expended on abatement per year	Internal reporting – Parks & Trees
Change in # of invasive species/pests	Internal reporting – Parks & Trees
Trees/canopy coverage lost to invasive pests	Internal reporting – Parks & Trees
# of outreach programs/individuals engaged	Internal reporting – Parks & Trees / Environment
#/% of infrastructure projects implemented with climate change factors considered	Internal reporting - Engineering

GOAL 5: MINIMIZE DISRUPTION TO MUNICIPAL SERVICES AND PROGRAMS OFFERED

RECOMMENDED INDICATOR	POTENTIAL SOURCE
# of events/programs cancelled	Internal reporting – Rec/Tourism
# of closures	Internal reporting – Rec/Tourism/ Building Services
# of service interruptions (Transit, Service Centre)	Internal reporting
# of requests for information regarding closures & cancellations	Internal reporting

GOAL 6: CREATE PARTNERSHIPS AND EMPOWER THE COMMUNITY

RECOMMENDED INDICATOR	POTENTIAL SOURCE
# of partnerships/networks re: climate change	Internal reporting
# of interactions with other levels of government re: climate change	Internal reporting
\$ received for funding climate change projects	Internal reporting
\$ dispersed to community for climate change projects	Internal reporting

CITY OF FREDERICTON

CLIMATE CHANGE ADAPTATION PLAN

ADAPT
Fredericton

