

Climate Change Adaptation Strategies for the Community of Prince George

A Preliminary Stakeholder
Informed Guiding Document

MARCH 2020



Acknowledgements

This report was developed by the City of Prince George and ICLEI Project staff working with several community stakeholders.

City of Prince George Stakeholders:

Infrastructure Services & Public Works	Finance	External Relations
Planning & Development	Community Services	Strategic Initiatives & Partnerships

Community Stakeholders:

Regional District of Fraser-Fort George (RDFFG)	Lheidli T'enneh First Nations	Northern Health Authority
Chamber of Commerce	Emergency Management of British Columbia (EMBC)	Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (MFLNRORD)
Ministry of Transportation and Infrastructure (MOTI)	Ministry of Environment and Climate Change Strategy (MOECCS)	College of New Caledonia (CNC)
University of Northern British Columbia (UNBC)	Pacific Institute for Climate Solutions (PICS)	Fraser Basin Council
Canfor	Sinclair Group	Husky Energy
Tourism Prince George		

© 2020, ICLEI-Canada and the City of Prince George. All Rights Reserved.

The preparation of this plan was carried out with assistance from the Government of Canada and the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and the Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.

Table of Contents

Acknowledgements	1
Executive Summary.....	3
Introduction.....	6
Adaptation Changemakers.....	6
City of Prince George.....	6
Building off the 2009 Climate Change Adaptation Strategy.....	8
Scope, Intentions and Possible Limitations	10
Adaptation vs. Mitigation.....	11
Federal Policy Direction on Climate Adaptation	12
Provincial Policy Direction on Climate Adaptation	13
The Science of Climate Change.....	13
Climate Change in Canada.....	14
Climate Change in Prince George.....	15
Historic Climate Change.....	15
Future Climate Change.....	16
Impacts and Issues	18
Vulnerability and Risk Assessment	18
Future Direction	22
Vision for Prince George.....	22
Objectives, Focus Areas, and Actions.....	23
OBJECTIVE 1 Strengthen Infrastructure Resilience and Reduce Risk to Buildings and Property	24
OBJECTIVE 2 Protect Public Health and Improve Social and Economic Resiliency	29
OBJECTIVE 3 Enhance resilience of ecosystems and protect natural areas	38
OBJECTIVE 4 Integrate Climate Change Thinking and Response	52
Implementation and Governance.....	55
Oversight and Governance.....	55
City of Prince George – Environmental Services Division.....	55
City of Prince George Administration.....	55
Community Stakeholders and Partnerships.....	55
Community Stakeholder Working Group	56
Coordination.....	57
Funding	57
Monitoring and Review.....	58
Next Steps.....	58
Plan Review Schedule.....	58
Appendix A: ICLEI Canada’s Building Adaptive and Resilience Communities (BARC) Framework.....	59
Appendix B: Stakeholder Identified Impacts	60
Appendix C: Glossary of Terms.....	62
References.....	63

Executive Summary

Climate change has been described as the greatest challenge of this generation [i] and “the defining issue of our time” [ii]. The climate is changing globally but in Prince George, the climate is changing at an accelerated rate compared to the global average. Since 1942, Prince George has experienced an increase of approximately 2.8 °C in the winter months, and a decrease of approximately 10 extreme cold days (days below -25 °C) a year [iii]. In addition, Prince George has experienced a 40.5% reduction in winter precipitation and a 28.5% reduction in summer precipitation [iii], [iv]. These climatic changes can be linked to the mountain pine beetle infestation in the early 2000s, due to warmer winters not being able to keep the pest populations at bay, and extreme wildfire events in 2017 and 2018.

Prince George is expected to experience increasing annual mean temperatures, with the most significant impacts occurring in the winter months, changes in precipitation patterns resulting in drier summers and increased rainfall compared to snowfall in the winter, and more frequent and extreme weather events. Table A tabulates the expected climatic changes to occur in Prince George.

Table A: Summary of Climatic Changes for Prince George

RCP 8.5			
Climate indices	Baseline (1976-2005)	2021-2050	2051-2080
Mean annual temperature	3.9 °C	5.8 °C	7.6 °C
Days over 30 °C	1	7	18
Days below -30 °C	3.7	1.2	0.5
Freeze-thaw days	97	76.3	62
Mean annual precipitation	624 mm	665 mm	692 mm

The City of Prince George has long recognized the impacts that climate change has and will continue to pose to both the community and municipal operations. Prince George was one of the first municipalities in Canada to develop a Climate Change Adaptation Strategy in 2009. By recognizing the implications climate change could impose on Prince George, City staff collaborated with the University of Northern British Columbia to identify vulnerabilities and actions necessary to reduce future risks. Since then, extensive work has been undertaken to understand the impacts of climate change on road infrastructure and natural areas and reduce Prince George’s vulnerability to river flooding and forest fires.

Now, approximately a decade later as the impacts of climate change have been increasingly imminent, the City of Prince George has a renewed focus on continuing to improve the community’s adaptive capacity. As a part of the Adaptation Changemakers project, the City of Prince George

worked with community stakeholders to develop updated adaptation strategies for the community of Prince George. The development of this report was guided by ICLEI Canada’s Building Adaptive and Resilient Communities Program (BARC), a five-milestone adaptation framework for local governments which involved identifying local climate change projections and impacts, facilitating a risk and vulnerability assessment, and identifying community actions to increase resilience to projected changes.

As a part of this stakeholder informed process, sixty impacts to the built and natural environment and social and economic systems were initially identified for the community of Prince George utilizing the local climate projections. Risk and vulnerability assessments were then conducted to prioritize the climate change impacts, resulting in the development of eighteen (18) priority climate risks for the community of Prince George. These 18 climate risks were utilized to brainstorm goals and actions to reduce community vulnerabilities to climate change.

This process resulted in the development of the following objectives, focus areas and corresponding goals:

Strengthen Infrastructure Resilience and Reduce Risks to Buildings and Property	Protect Public Health and Improve Economic Resiliency	Enhance Resilience of Ecosystems and Protect Natural Areas	Integrate Climate Change Thinking and Response
<p><i>Focus Area: Transportation</i></p> <p>Goal #1: Improve resiliency of transportation infrastructure to a changing climate.</p> <p><i>Focus Area: Buildings and Infrastructure</i></p> <p>Goal #2: Improve resiliency of buildings to a changing climate.</p> <p>Goal #3: Improve resilience of energy infrastructure to increasing energy</p>	<p><i>Focus Area: Emergency Response</i></p> <p>Goal #4: Mitigate strain of a changing climate on emergency response procedures.</p> <p><i>Focus Area: Health and Well-Being</i></p> <p>Goal #5: Assist vulnerable populations to avoid or reduce health-related risks of extreme weather and temperatures.</p> <p>Goal #6: Mitigate the impacts of warmer temperatures and extreme heat into the long-term.</p>	<p><i>Focus Area: Slope Stability</i></p> <p>Goal #10: Reduce the risk of slope failure and other erosion hazards.</p> <p><i>Focus Area: Stormwater</i></p> <p>Goal #11: Enhance stormwater management to prevent overland flooding and contamination in the context of changing climate conditions.</p> <p><i>Focus Area: River Flooding</i></p>	<p><i>Focus Area: Governance and Education</i></p> <p>Goal #17: Incorporate climate change adaptation into municipal decision-making processes, policies and plans.</p> <p>Goal #18: Inspire and track progress of climate action at the City and in the Community.</p>

<p>demand and extreme weather events.</p>	<p>Goal #6: Mitigate the impacts of warmer temperatures and extreme heat into the long-term.</p> <p>Goal #6: Mitigate the impacts of warmer temperatures and extreme heat into the long-term.</p> <p>Goal #7: Build a sense of community and reduce social isolation.</p> <p>Goal #8: Support local food production.</p> <p><i>Focus Area: Economic Resilience</i></p> <p>Goal #9: Encourage local industry and commercial business to identify and plan for climate-related risks and opportunities that may affect their business activity.</p>	<p>Goal #12: Continue to enhance river flood resilience in the context of changing climate conditions.</p> <p><i>Focus Area: Water Supply</i></p> <p>Goal #13: Conserve and protect groundwater and surface water resources.</p> <p><i>Focus Area: Forests & Wildfire</i></p> <p>Goal #14: Proactively mitigate wildfire risk at the community scale.</p> <p><i>Focus Area: Ecosystems</i></p> <p>Goal #15: Protect natural assets and enhance ecosystem services.</p> <p>Goal #16: Raise awareness of and restrict spread of invasive species throughout community.</p>	
---	---	--	--

These objectives and goals guided the development of potential actions and possible partnerships that act as a framework for the City of Prince George in the coming years to increase adaptive capacity. The identified actions, combined with actions developed conjunctively with the Climate Change Mitigation Planning process, will guide the City as it develops a Climate Action Strategy. This process will involve prioritizing the action items, identifying municipal and community stakeholders who will be responsible for the implementation of actions, monitoring metrics and timelines.

Introduction

Adaptation Changemakers

Development of Climate Change Adaptation Strategies for the Community of Prince George was facilitated by the City's participation in ICLEI Canada's Adaptation Changemakers project. Supported by technical guidance from ICLEI and Regional Experts, Adaptation Changemakers was a two-year initiative that engaged eight communities across Canada to build local capacity for climate change resilience and advance efforts on adaptation. Built on a cohort model, this project brought the eight participating communities together multiple times over the course of the project, gathering at three national workshops to network, learn, and share experiences about adaptation planning.

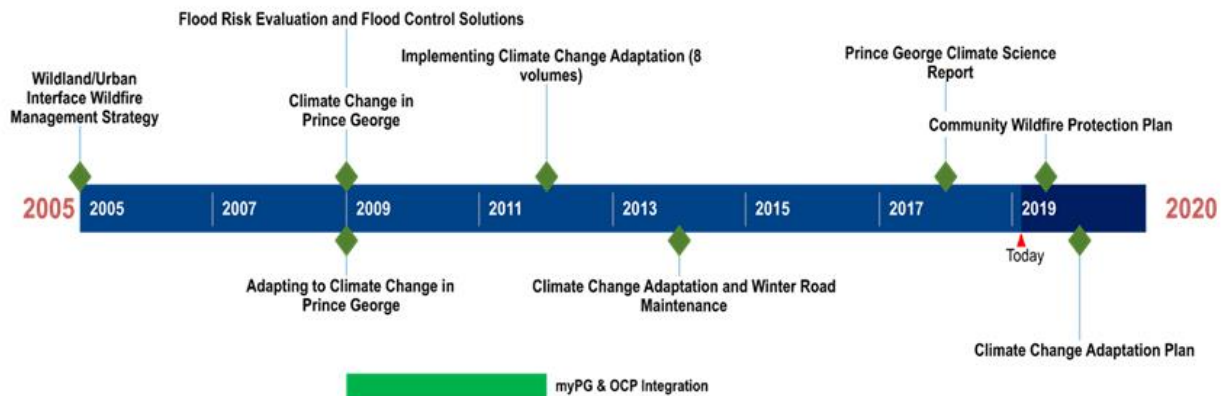
Each Changemakers municipality followed Milestones 1 – 3 of ICLEI Canada's Building Adaptive and Resilience Communities (BARC) program – a five milestone planning framework that supports the development and implementation of municipal climate change adaptation strategies. The process involved identifying local climate change projections and impacts, facilitating a risk and vulnerability assessment, and identifying community actions to increase resilience to projected changes. Each step built upon the findings of the other, culminating in the production of an implementation-ready report that is supported by community stakeholders. One aspect unique to the Changemakers process was the requirement for these Adaptation Strategies to include non-municipal partners on planning and implementation. The Municipality acts as a coordinator and champion of the report, however various actions and risks within the plan will need to be owned and implemented by non-municipal stakeholders. This collaborative co-governance model allows the burden of responsibility to be shared amongst key partners and increases resilience in areas outside the corporation of the City.

Development of the Climate Change Adaptation Strategies for the Community of Prince George was guided by ICLEI Canada's Building Adaptive and Resilient Communities (BARC) program). BARC is a five-milestone planning framework for local governments aimed at preparing communities for the impacts of climate change. The comprehensive planning methodology that includes guides municipalities through areas of research and climate impact assessment methods, plan development, action-setting processes, implementation planning, and monitoring and review strategies (see Appendix A). As part of the Changemakers project, Prince George worked through and completed Milestones 1 – 3 of the framework, which culminate in the creation of this report.

City of Prince George

The City of Prince George (City) has long been a leader in climate change mitigation and adaptation planning. Prince George was one of the first municipalities in Canada to develop a Climate Adaptation Strategy in 2009 and complete all five milestones as part of the Federation of Canadian Municipalities (FCM) Partner for Climate Protection (PCP) Program in 2011. The myPG Sustainability Plan and Official Community Plan expresses the future goals of the community, which includes “Reduce carbon emissions and adapt to climate change” which supports the additional

environmental goals to protect the air, water and terrestrial environments while reducing waste and being a leader in green energy.



Prince George has been acknowledging and experiencing the consequences of climate change over the past two decades, including enduring the spread of the mountain pine beetle infestation, more intense forest fires and warming winters. These events stimulated a collaboration with the University of Northern British Columbia in 2009 to outline the climate change adaptation priorities for the City at the time which involved an intensive consultation process with stakeholders and the wider community. In response to the changing climate, the City has implemented adaptation planning through floodplain mapping, wildfire mitigation and road maintenance over the past 10 years.



In addition, the City has committed to reducing greenhouse gas (GHG) emissions associated with climate change through undertaking actions identified in the 2007 Energy and Greenhouse Gas Management Plan and 2010 Carbon Neutral Corporate Plan. These actions have involved the addition of electric vehicles to the City fleet, the construction of the new RCMP detachment to LEED standards, and converting biogas produced at the Wastewater Treatment Centre into electricity. The City is also a green energy leader, being one of the few municipalities in Canada to operate a fully renewable district energy system that provides heat and hot water to 11 municipal buildings in the downtown.



Building off the 2009 Climate Change Adaptation Strategy

Over a decade later, Prince George has a renewed focus on reducing its vulnerability to climate change. As the impacts of climate change become increasingly imminent, it is evident that significant adaptation efforts are needed. The Region experienced record-breaking wildfire seasons in 2017 and 2018, resulting in Prince George receiving an influx of evacuees from neighbouring communities. In addition, the smoke caused by the wildfire events resulted in hazardous air quality conditions throughout the summer. Researchers have noted that wildfire seasons are starting earlier and getting longer, concluding that human-induced climate change “played a major role in the extreme 2017 wildfire season” [iii]. These events resulted in escalating social and economic costs, with the 2017 wildfire season costing the Provincial Government approximately \$4.8 million on emergency response to accommodate evacuees [v].

Prince George is also experiencing dramatically warmer winters, with winter minimum temperatures increasing by 9 °C since 1942 [iii]. These changes have resulted in increasing freeze-thaw cycles and rain on snow events leading to icy roads, more potholes and winter flooding events. In 2019, the City spent over \$530,000 to steam frozen catchbasins and culverts following several rain on snow events to prevent overland flooding compared to \$52,000 in 2016 and \$130,000 in 2017 [v].

The physical, social and economic impacts of climate change are already being experienced locally and are expected to worsen; therefore, community climate action is essential to prepare for and mitigate the costs and risks associated with these changes now more than ever.

The City of Prince George’s 2009 Climate Change Adaptation Strategy provided an overview of adaptation priorities as shown in Table 1 (right).

Following the development of the 2009 strategy, the City implemented measures to reduce vulnerabilities of several of the aforementioned priorities with support from Natural Resources Canada’s Regional Adaptation Collaboration (RAC). These included:

1. Implementing Climate Change Adaptation Efforts into the myPG Integrated Community Sustainability Plan and the Official Community Plan, which are overarching guiding documents for the community.
2. Developing a Community Wildfire Protection Plan and removing local fire hazards primarily related to the mountain pine beetle infestation in municipal boundaries.
3. Identifying local river flooding risks, developing an Emergency Response Bylaw and Flood Plain Bylaw and purchasing residential properties along River Road that were vulnerable to flooding and rezoning the properties to park space.
4. Researching how a changing winter climate may affect vehicle collision rates and snow and ice control operations.
5. Analyzing intensity, duration and frequency (IDF) rainfall curves, and assessing the impacts of precipitation and freeze-thaw cycles changes locally.
6. Projecting how natural areas and ecosystems will be impacted by changes in soil moisture and drought and identifying which local species may be at risk of climate change.

Table 1: Prince George's climate adaptation priorities from 2009 Climate Change Adaptation Strategy

Level of Priority	Impact
Top Priorities	Forests
	Flooding
High Priorities	Transportation Infrastructure
	Severe weather/emergency response
	Water Supply
Medium Priorities	Slope Stability
	Stormwater
	Buildings and utilities
Other Priorities	Health
	Agriculture
	New residents and businesses

The priorities identified in the 2009 Climate Change Adaptation strategy were implemented into the City of Prince George Official Community Plan in 2011 and provides guiding objectives related to climate change adaptation, as shown in Table 2 (below).

Table 2: Objectives from Section 6.3 of the City's Official Community Plan (OCP) 2011 which identify the significance of climate change adaptation in Prince George.

Objective 6.3.1	Promote climate change adaptation in order to minimize negative climate related impacts on human safety, health and well-being.
Objective 6.3.2	Consider climate change adaptation in all aspects of future decision making related to the priorities identified in the Adapting to Climate Change in Prince George document.
Objective 6.3.3	Adapt to climate change by encouraging infrastructure development that minimizes the risk of negative climate related impacts.
Objective 6.3.4	Adapt to climate change by promoting resiliency to unexpected climate related changes.
Objective 6.3.5	Adapt to climate change by planning to capitalize on positive impacts that may arise as a result of climate related changes in the region.
Objective 6.3.6	Improve public awareness of climate change, and work to concurrently adapt to and mitigate climate change impacts.

As a part of the Changemakers Project, the City of Prince George is building off the foundational work completed in the 2009 strategy. Due to the extensive work completed previously, Prince George's adaptation priorities have grown as demonstrated in this updated Preliminary Community Climate Change Adaptation Strategy.

Scope, Intentions and Possible Limitations

This report was developed to guide climate change adaptation strategies for the community of Prince George and provide updated climate projections and action items to the City of Prince George's 2009 Climate Change Adaptation Strategy. Building on the 2009 strategy, these efforts have allowed the City to review updated forecasted impacts and vulnerabilities and advance the community of Prince George further toward climate resilience of its economic and social systems and the built and natural environment.

The process involved a wide range of stakeholders that represented social, economic, infrastructure and environmental sectors. The diversity of stakeholders involved throughout this process provided a significant opportunity for engagement on climate change adaptation in Prince George. Stakeholders identified risks and vulnerabilities that Prince George may face in a changing climate, and conceptualized actions needing to be implemented across various sectors. This collaborative effort is innovative and allows the burden of responsibility of adapting to climate change to be shared amongst community stakeholders.

Although stakeholders from a variety of sectors were engaged in this process, there are additional community organizations that were not able to be involved in this exercise for a variety of reasons. Therefore, the identified risks and impacts and recommended actions in this report should not be viewed as an all-inclusive list for the community of Prince George. The impacts and recommended

actions identified through this process were determined by participating stakeholders and may be more reflective of the stakeholders involved rather than the broader community. They are also reflective of each stakeholder's climate change knowledge, experiences and capacities at the time of the engagement sessions. As stakeholders become more and more familiar with the risks, experiences and realities of climate change, it is likely that additional or revised actions may surface over time. The recent and significant impacts that forest fires have had on stakeholder's operations and the community of Prince George as a whole just prior to the engagement sessions may also have influenced some of the discussions and areas of focus.

Due to capacity constraints and available timelines the actions in this report are recommendations and have not yet been communicated to all the identified stakeholders. Stakeholders that participated in the development of this report recommended possible partners for implementation. These key community partners have not yet approved or committed to the recommended actions for implementation and further work is needed in this area before these actions can be implemented. Additional work on prioritizing actions and identifying leading and lagging measures of success is also needed.

The adaptation strategies identified in this document will be utilized to guide the City of Prince George as it develops a Climate Action Strategy, which will seek to integrate the findings of this report in conjunction with the City's Climate Change Mitigation Plan and other relevant plans and strategies. The climate change projections, risk and vulnerability assessment and recommendations identified in this document will guide the development of priority actions and success indicators for the City of Prince George Climate Action Strategy and following work plans. The Climate Action Strategy will be City-owned and specific to the actions that the City will have direct influence or control over to increase adaptive capacity. Additionally, the City will continue to advocate for community stakeholders to consider climate change adaptation in their operations, and implement the suggested actions developed for this report. Next steps will involve engaging more deeply with both municipal and community stakeholders to determine their capacity for taking on the suggested actions.

Adaptation vs. Mitigation

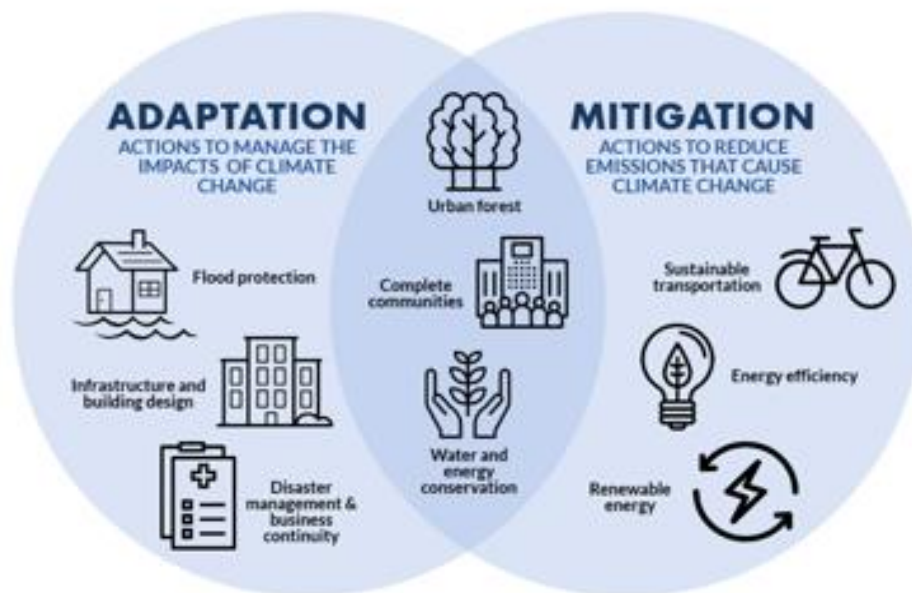
Climate change refers to changes in long-term weather patterns caused by natural phenomena and human activities. Addressing climate change requires a two-pronged approach: reducing greenhouse gas emissions (mitigation) and preparing for the impacts of climate change (adaptation).

Mitigation refers to the implementation of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere. These include transitioning to low-carbon energy sources and improving energy efficiency. However, the effects of climate change are wide ranging and will require a diversity of responses. While mitigation efforts work to contain the long-term impacts of global warming, adaptation measures are needed to address the climate change impacts that are already happening and prepare for climate change impacts that are expected to worsen if mitigation efforts globally are not successful. Adaptation is not meant to replace or undermine mitigation efforts, rather adaptation complements local government efforts to protect and improve their long-term sustainability. Climate change

adaptation refers to any initiative or action that increases the resilience of social, ecological, physical, and economic systems to changing climate conditions.

ADAPTATION = managing the unavoidable
MITIGATION = avoiding the unmanageable

Adaptation and mitigation are not mutually exclusive. Many actions can have co-benefits, meaning they contribute both to resilience and to reducing GHG emissions. For example, using green infrastructure such as bioswales or rain gardens can help retain rainwater and mitigate overland flooding; they also sequester carbon and emit fewer emissions during installation, maintenance and replacement as compared to a traditional concrete asset or pipe.



Source: ICLEI Canada, 2019

Federal Policy Direction on Climate Adaptation

Canada was one of 195 countries to sign the Paris Agreement in December 2015. The Agreement aims to keep the global temperature to well below two degrees Celsius, and to drive efforts to limit the temperature increase even further to 1.5 degrees Celsius above pre-industrial levels. In terms of adaptation, the Agreement has a goal to enhance adaptive capacity, strengthen resilience and reduce vulnerability to global climate change, in line with the temperature goal [vi].

The Government of Canada has also produced several policy documents that support and guide the country's position on climate change adaptation. For example, in 2016, the Government of Canada released its Pan Canadian Framework on Clean Growth and Climate Change, which includes adaptation considerations and actions to improve climate resiliency[vii]. Major focus areas include building climate resilience through infrastructure, protecting and improving human health and well-

being, and reducing climate-related hazards and disaster risks. The framework recognizes the important role that Canadian municipalities will play in implementing climate solutions locally.

The Government of Canada has also taken several ad-hoc steps in recent years to help Canadians adapt to a changing climate[viii], [ix], [x] including:

- Developing the Expert Panel on Climate Change Adaptation and Resilience Results in August 2017. The Expert Panel was tasked with providing advice to the federal government on how to measure progress on adaptation and climate resilience[x].
- Creating the Federal Adaptation Policy Framework, which brings the consideration of climate change risks into federal decision-making.
- Creating the Canadian Centre for Climate Services, which provides public information on understanding and adapting to climate change.

Provincial Policy Direction on Climate Adaptation

In 2019, the Province of British Columbia completed a Preliminary Strategic Climate Risk Assessment for B.C. as a first step in better understanding climate-related risks in B.C. and help government develop appropriate measures to address those risks. The assessment is being used to inform a provincial climate preparedness and adaptation strategy to help protect people, communities and businesses from the impacts of climate change (set to be released in late 2020). While the risk assessment is not intended to be used as a prediction of future events it can act as a tool to evaluate the likelihood and potential consequences of each event happening in the future to understand the degree of risk each poses for the province to help prepare.

Key Findings of the Provincial Assessment are:

- The greatest risks to B.C. are severe wildfire season, seasonal water shortage, heat wave, ocean acidification, glacier loss, and long-term water shortage.
- Other risks that have the potential to result in significant consequences include severe river flooding and severe coastal storm surge, although these events are less likely to occur.
- Nearly all risk event scenarios (except moderate flooding and extreme precipitation and landslide) would have major province-wide consequences in at least one category.

The Science of Climate Change

Climate change is defined as any change in global or regional climate patterns. While the Earth's climate has naturally fluctuated for millions of years, changes in climate from the mid-to-late 20th century onwards are largely attributed to increases in human activity. Human activities affect the climate system through two means – changes to land surface (e.g. deforestation) and altering the composition of the atmosphere through increasing atmospheric concentrations of GHGs through the burning of fossil fuels.

According to the Intergovernmental Panel on Climate Change (IPCC), the United Nations body for assessing the science related to climate change, global surface air temperature increased by 0.74 °C between 1906 – 2005. Moreover, both the World Meteorological Organization and the American Meteorological Society identified 2010 as the warmest year on record, and have confirmed the existence of a strong, long-term global warming trend [xi], [xii].

Warming of the Earth's surface and atmosphere also results in changes in evaporation and precipitation patterns. In general, warmer temperatures lead to greater potential evaporation of surface water, thereby increasing the amount of moisture in the air. Typically, warmer air can hold more moisture, meaning more intense precipitation events are expected as a result of climate change (this is true if the annual mean temperature does not exceed about 16 °C and is highly location dependent) [xiii]. However, precipitation trends tend to be more difficult to predict than temperature and will vary greatly depending upon geographic location.

It is important to note that uncertainty is an integral part of the study of climate change. Uncertainty is factored into climate change scenarios, models, and data, and reflects the complex reality of environmental change and the evolving relationship between humans and the planet. Climate change cannot be predicted with absolute certainty in any given case, and all considerations of data must consider this. While it is not possible to anticipate future climatic changes with absolute certainty, climate change scenarios help to create plausible representations of future climate conditions. These conditions are based on assumptions of future atmospheric composition and on an understanding of the effects of increased atmospheric concentrations of greenhouse gases (GHG), particulates, and other pollutants. It is important to mention the time lag between carbon dioxide entering the atmosphere and the resulting atmospheric warming, which can be anywhere from several decades to centuries. This means that the impacts of atmospheric carbon dioxide may not be fully realized until a certain time frame after maximum carbon dioxide emissions have been released [xiv].

Climate Change in Canada

Similar to global trends, Canada has been warming over the last six decades, with average temperatures over land increasing by 1.5 °C between 1950 -2010[ix]. This rate of warming is almost double the global average reported over the same period, meaning an increase of 2 °C globally could result in a 3-4 °C change in Canada. The years 2011 and 2012 were found to be 1.5 °C and 1.9 °C warmer than the 1961-1990 average in Canada, with 2018 now standing as the warmest year on record globally.

Canada has also generally become wetter over the past several decades, with average annual precipitation across the country increasing by approximately 16% between 1950-2010. This increase is dominated by large changes in British Columbia and Atlantic Canada. Extreme precipitation events are also likely to become more intense and more frequent – recent studies show that a 1-in-20-year storm event are likely to become 1-in-10-year storm events by the 2050s [xv], [xvi].



Climate Change in Prince George

Historic Climate Change

Although climate change may feel like a problem of the future, we know that the climate is already changing, and the local impacts are already being experienced. Climatic changes have occurred predominantly in the winter months from October to March. Winter average temperatures in Prince George have increased by approximately 2.8°C since 1942, and extreme cold days (below -25°C) are becoming less frequent [iii]. Since 1956, extreme cold days have decreased from approximately 17 days a year to 7 days a year and minimum winter temperatures have increased by 9°C [iii]. Prince George has also experienced a significant reduction in annual precipitation with winter precipitation decreasing by 40.5% and summer precipitation decreasing by 28.5% since 1942 [iii], [iv]. Table 3 (below) summarizes the observed historic climatic changes in Prince George.

These climatic changes have resulted in warmer winters leading to increased rain on snow events and freeze-thaw events, and drier summers leading to increased forest fire risks – all of which pose potential public safety and operational challenges.

Table 3: Summary of Historic Climate Change in Prince George

Number of Extreme Cold Days Decreasing (between 1956 and 2019)	Annual days below -25C have decreased from 17 days to 7 days a year
Average Winter Temperatures have increased (between 1942 and 2018)	+2.8 C
Minimum Winter Temperatures have increased (between 1942 and 2018)	+9.0 C
Winter Precipitation has decreased (between 1942 and 2018)	-40.5%
Summer Precipitation has decreased (between 1942 and 2018)	-28.5%

Future Climate Change

To develop the projected impacts of climate change on the City of Prince George, models and scenarios from the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report were used. The Climate Atlas and Canadian Climate Data and Scenarios tools were utilized to access downscaled climate data for the area. Temperature and precipitation are the parameters that were included as part of the assessment phase. Findings include increased temperature, increased precipitation in fall, winter, and spring, and increased intensity of rainfall. A summary of the climatic changes discussed in this report can be found in Table 4 (below).

Table 4: Summary of Climatic Changes for Prince George

RCP 8.5			
Climate indices	Baseline (1976-2005)	2021-2050	2051-2080
Mean annual temperature	3.9 °C	5.8 °C	7.6 °C
Days over 30 °C	1	7	18
Days below -30 °C	3.7	1.2	0.5
Freeze-thaw days*	97	76.3	62
Mean annual precipitation	624 mm	665 mm	692 mm

* A freeze-thaw cycle occurs when the daily maximum temperature (T_{max}) is higher than 0 °C and the daily minimum temperature (T_{min}) is less than or equal to -1 °C. The minimum temperature of -1 °C (rather than 0 °C) is used as the threshold for freezing to raise the likelihood that water actually froze at the surface [xvii].

The infographic below summarizes key data on historic and future climate change for Prince George.

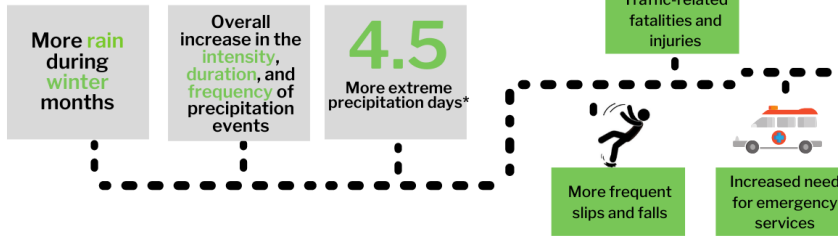


CLIMATE CHANGE IN PRINCE GEORGE

This infographic presents some of the key climate impacts for the 2080s, it is important to remember that many of the impacts outlined are already being felt across the community.

EXTREMÉ WEATHER & NATURAL HAZARDS

By 2080, we can expect...



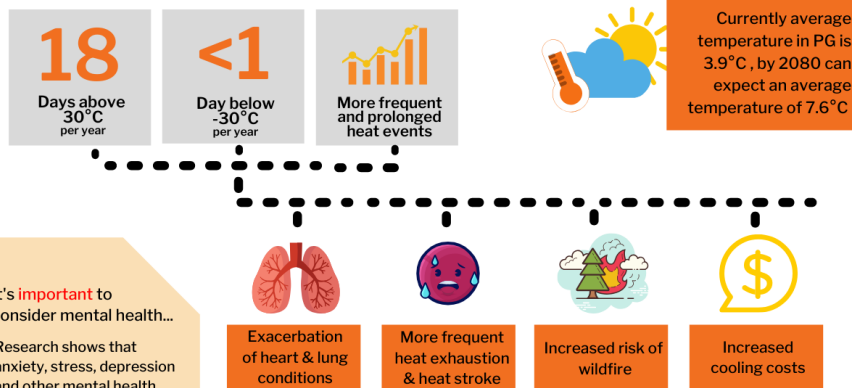
CHANGING WINTERS

By 2080, we can expect...



CHANGING TEMPERATURES

By 2080, we can expect...



* Projections are based on a 'business as usual' emissions scenario – RCP8.5
 * Baseline periods: Climate Atlas of Canada (1976-2005) . Projection periods: 2080s (2050-2080).
 * 99th percentile rainfall event, where the event's precipitation total is greater than or equal to 99 percent of all 24-hour storms on an annual basis.

Sources:
 Prairie Climate Centre (2019). Climate Atlas of Canada, version 2 (July 10, 2019). <https://climateatlas.ca>

Impacts and Issues

Impact statements consider the projected climatic changes and their effects on built, natural, and human/social systems. A workshop was held in October 2018 where participants were divided into groups and asked to develop impact statements for each system, thinking about the specific changes Prince George could experience. The group identified 62 impacts that were later used to inform a vulnerability and risk assessment, where they were further refined and prioritized. The full list of these impacts is provided in Appendix B.

Impact statements are intended to capture:

- A climatic threat/change (e.g. rising temperatures)
- The outcome of the climatic change (e.g. extreme heat event)
- The consequences associated with this outcome (e.g. heat stress)

Vulnerability and Risk Assessment

Vulnerability, or the degree to which a system is susceptible to the impacts of climate change, is a function of both sensitivity and adaptive capacity. Sensitivity is defined as the degree to which a system is affected by climatic conditions (e.g. temperature increases) or a specific climate change impact (e.g. increased flooding). Adaptive capacity is defined as 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.

In other words, a vulnerability assessment determines how susceptible Prince George is to changes to the climate (e.g. heatwaves, extreme storms, sea level rise), and how prepared we are for those changes. For example, local trees may be affected by hotter and drier summers, but if most of the species are not susceptible to damage, and there is a plan to affordably replace those species over time, the vulnerability is low. Conversely, if there is no funding to replace the trees, then the vulnerability is high. Alternatively, Prince George's vulnerability to poor air quality from wildfires is higher because there is only so much that can be done to limit the impact on human health. Clean air shelters and homes equipped with air purifiers can help to lower the vulnerability of poor air quality on Prince George residents.

In February 2019, an online questionnaire was sent to 48 local stakeholders to assess the vulnerability of Prince George to the climate change impacts that were identified in the second local meeting; these impacts related to the built, natural, and human/social systems within the city. As a result of the vulnerability assessment, 23 low-vulnerability impacts were removed or combined with pre-existing impacts to create an updated list of 37 impact statements to move onto the risk assessment process.

Analyzing risk is a key step in adapting to climate change and planning for a future in which the climate will be different than it is today. A local workshop involving a variety of stakeholders and local experts was held to determine the risk of Prince George to the 37 impact statements that moved forward from the vulnerability phase. The risk assessment was used to further prioritize which risks are most pertinent to plan for. In the risk assessment workshop, participants were asked to assess the consequences of each climate impact statement using the 12 criteria listed in Table 5 (below).

Table 5: Criteria Used to Assess the Consequence of Climate Impact Statements

Social	Economic	Environmental
Public Health & Safety	Property Damage	Air
Displacement	Local Economy & Growth	Water
Loss of Livelihood	Community Livability	Soil
Cultural Aspects	Public Administration	Ecosystem Function

Physical Impacts

Changes in temperature and precipitation will affect Prince George’s built environment from roads, sidewalks and bridges to buildings and utility infrastructure to parks and public spaces. These climatic changes will result in increased maintenance requirements, additional replacements and increased risk of lost assets. Changes in precipitation will have a direct impact on the City’s storm and road infrastructure, such as events exceeded the system’s capacity and causing localized flooding. The physical impacts to assets may also result in impacts to public health and safety as extreme weather events can cause dangerous conditions.

Economic Impacts

The economic burden associated with climate change impacts is expected to increase over time, with the National Round Table on Environment and Energy estimated that climate change costs for Canada could escalate from \$5 billion in 2020 to between \$21 to 43 billion per year by the 2050s [xviii]. Public Safety Canada estimates that for every dollar invested in climate change adaptation \$3 to \$5 is saved in recovery costs [xix].

Locally, climate change has impacted the forestry sector due to the mountain pine beetle infestation and increasing intensity of wildfires. Climate change also has also affected local tourism and recreational facilities due to smokier summers and warming winters. In addition, food costs may continue to rise due to climate change impacts such as hurricanes and droughts in areas that Northern BC relies on for food production.

Natural Environment Impacts

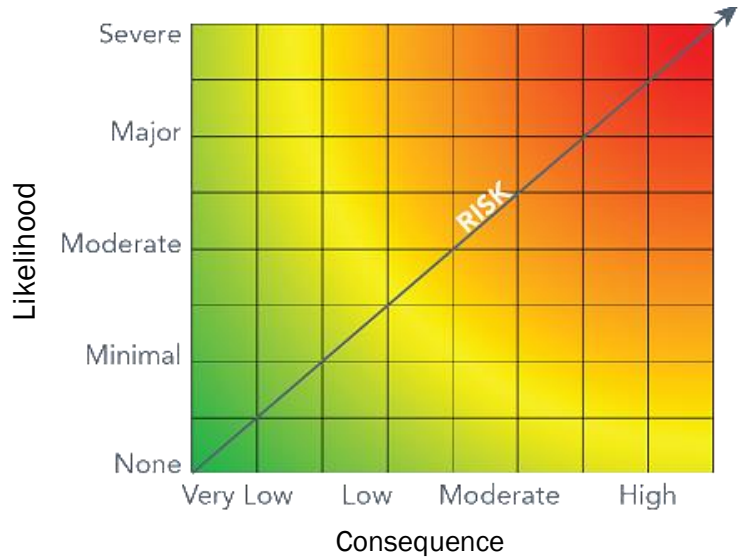
Climate change has a significant influence on the natural environment and the basis that is provided to the community in the form of economic, social and public health benefits. Prince George relies on this natural capital for the delivery of ecosystem services such as air and water purification, flood mitigation, carbon sequestration and recreational and physical and mental health benefits. Prince George’s natural environment is already under stress as a result of human activities such as development and pollution. Climate change is exacerbating the impacts on

natural environments such as increased erosion, decreased soil moisture and the spread of invasive plants.


















Top Climate Risks

Risk is a function of likelihood and consequence. A likelihood score was pre-determined for each impact statement by the project team, and participants were asked to review these scores at the workshop. The focus of the working session was to assign consequence scores for each of the social, economic, and environmental factors above to determine the overall risk score for each impact statement.

Below is a summary of the most significant climate risks to Prince George (based on stakeholder participation in workshops to date, additional information collected through online surveys and correspondence, interviews with experts, and consultation with the Changemakers team in Prince George). Defining risk is intended to be an iterative process and should be revisited and reevaluated every five years, and this document should be treated as a living document that can be updated in the interim. The priorities established are reflective of the stakeholders' perception, capacity, and knowledge; these perceptions may have been influenced by the recent (2017/2018) wildfire activities. The risks listed on the following page were identified by Prince George's stakeholder group as priority risks in the community.



TOP CLIMATE RISKS FOR THE COMMUNITY OF PRINCE GEORGE

	Hotter and drier summers increasing wildfire risk, affecting infrastructure, ecosystems, and people [High risk]
	Increase in extreme weather events and wildfires increasing demand on emergency management and health services [Medium-high risk]
	More extreme rainfall events and freeze thaw events leading to overland flooding and increased slope instability [Medium-high risk]
	Rising annual temperatures increasing invasive species and plant diseases, threatening native species [Medium-high risk]
	Rising annual temperatures and hotter summers impacting the health of aquatic systems, grasslands and forests [Medium-high risk]
	Hotter summers decreasing moisture content in soil and ability to absorb storm water [Medium-high risk]
	More extreme rainfall events (including rain on snow events) causing overland flooding [Medium risk]
	Hotter and drier summers increasing fine particulates, ground-level ozone, allergens, and smoke, leading to poor air quality [Medium risk]
	Increase in extreme heat events affecting health of vulnerable populations (i.e. pregnant women, homeless, elderly) [Medium risk]
	Higher summer temperatures increasing demand on infrastructure, water supply, and energy resources [Medium risk]
	Warmer winters and changing freeze/thaw cycles causing localized flooding affecting infrastructure (e.g., potholes), operations (e.g., salt use), and safety (e.g., slip and falls) [Medium risk]
	Smoke from wildfires affecting safety and productivity of outdoor workers [Medium risk]
	Warmer winter temperatures and rising annual temperatures reducing die-off of pests (e.g. beetle infestation) [Medium risk]
	Increase in heavy rainfall events causing riverbank erosion and loss of riparian habitat [Medium risk]
	Warmer winter temperatures impacting winter sports and tourism [Medium risk]
	Hotter, drier summers and wildfire limiting outdoor recreational activities (e.g. camping, swimming) [Medium risk]
	Warmer winter temperatures impacting hunting, fishing, and trapping, including for Indigenous communities [Medium risk]



Future Direction

The Vision, Objectives and Actions presented in this report are a combination of City administration and community-led measures that have been developed by community stakeholders and City Staff to address the community of Prince George's priority climate impacts and risks. A detailed implementation table can be found associated with each action.

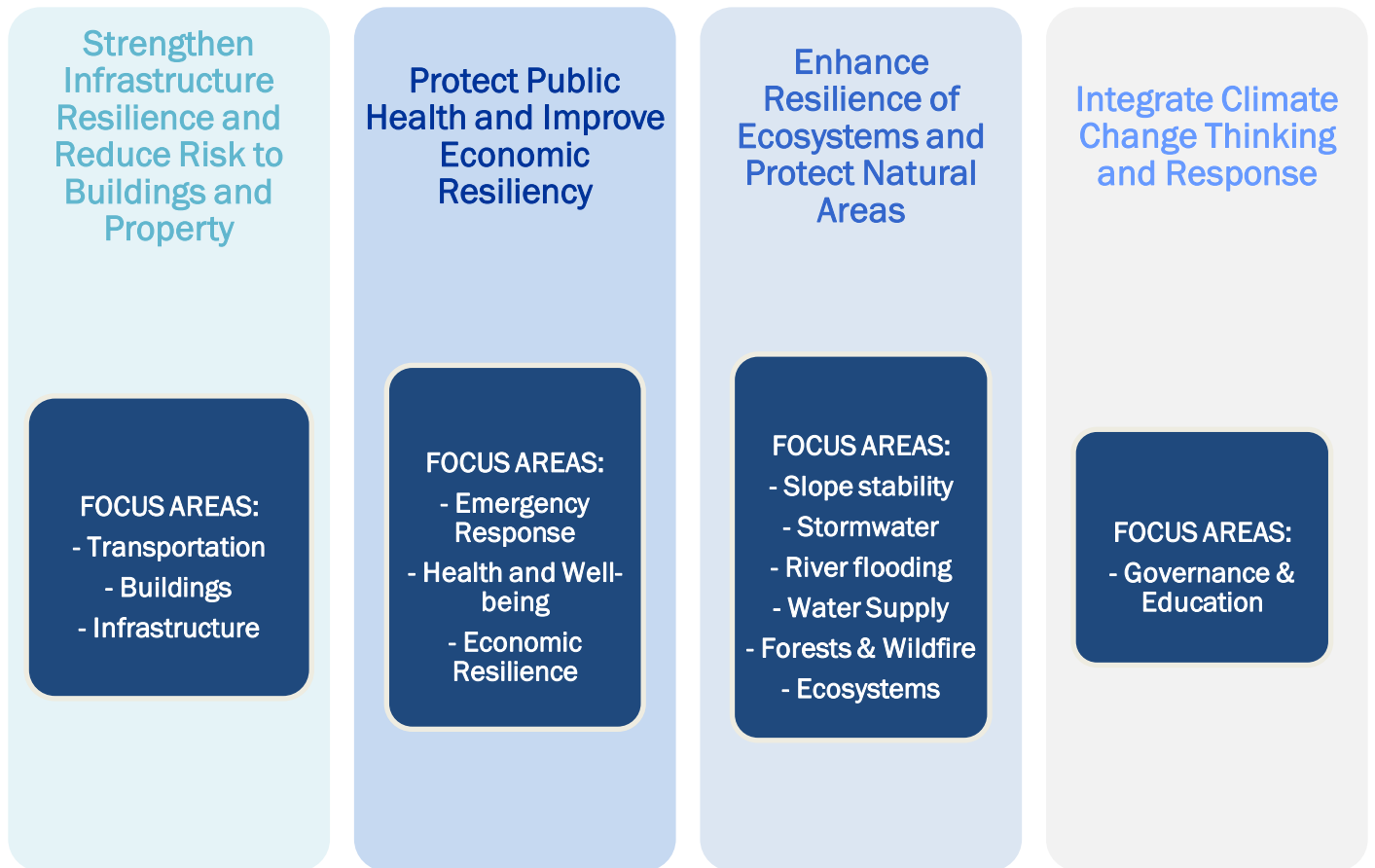
The City of Prince George intends to utilize these identified climate impacts and risks to assist in prioritizing action items as part of the upcoming Climate Action Strategy. This Strategy focuses more on impacts that are directly related to City infrastructure and initiatives that the City has direct control or influence over. However, it will recognize the importance of partnering and integrating the City's initiatives with those of partner agencies and seek to continue to advance the strategies identified in this report. As a part of the Climate Action Strategy, actions will be prioritized, the roles of implementation will be identified, and monitoring metrics and timelines will be developed.

Vision for Prince George

The City of Prince George will continue to be a leader in responding to and preparing for current and future climate change impacts. The City will focus on increasing the community's adaptive capacity to climate change and reducing climate risks by working in partnership with local stakeholders and integrating climate change adaptation across the organization. It is our vision to be able to work, live and play in an economically vibrant, healthy and sustainable community now and into the future.

Objectives, Focus Areas, and Actions

To provide a strategic framework and direction for the Climate Change Adaptation Strategies for the Community of Prince George, the actions identified to address local risks have been divided into four core objectives, with five corresponding themes.





OBJECTIVE 1 | Strengthen Infrastructure Resilience and Reduce Risk to Buildings and Property

Focus Area: Transportation Infrastructure

Description:

Transportation infrastructure in Prince George includes roads, bike lanes, laneways, pedestrian walkways, bridges, railways, boat launches and airport runways. The City of Prince George maintains 803 km of road within municipal boundaries to ensure that vehicles, cyclists and pedestrians can move safely throughout our community. Transportation infrastructure in Prince George is already experiencing the impacts of a changing climate such as the increased severity of freeze-thaw cycles resulting in additional maintenance requirements. Transportation infrastructure is also impacted as a result of other focus areas such as flooding, stormwater and emergency response. As climate continues to change it is anticipated that City and regional road networks and operational practices will be impacted; therefore, it is necessary to enhance the resilience of these systems.

Goal 1: Improve resiliency of transportation infrastructure to a changing climate

Action 1.1: Evaluate opportunities to improve road design and maintenance procedures to accommodate increased impact of freeze-thaw conditions.

Potential Supporting Actions:

- Partner with post-secondary institutions and other road authorities, where possible, to conduct research on new road materials (e.g. permeable pavement) in winter climates and evaluate effectiveness regarding freeze-thaw events.
- Implement recommendations identified in Salt Management Plan.
- Create a working group dedicated to evaluating strategies for road design and maintenance through a lens of climate change adaptation.
- Evaluate correlations between past climate data and operation and maintenance budgets and implement information with climate projections for budget planning.
- Conduct vulnerability assessments of the roads network using a tool such as PIEVC (Engineers Canada) to identify infrastructure that will be impacted by climate change and prepare plan for making improvements.

Action 1.2: Improve winter travel conditions and maintain road safety for all road users.

Potential Supporting Actions:

- Identify and evaluate specific operational procedures; where possible budget and implement specific maintenance actions (during rain on snow or freeze-thaw events) to reduce the risk of pedestrians falling (e.g. sidewalk sanding).
- Fine-tune snow and ice control operational procedures (based on road class - Arterial, Collector, Local) to align with projected weather patterns (e.g. freeze-thaw events) and communicate this information to the public.
- Encourage organizations to implement telecommuting and carpooling policies to reduce vehicle traffic in poor conditions.
- Consider incorporating climate change projections into public education materials regarding driving safety.
- Continue to communicate snow and ice clearing status and warn of freeze-thaw events during winter operations.

Action 1.3: Explore how transportation networks (e.g. roads, transit, and airport) can be enhanced to better facilitate emergency response and business continuity in severe weather events.

Potential Supporting Actions:

- Investigate goods distribution patterns both into and out of city and consider alternative routes/sources/relationships to ensure secure and consistent sourcing in an emergency.

Action 1.4: Provide reliable transportation alternatives to diversify mobility options and increase redundancy.

Potential Supporting Actions:

- Increase kilometers of reliable cycling lanes throughout the City.
- Conduct a pilot project on protected bike lines to assess increase in cycling.
- Prioritize transit routes for removing climate hazards.
- Continue communication to public of emergency evacuation protocol and procedures (e.g., evacuation route signage).

Supporting Details for Transportation Infrastructure Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • More extreme rainfall events causing transportation disruptions. • Warmer, wetter winters increasing sidewalk and road maintenance. • Warmer winters changing freeze/thaw cycles causing strain on City infrastructure. • Warmer winter temperatures causing mobility issues or incidents due to ice. • Warmer, wetter winters causing road bans in the forestry sector. • Fewer days below -10°C increasing road salt use, damaging infrastructure and affecting water quality.
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • Budgets for road rehabilitation have been increased significantly since 2014. • The City partnered with the University of Waterloo to investigate if increased icy road conditions due to more freeze-thaw events were causing more vehicle accidents and review the correlation under current snow control budgets and project climate change impacts on future snow control budgets. • An assessment was performed in 2012 to assess how changes in precipitation and freeze-thaw cycles may impact infrastructure and operational practices. • The City updated its Salt Management Plan in 2019. • The City’s Snow and Ice Control Policy was developed in September 2019. • In collaboration with BC Transit, the City of Prince George initiated a Transit Future Action Plan. • River Road, which is in the flood plain, was permanently raised following the 2007-2008 ice jam to help contain flood waters and provide vehicular access to inundated properties during flood events.
<p>Municipal Role</p>	<ul style="list-style-type: none"> • Ensure municipal service levels are not impacted by a changing climate. • Maintain road and sidewalks to ensure public safety for all road and sidewalk users.

	<ul style="list-style-type: none"> • Design and build public roads, sidewalks, bike lanes and public spaces to be resilient in a changing climate. • Regulate road use through speed limits and parking restrictions. • Influence land use and urban design policies and guidelines to maximize life cycle of existing transportation infrastructure.
Possible Partnerships	<ul style="list-style-type: none"> • Ministry of Transportation and Infrastructure • Emergency Management BC • BC Transit • Insurance Corporation of British Columbia • PG Airport Authority • Lheidli T'enneh First Nation • University of Northern British Columbia • College of New Caledonia • Other Local Governments/Road Authorities • Private Parking Lot Owners and Maintenance Companies • Private Forestry, Petroleum and Mining Industries
Possible Financing Options	<ul style="list-style-type: none"> • Federal Gas Tax Fund • Investing in Canada Infrastructure Program • Green Infrastructure – CleanBC Communities Fund
Possible Co-benefits	<ul style="list-style-type: none"> • Maximizing life cycle of existing transportation infrastructure prevents future emissions associated with building new roads. • Encouraging diverse modes of transportation, such as walking and cycling, which contributes to reducing community greenhouse gas emissions.

Focus Area: Buildings and Infrastructure

Description:

The majority of Prince George's infrastructure and housing stock is from the 1970's meaning that most of the local infrastructure was built to a different standard than would be expected today. In addition, the wear and tear of the past 50 years or more have added additional stressors to buildings and infrastructure including a changing climate. Building and infrastructure design has transitioned to improve energy efficiency with the BC Energy Step Code being implemented into the BC Building Code in 2023; however, standards for building resiliency have been slower to take hold. As our climate changes our buildings and infrastructure will need to be able to withstand stronger wind events, increased freeze-thaw cycles and rain on snow events, changes to water tables, and indoor air quality issues such as wildfire smoke and mold. Infrastructure Canada is currently working on the *Climate-Resilient Buildings and Core Public Infrastructure Initiative*, which will "integrate climate resiliency into building and infrastructure design, guides and codes [xx]." In addition, as our climate continues to change so will the demand on infrastructure and energy resources.

The City has taken leadership on reducing corporate energy use by building the new RCMP building to LEED standards in 2013 and implementing the Downtown Renewable Energy System in the downtown, which provides heat and hot water to 11 buildings.

Goal #2: Improve resiliency of buildings to a changing climate.

Action 2.1: Reduce impacts of extreme weather on City-owned or leased buildings.

Action 2.2: Raise awareness of risks of changing climate to residential and commercial buildings.

Potential Supporting Actions:

- Explore opportunities to increase resiliency of City-owned or leased buildings through design.
- Identify vulnerabilities of City-owned or leased buildings to extreme weather.
- Include future climate projections and energy efficiency in assessments of City-owned or leased building conditions.
- Perform a Climate Lens Assessment on new capital projects such as new City-owned buildings and infrastructure.

Goal #3: Improve resilience of energy infrastructure to increasing energy demand and extreme weather events.

Action 3.1: Improve understanding of energy sector and related inter-dependencies across the community.

Potential Supporting Actions:

- Work with utilities to understand the risk of outages and “down-time” due to extreme weather.
- Identify interdependencies between electricity outages and other utilities (natural gas, telecoms, water).
- Encourage homeowners and local businesses to proactively improve building resiliency to extreme weather.

Action 3.2: Promote City’s Downtown Renewable Energy System as a locally generated, resilient energy source.

Potential Supporting Actions:

- Facilitate additional connections to downtown renewable energy system.
- Develop promotional materials to raise awareness of benefits of Downtown Renewable Energy System.

Supporting Details for Buildings and Infrastructure Focus Area

Associated Climate Change impacts	<ul style="list-style-type: none">• Warmer winters and changing freeze/thaw cycles causing strain on infrastructure.• Higher summer temperatures increasing demand on infrastructure and energy resources.• Increased extreme wind events increasing tree fall, affecting water retention and slope stability.
What has been completed so far?	<ul style="list-style-type: none">• The City of Prince George routinely improves energy efficiency in City-owned facilities to reduce energy loading.• Improvements to building materials/HVAC systems/building envelopes?• Asset Management Strategy• RCMP Building built to LEED standards.

	<ul style="list-style-type: none"> • Connections to Downtown Renewable Energy System. • Road Rehab CeP programs.
Municipal Role	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Ensure City of Prince George-owned buildings and infrastructure can withstand a changing climate. • Continue to reduce energy usage in City buildings to offset energy demand. • Encourage connections to the City's Downtown Renewable Energy System.
Possible Partnerships	<ul style="list-style-type: none"> • University of Northern British Columbia • Canadian Home Builders Association • Northern Regional Construction Association • BC Housing • BC Hydro • Fortis BC
Possible Financing Options	<ul style="list-style-type: none"> • Investing in Canada Infrastructure Program • FCM Green Municipal Fund • Infrastructure Planning Grant Program [xx] • Disaster Mitigation and Adaptation Fund • Real Estate Foundation of BC • Clean Water and Wastewater Fund
Possible Co-benefits	<ul style="list-style-type: none"> • Decreased energy use and reduction in GHG emissions.





OBJECTIVE 2 | Protect Public Health and Improve Social and Economic Resiliency

Focus Area: Emergency Response

Description

Climate change is expected to increase the magnitude and frequency of extreme weather events in Prince George, such as forest fires, ice jams, freshet flooding, rain on snow events, heavy rain, snow and ice storms and high winds. Over the past decade Prince George has experienced nearby wildfire events and flooding events that have triggered the need for Emergency Reception Centres to accommodate those who were impacted. The City of Prince George's Emergency Plan outlines the actions that will be taken during a local emergency or disaster and coordinates evacuation routes throughout the City. Bylaw No. 7920 allows the City to develop and implement emergency response plans such as providing emergency service centres and implementing necessary emergency action.

Goal #4: Mitigate strain of a changing climate on emergency response procedures.

Action 4.1: Raise Awareness of the City of Prince George's Emergency Plan.

Potential Supporting Actions:

- Ongoing communication to the public of evacuation protocol and procedures (e.g. Evacuation route signage) and locations of community evacuation centres.
- Expand internal and external communication channels.
- Continue training City staff on emergency preparedness procedures.
- Provide opportunities for education & empowerment with school children on what they can do to prepare for an emergency and what they can do in an emergency to be safe.

Action 4.2: Raise awareness about ongoing risks that community-scale emergencies, such as wildfire, present to the community.

Potential Supporting Actions:

- Encourage forums for intergenerational connection (e.g. seniors to youth, nursing homes and schools) on emergency management.
- Support communication of population health impacts associated with fire season.
- Encourage extreme weather event block watch/community emergency champion program at neighbourhood level for proactive/planning/info sharing and evacuation support to build resilient neighbourhoods.
- Work with private property owners to educate and build awareness of climate change to personal property (e.g. FireSmart, flood protection, windstorm risks).

Action 4.3: Undertake detailed research to help inform emergency response plans and activities.

Potential Supporting Actions:

- Plan for emergency evacuees integrated into current large centre health care plan.
- Assess risk of natural hazards to health infrastructure throughout the community.

Action 4.4: Increase the community's uptake of household emergency kits.

Potential Supporting Actions:

- Encourage local residents to build their own household emergency kits.
- Partner with local businesses, community service providers, and other organizations to sell emergency preparedness kits at community-wide events, festivals and at high-traffic community hubs such as churches, businesses, etc.
- Educate on what an emergency kit is, what is included in a kit, when to replenish, and why it is important to have one.
- Social media campaign - when you change the battery in your smoke alarm, check your emergency kit.

Supporting Details for Emergency and Response Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • More extreme wildfires increasing demand on emergency management and health services. • Warmer winters and hotter summers increasing climate refugees or homeless populations coming to Prince George. • Hotter, drier summers increasing interface wildfires, causing mass evacuation or permanent migration. • More extreme rainfall events causing transportation disruptions (e.g. highway/bridge washouts). • More extreme rainfall events causing overland flooding from river level rise, creating property loss/damage. • Warmer winter temperatures causing mobility issues or accidents due to ice.
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • The City hosted a series of training exercises in May 2019 to train staff, external agencies and emergency personal to refine the City Evacuation Plan. • Evacuation Plan contains information on Community Evacuation Centre locations, which are based on areas in the garbage collection map. • A new Emergency Plan and Emergency Programs Division was introduced in 2019 which includes a dedicated Emergency Programs Manager and Coordinator. • Emergency Support Services (ESS) and Emergency Operations Centre (EOC) training for City staff provided annually since 2017 to enhance staff capacity. • City of Prince George staff and resident volunteers trained in hosting large-scale evacuation centres following 2017 and 2018 wildfire seasons.
<p>Municipal Role</p>	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Ensure the City of Prince George is prepared and able to recover from an emergency or disaster. • Support public safety and emergency response through operation of Emergency Services including the Fire Department, RCMP and Public Works Department. • Communicate the City’s Emergency Plan and evacuation routes
<p>Possible Partnerships</p>	<ul style="list-style-type: none"> • Regional District of Fraser-Fort George • Lheidli T’enneh First Nation

	<ul style="list-style-type: none"> • Northern Health • First Nations Health Authority • BC Centre for Disease Control • School District 57 • Ministry of Transportation and Infrastructure • Emergency Management BC • Local Media Outlets
Possible Financing Options	<ul style="list-style-type: none"> • UBCM Community Preparedness Fund • Disaster Mitigation and Adaptation Fund

Focus Area: Health and Well-Being

Description

The diverse and far reaching impacts of climate change on health have become more understood over the past decade with impacts predominantly affecting vulnerable populations such as the elderly, children, the socially and economically disadvantaged and those with pre-existing health conditions.

Our region may expect more days above 30°C and poor air quality events (associated with impacts such as wildfire smoke), which can lead to heat exhaustion, cardio and respiratory ailments, and mental health concerns. In addition, extreme weather events such as flooding and wildfires, and associated evacuations and potential property loss can lead to mental distress and anxiety. Rapid changes in temperature and more weather extremes can result in increases in injuries (e.g. Traffic related or slips and falls). Warmer annual temperatures and increased precipitation events can also lead to new vector-borne illnesses such as Lyme disease and West Nile Virus and increase the likelihood of spread for existing illnesses.

In addition to these more direct impact to health, climate change can also impact many important socio-economic determinants of health (such as food security, income, housing, social connections, etc.) that are instrumental at determining health outcomes.

Although the City of Prince George does not have jurisdiction over health services, the City can collaborate with community partners to share information on climate change related health impacts and provide facilities and/or services for residents that would help to mitigate these impacts.

Health and well-being also include building community-based resilience by reducing social isolation and supporting local food production. Climate projections demonstrate an increase in growing degree-days per year that will allow crops that were not previously able to grow here viable, such as corn and cereals. Supporting local food production is an important adaptation strategy but also assists in decreasing carbon emissions associated with transporting foods to our region.

Goal #5: Assist vulnerable populations to avoid or reduce health-related risks of extreme weather and temperatures.

Action 5.1: Consider expanding outreach programs pertaining to extreme weather and climate change that provide benefits for all residents and ensure that marginalized populations needs are met.

Potential Supporting Actions:

- Support a workshop that would bring together the City and health and social agencies to identify existing resources and establish a protocol for ensuring outreach workers connect with their vulnerable clients during these events. From the workshop the following may be reviewed:
 - ◇ Explore opportunities to provide extreme weather centres to protect those impacted by extreme weather events.
 - ◇ Determine whether outreach programs can be provided during extreme weather events that ensure marginalized populations are safe and needs are met.
 - ◇ Work with BC Housing to establish an Extreme Weather Response Fund for summer months that can be accessed by shelters/municipalities to provide cooling stations/resources for vulnerable populations.
 - ◇ Consider how SD57 might be engaged to utilize school sites identified on the City's evacuation plan as cooling sites/resource centres for the vulnerable during extreme weather events.
 - ◇ Explore the potential to provide portable water fountains in areas where there is a high degree of vulnerability.
 - ◇ Consider programs to support individuals suffering from climate-related mental health concerns.
- Educate elderly/disabled people about how to avoid slips and falls (e.g., wear cleats, more visually aware) through seniors' groups & other community organizations.

Action 5.2: Improve policies to protect outdoor workers from extreme weather events and poor air quality.**Potential Supporting Actions:**

- Communicate climate-related health impacts to outdoor workers such as increased freeze-thaw events, extreme heat and wildfire smoke.
- Implement best practices to keep outside workers safe during extreme weather and air quality events.
- Set thresholds for reducing or altering work during extreme weather and air quality events.

Action 5.3: Support and promote installation of and upgrades to air filtration systems.**Potential Supporting Actions:**

- Implement improved air filtration systems in City-owned or leased buildings.
- Explore the feasibility of using City-owned buildings with air filtration systems as refuges (clean air shelters) from poor air quality events.
- Continue enforcement of the City of Prince George Clean Air By-law (e.g. attending open burning complaints).
- Support education and information sharing initiatives about air filtration systems so residents can shelter in place.
- Provide messaging through City Communication channels to provide information on indoor recreation opportunities during extreme weather and air quality events.

Action 5.4: Monitor and plan for the potential introduction of additional health concerns to the community.**Potential Supporting Actions:**

- Support the communication of vector-borne disease (e.g. ticks, blue-green algae) and heat protection measures during summer, Heat Alerts and days with High UV Index.

Goal #6: Mitigate the impacts of warmer temperatures and extreme heat into the long-term.

Action 6.1: Identify and support initiatives that address the impacts of extreme heat and warmer weather.

Potential Supporting Actions:

- Collaborate with educational institutions to quantify the extent to which urban heat island may affect Prince George into the future.
- Update *Subdivision and Development Servicing Bylaw* and other bylaws to require shade trees in new development, and in City streets, parks and buildings to reduce cooling loads on buildings.
- Educate residents and development community of benefits of shade trees for regulating building temperatures and reducing urban heat island.

Action 6.2: Consider impacts of climate change on recreational opportunities.

Potential Supporting Actions:

- Encourage Tourism Prince George and other recreational organizations to carry out assessment of how outdoor recreational activities will be impacted by climate change.
- Engage with Engage Sport North, the YMCA and other non-profit organizations to determine what is needed to increase delivery and promotion of indoor public programming during extreme weather and air quality events.
- Assess the capacity of City Civic Facilities to offer indoor use during extreme weather and air quality events – such as walking/jogging inside the CN Centre or Rolling Mix Arena.
- Consider adapting pool maintenance schedules to shoulder seasons to provide additional indoor recreational activities.
- Consider offering free public transit during extreme weather and air quality events so residents can travel to indoor recreation opportunities and/or extreme weather centres.
- Identify and support alternatives for winter sporting events that may be impacted by extreme weather and changing winter conditions.

Goal #7: Build a sense of community and reduce social isolation.

Action 7.1: Encourage the development of inclusive, resilient neighbourhoods that build a sense of community and reduce social establishment.

Potential Supporting Actions:

- Establish a help-your-neighbour program to implement during extreme weather events.
- Continue to promote community parks, events, programs and services that bring residents together.
- Encourage existing community associations to expand neighbourhood-level programs to reduce social isolation.
- Support the development of compact communities through multi-use and multi-family developments.
- Provide educational opportunities on climate resiliency at the neighbourhood scale.

Goal #8: Support local food production.

Action 8.1: Support residential food production opportunities to encourage local food self-reliance.

Potential Supporting Actions:

- Establish priority areas for community garden spaces and associated activities and prepare standard maintenance agreements
- Promote and continue supporting garden workshops and educational resources offered through REAPS, including composting and water-wise workshops.
- Consider creating an indoor community garden space to support local food production year-round.
- Expand edible landscaping opportunities in City garden design and communicate to the community.

Action 8.2: Support local farmers in developing and implementing sustainable and resilient management practices.

Potential Supporting Actions:

- Facilitate collaboration among local agricultural community, community groups, City and academic institutions to share resources and best practices for adaptation in agriculture
- Support networking amongst producers to share resources, tools, and knowledge about efficient and resilient agricultural practices
- Designate a City representative to collaborate with local working groups, such as the Local Food PG Society, to understand needs from agricultural community.
- Continue to preserve ALR land.
- Collaborate with educational institutions to undertake a study to consider the potential for increased agricultural capacity in the future.

Supporting Details for Health and Well-being Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none">• Warmer winter temperatures impacting winter sports and tourism.• Warmer winter temperatures causing mobility issues or accidents due to ice.• Higher summer temperatures increasing heat island effect.• Warmer winters and hotter summers increasing climate refugees or homeless populations coming to Prince George.• Hotter summer temperatures increasing UV exposure and heat stress.• Hotter and drier summers increase PM_{2.5}, ground-level ozone, allergens, and smoke, leading to poor air quality and negative health impacts.• Increase in extreme heat events affecting health of vulnerable populations (e.g. Homeless, elderly).• Hotter, drier summers limiting outdoor recreational activities (e.g. Campfires, camping, ATVing).• More extreme wildfires causing loss of holidays and summer vacation.• Increase in extreme events impacting safety and productivity of outdoor workers.• Increase in extreme weather events increasing pressure and demand on social services.• Increase in extreme weather events affecting mental health.• More extreme weather affecting food systems.• Rising annual temperatures increasing length of growing season.
---	--

<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • The BC Climate Action Initiative created Regional Adaptation Strategies for the Agricultural Sector of Fraser-Fort George in 2019, which involved collaboration with the Regional District of Fraser-Fort George. • Health agencies were engaged as a part of the Climate Change Adaptation Plan stakeholder engagement process. • The City of Prince George provides space for the Prince George Farmers Market and the City’s Official Community Plan provides strong support for the connection of local food production and healthy communities. • The City provides services, offers programs and has civic infrastructure and facilities that support social and physical activities in Prince George • The City attended a Practical Wildfire Smoke Preparedness Workshop that was hosted by the BC Centre for Disease Control in Prince George in May 2019
<p>Municipal Role</p>	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Support social resilience through health and well-being initiatives. • Work with health agencies to support incorporating climate change related health impacts into service delivery.
<p>Possible Partnerships</p>	<ul style="list-style-type: none"> • Northern Health • First Nations Health Authority • Carrier Sekani Family Services • BC Centre for Disease Control • Regional District of Fraser-Fort George • WorkSafe BC • BC Housing • Community Partners Addressing Homelessness • School District 57 • University of Northern British Columbia • Prince George Council of Seniors • Canadian Mental Health • Ministry of Agriculture • Ministry of Forests, Lands, Natural Resource Operations and Rural Development • BC Agriculture and Food Climate Action Initiative
<p>Possible Financing Options</p>	<ul style="list-style-type: none"> • UBCM Community Preparedness Fund • Disaster Mitigation and Adaptation Fund • Northern Health Imagine Grant program • Federal HealthADAPT and First Nation Adapt Program

Focus Area: Economic Resilience

Description

Prince George’s economy is reliant on the natural resources that surrounds it, making it susceptible to the impacts of climate change. Warmer and wetter winters and hotter and drier summers are already affecting the forestry industry, which will continue to be vulnerable to a changing climate. Warmer winters and longer wildfire seasons will also be challenging for the tourism sector that works to attract tourists to the local ski

hills in the winter months and beautiful natural landscapes for hiking and hunting in the summer months. However, climate change may also benefit the economy if the community is prepared to pursue those opportunities. Impacts of climate change in other regions may also entice businesses to relocate to Prince George, such as data storage facilities. Further research will be particularly necessary to ensure the local economy is resilient to a changing climate.

Goal #9: Encourage local industry and commercial business to identify and plan for climate-related risks and opportunities that may affect their business activity.

Action 9.1: Encourage business community to develop their own climate action plans.

Potential Supporting Actions:

- Engage with additional business community stakeholders to better understand how they may be affected by a changing climate.
- Continue legacy of Clean Tech Project.
- Collaborate with educational institutions to undertake study on business development and profitability of making environmental adaptations by increasing their profits.
- Submit a Call to Action to the business community to identify business risks and new opportunities.
 - ◊ Consider hosting meeting of top employers to share information on economic benefits of adapting to a changing climate.
- Host workshops and roundtables to communicate regulatory changes when appropriate, such as emissions reductions standards and sharing knowledge on benefits of increasing energy efficiency.
- Work with construction businesses that are implementing Energy Step Code to assist in promoting the benefits of their builds’ energy efficiency.
- Consider sponsoring an Environmental Award through the Chamber of Commerce for businesses that are successful in reducing energy usage.

Action 9.2: Understand the social and economic impacts of climate change on the economic sector.

Potential Supporting Actions:

- Advocate for collaborations between UNBC, CNC, the Commercial and Industrial Sectors and higher levels of government to perform a social and economic vulnerability assessment of impacts of a changing climate on the economic sector.

Action 9.3: Identify and pursue economic opportunities that may benefit from a changing climate.

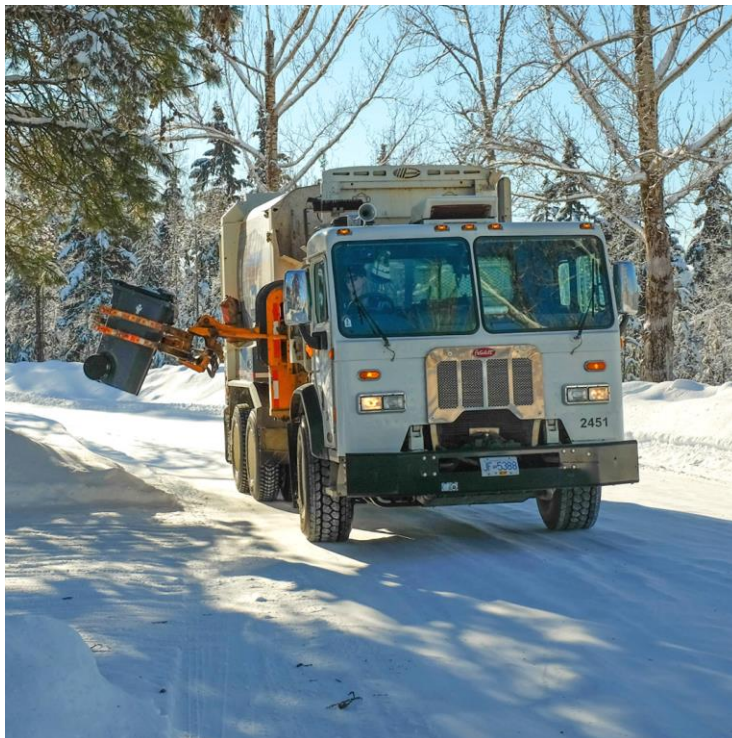
Potential Supporting Actions:

- Collaborate with educational institutions to undertake economic assessment and feasibility study to identify new industries that may benefit from climate change in Prince George.

Supporting Details for Economic Resilience Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • Warmer, wetter winters causing road bans in the forestry sector. • Warmer winters and drier summers impacting forestry industry (e.g. Shortening the logging season, no equipment use with fire bans). • Increase in extreme weather events affecting business continuity. • More frequent and intense drought in summer months affecting industry due to low river levels. • Warmer winter temperatures and rising annual temperatures reducing die-off of pests (e.g. Beetle infestation). • Increase in extreme heat events impacting safety and productivity of outdoor workers.
---	---

<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • The City led a Clean Technology project from 2017-202 which supported local businesses to develop and export technologies that increase efficiencies and minimize environmental impacts; of which most here utilized by natural resource related industries.
<p>Municipal Role</p>	<ul style="list-style-type: none"> • Facilitate the attraction and retention of businesses and residents that support Prince George's growth
<p>Possible Partnerships</p>	<ul style="list-style-type: none"> • Regional District of Fraser-Fort George • Chamber of Commerce • Downtown Business Improvement Association • Downtown Prince George • Forestry Sector • Tourism Sector • Business Community • Prince George Farmers Market • REAPS • University of Northern British Columbia • College of New Caledonia
<p>Possible Financing Options</p>	<ul style="list-style-type: none"> • Ministry of Jobs, Trade and Technology funding programs. • Ministry of Agriculture funding programs. • Western Economic Diversification • Northern Development Initiative Trust





OBJECTIVE 3 | Enhance resilience of ecosystems and protect natural areas

Focus Area: Slope Stability

Description:

The City of Prince George lies within a river valley and surrounded by undulating hills, with an elevation varying from 568 m to 860 m across the boundaries of the municipality. The Official Community Plan designates slopes over 20% grade to be significant and aims to protect steep slopes by restricting development in these areas.

Goal #10: Reduce the risk of slope failure and other erosion hazards.

Action 10.1: Assess slope stability and erosion hazards and implement slope stabilization practices as required.

Potential Supporting Actions:

- Undertake further study to determine the local impacts of climate change on slopes.
- Review significant slope inventory and develop slope stability and erosion control strategy or Master Plan (Hillside Development Guideline) and consider expanding OCP Schedule B-3 with updated climate projections.
- Explore opportunities and possibly develop a pilot project to retain moisture and provide nutrients (e.g. biosolids) to enhance vegetation growth on steep slopes.
- Develop and implement Erosion & Sediment Control Bylaw or permitting process for private development.
- Using the 2013 Geological Hazard Overview of the Cranbrook Hill Escarpment Area as a baseline, assess the slope to determine potential risk from increased rainfall events.
- Communicate presence of significant slope area to developers and general public and ensure there is an understanding of the benefits of vegetation on these slopes.
- Develop an informational pamphlet for residents to follow to reduce the risk of slope failure on their and adjacent properties.

Supporting Details for Slope Stability Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • Increased extreme wind events increasing tree fall, affecting water retention and slope stability and causing damage to infrastructure. • Increase in heavy rainfall events causing riverbank erosion and loss of riparian habitat.
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • Schedule B-3 of the Official Community Plan designates areas over 20% grade to be Significant Slopes and specifies that development should be located at a safe distance from these areas to avoid erosion and landslide hazards. Several development activities are restricted in proximity to significant slope areas such as excavation, irrigation, and tree clearing. • Tree Protection Bylaw No. 6343 which prevents the removal of trees in areas zoned as AG (and includes slopes over 20%) was created in 1995 and updated in 2012.

	<ul style="list-style-type: none"> • Slope stability was identified as a priority local climate impact in the 2009 Climate Adaptation Strategy. • During pine beetle removal operations in 2007, infected trees were not cut down in significant slope areas. • Slope stabilization works occurred at Fraser River Benchlands in 2016 and Airport Hill in 2018. • Geological Hazard Overview performed in 2013 of the Cranbrook Hill Escarpment Area.
Municipal Role	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Ensure development activities do not impact slope stability. • Protect civic infrastructure from slope stability concerns
Possible Partnerships	<ul style="list-style-type: none"> • University of Northern British Columbia • Ministry of Transportation and Infrastructure • Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Possible Financing Options	<ul style="list-style-type: none"> • Infrastructure Planning Grants • FCM Green Municipal Fund • Disaster Mitigation and Adaptation Fund
Possible Co-benefits	<ul style="list-style-type: none"> • Identification of hazards to provide direction for future development in areas close to (above or below) significant slope areas. • Improved drainage management prevents impacts to property. • Decreases operational time for fallen and hazard trees by Parks staff.

Focus Area: Stormwater

Description:

The City's stormwater system collects runoff from rainstorms, snow melt and residential and commercial water usage through a network of pipes, culverts and ditches and eventually discharges into a natural watercourse. The storm system is made up of over 800 culverts, 5528 catchbasins, 4046 manholes, 412 km of below ground piping, 1087 km of ditches and 24 detention/retention ponds. This system is essential and protects the Prince George community from flooding and erosion, however under increased flows the system can't always keep up to the demand. Precipitation is expected to increase for the region as the climate changes resulting in more intense storm events. In addition, in the winter months it is projected that rain on snow events will become more common contributing to localized flooding due to frozen or blocked catchbasins. Impervious surfaces such as undeveloped areas and wetlands are essential for flood mitigation and groundwater recharge and slowing down stormwater runoff, plus they assist with water purification. In addition, the stormwater system is aging which has resulted in sink holes from deteriorated metal storm piping and corroding culverts. Investment in these systems is pertinent for ensuring that our community is resilient to a changing climate.

Goal #11: Enhance stormwater management to prevent overland flooding and contamination in the context of changing climate conditions.

Action 11.1: Improve understanding of overland flooding risks through communication and data collection.

Potential Supporting Actions:

- Expand programming and outreach to keep storm drains clear year-round.
- Identify locations to install rainfall gauges and collect and process data to inform stormwater management and to better understand inflow and infiltration.
- Consider expanding floodplain/risk mapping development permit areas to include creeks.
- Develop education programming around low- or no- cost options for adapting homes and other buildings to flooding, such as a downspout disconnection campaign.
- Consider implementing a neighbourhood “Adopt a Catchbasin” program and encourage residents to clear catchbasins of debris to mitigate blockages.

Action 11.2: Improve the resilience of stormwater infrastructure to accommodate increased precipitation and extreme weather events.

Potential Supporting Actions:

- Incorporate climate change projections into the City’s Integrated Stormwater Master Plan (ISMP).
- Implement recommendations identified in Integrated Stormwater Master Plan.
- Review City Storm Sewer Bylaw and develop funding mechanism for stormwater upgrades.
- Consider updates to stormwater design standards, such as larger, more efficient inlets to catchbasins to accommodate increased flows and stormwater detention ponds.
- Encourage maximum onsite retention by identifying locations that would benefit from stormwater detention ponds, recharge chambers and perforated pipes including new and existing developments.

Action 11.3: Seal sanitary manholes to prevent infiltration of rainwater and surface water.

Potential Supporting Actions:

- Prioritize manholes along Bittner Creek sanitary line and in the Western Acres Subdivision.
- Identify storm and sanitary cross-connections in residential and commercial properties.
- Encourage deactivation of private onsite septic systems and connection to City sanitary services.

Action 11.4: Promote and expand the use of green infrastructure and nature-based solutions for stormwater management.

Potential Supporting Actions:

- Create a rain garden pilot project and demonstration garden and evaluate effectiveness and complement with public education signage.
- Review and understand best management practices from other communities with similar climate to Prince George as to when to use natural assets for stormwater treatment versus engineered assets.
- Perform a pilot investigation into the effectiveness of bio-swales for a cold climate in areas of the City where the soils are fine-grained.
- Investigate green infrastructure alternatives (e.g. permeable pavement, bioswales, rain gardens, daylighting) to determine applicability for local stormwater management.
- Facilitate local workshops on the benefits of natural assets.
- Communicate benefits of City storm and sanitary sewer services

Supporting Details for Stormwater Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • More extreme rainfall events causing overland flooding and damage to aging/inadequate infrastructure. • More extreme rainfall events causing flooding from pooling in low lying areas or rainfall exceeding the capacity of the drainage system. • More extreme rainfall events causing transportation disruptions. • More extreme rainfall events causing inflow and infiltration of rainwater into sanitary sewer systems. • Increase in heavy rainfall events causing overland flooding and sinkholes. • Hotter, drier summers decreasing moisture content in soil and ability to absorb stormwater
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • Watershed Drainage Plans have been developed for nearly all the drainages within the City of Prince George to optimize stormwater management which include climate change projections. • A Stormwater Master Plan will be completed in 2021 which will include climate change projections and a Natural Assets Strategy. • The McMillan Creek Monitoring Study monitors water quality in the City's largest urban stream in collaboration with the MFLNRORD. • The Official Community Plan encourages Integrated Stormwater Management which focuses on the relationships between the natural and built environments. • Rainfall gauges have been installed at water pump stations. • Additional weather data is collected through weather stations installed at Tyner Boulevard and Vellencher Road. • The Utilities Division performs routine inspections of stormwater infrastructure through Cityworks.
<p>Municipal Role</p>	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Operate and maintain stormwater system by ensuring system can accommodate flows and prevent overland flooding. • Ensure storm water quality leaving the City's storm water system meets Provincial water quality guidelines.
<p>Possible Partnerships</p>	<ul style="list-style-type: none"> • Ministry of Forests, Lands, Natural Resource Operations and Rural Development • University of Northern British Columbia • Regional District of Fraser-Fort George • Northern Health • Recycling and Environmental Action Planning Society • Development and Business Community.
<p>Possible Financing Options</p>	<ul style="list-style-type: none"> • Infrastructure Planning Grants • FCM Green Municipal Fund • Disaster Mitigation and Adaptation Fund • Municipal Natural Assets Initiative • National Disaster Mitigation Program

Possible Co-benefits

- Green infrastructure stormwater projects improve stormwater quality, retention, and biodiversity, are less carbon intensive than engineered stormwater projects, and may provide recreational opportunities.

Focus Area: River Flooding

Description:

The City of Prince George lies at the confluence of the Fraser and Nechako River Systems, two of BC's largest watersheds, with the downtown core existing in the 200-year floodplain. Prince George has experienced extensive flooding events over the past several decades, with flooding on the Fraser aligning with Spring freshet and winter ice jam flooding occurring on the Nechako. Between 2007 and 2008 Prince George experienced flood conditions three times, including a highly publicized ice jam event that required the emergency construction of temporary dikes.

The impacts of climate change on river flooding is not well understood in Prince George, making flooding projections difficult. Despite this, the hydrologic cycles within the watersheds of the Nechako and Fraser River watersheds are expected to be influenced by climate change. For instance, much of the forests within the Fraser River and Nechako watersheds are at a moderate to high risk to wildfires and post fire changes to the hydrologic cycle and associated flooding has been well documented in other areas [xxi]. The impacts of the mountain pine beetle epidemic on surrounding forested areas are also anticipated to have an influence on hydrographic flows and was exacerbated by climate change.

Thirty percent of the Nechako River is regulated by Rio Tinto operations and the impacts of changing precipitation cycles may influence frequency of releases; however, this information is largely unknown at this time. It is anticipated that climate change will result in increased spring flows; however the 2009 Climate Change Adaptation Strategy recommends that "more hydrographic analysis and modeling are required to more accurately assess the impacts of climate change" on flooding in our region [xxii].

Goal #12: Continue to enhance river flood resilience in the context of changing climate conditions.

Action 12.1: Reduce climate-related river flooding impacts to residents residing in at-risk areas.

Potential Supporting Actions:

- Work with existing at-risk developed areas to reduce future flood risks.
- Evaluate and consider opportunities to move existing at-risk properties.
- Educate affected homeowners on how to protect their home before, during, and after flooding events.
- Share information about Prince George's floodplain through communication channels, and potentially focus on Floods as a topic for Emergency Preparedness Week.
- Share PreparedBC's *Flood Information for Homeowners and Home Buyers* that have homes within identified floodplain areas, or those looking to develop or purchase a home in this area.

Action 12.2: Create an inter-jurisdictional working group to evaluate local river flooding risks.

Potential Supporting Actions:

- Future actions for the working group could include:
 - ◇ Review ice-related flooding data.

- ◇ Evaluate current diking and dam systems based on climate change projections and flooding models.
- ◇ Obtain updated hydrological projections for the Fraser and Nechako Rivers under climate scenarios.

Supporting Details for River Flooding Focus Area

Associated Climate Change impacts	<ul style="list-style-type: none"> • More extreme rainfall events affecting infrastructure management decisions (e.g. Rio Tinto dam). • More extreme rainfall events causing overland flooding from river level rise, creating property loss/damage. • Increase in heavy rainfall events causing loss of recreational trails along river. • Rising annual temperature accelerating glacier melt. • Increase in heavy rainfall events causing riverine flooding and increased sediment deposit in streams and creeks. • Impacts to snowpack melt and spring freshet.
What has been completed so far?	<ul style="list-style-type: none"> • The City retained consultants to investigate long term solutions for flood protection and prepare a <i>Flood Risk Evaluation and Flood Control Solutions Plan</i>. The reports identified areas of risk along the Fraser and Nechako Rivers and provided recommendations for these areas. • The City of Prince George Flood Plain Bylaw was adopted in 2007 to regulate development in flood prone areas. This bylaw was updated with new flood plain maps in 2010 and the freeboard allowance was increased to 1.0m. • The City has purchased several pieces of land in flood prone areas from private landowners and rezoned the land to parkland to mitigate flooding hazards. • River Road, which is in the flood plain, was permanently raised following the 2007-2008 ice jam to help contain flood waters and provide vehicular access to inundated properties during flood events. • Several policies throughout the City's OCP address flooding hazards. <ul style="list-style-type: none"> ○ Schedule D-4 of the City's Official Community Plan (OCP) identifies Flood Hazard Development Permit Areas. • The <i>Emergency Response Bylaw</i> provides for the "establishment, administration and operation of an Emergency Response and Recovery Plan" in the event of a major flooding event. • City staff have been involved in the Rio Tinto Water Engagement Initiative relating to flow regimes and releases and how Prince George may be impacted.
Municipal Role	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Communicate flooding hazards to the general public. • Restrict development in flood-prone areas. Continue to implement flood mitigation projects
Possible Partnerships	<ul style="list-style-type: none"> • Ministry of Forests, Lands, Natural Resource Operations and Rural Development • Emergency Management BC

	<ul style="list-style-type: none"> • Northern Health • University of British Columbia • Regional District of Fraser-Fort George • District of Vanderhoof • Rio Tinto Alcan • Department of Fisheries and Oceans Canada • BC Hydro • Insurance Sector
Possible Financing Options	<ul style="list-style-type: none"> • UBCM Community Resiliency Investment Program • National Disaster Mitigation Program (NDMP)
Possible Co-benefits	<ul style="list-style-type: none"> • Awareness of flood risk for existing property owners in the floodplain.

Focus Area: Water Supply

Description

The City of Prince George relies on groundwater collector wells located within the Lower Nechako River Valley Aquifer to provide drinking water to approximately 65,000 residents. The Nechako River charges the aquifer effectively supplying 80% of the collector wells water. Due to the proximity of the Nechako and Fraser Rivers to the community, attitudes and habits have formulated to trust there is a limitless abundance of water in Prince George. Increasing summer and winter temperatures will have an impact on groundwater sources in British Columbia, due to diminishing snowpacks and increased evaporation. Given the abundance of the groundwater source, we are not at risk of water shortages in the near future. However, the community's water demand may rise to accommodate hot and dry summer conditions and put a greater stress on the drinking water infrastructure. In addition, the aquifers are vulnerable to contamination due to a lack of a natural protective layer.

Goal #13: Conserve and protect groundwater and surface water resources.

Action 13.1: Implement water conservation measures.

Potential Supporting Actions:

- Enforce water use restrictions and explore phased water-use restrictions to reduce stress on infrastructure and foster sustainable water usage practices
- Expand Water Conservation Outreach Program to continue to raise awareness on water conservation
- Investigate feasibility and opportunity to implement universal water metering
- Expand infrastructure leak detection and repair program
- Consider utilizing stormwater infrastructure to offset water demand not for human consumption (e.g. Soccer field irrigation).

Action 13.2: Increase awareness of groundwater aquifer drinking water source.

Potential Supporting Actions:

- Continue to monitor aquifer health through water quality sampling and review climate risk through aquifer volume monitoring.
- Install signage in groundwater protection area.

- Update capture zone analysis from 2003.
- Enhance community awareness around relationship between climate risk and health of groundwater aquifer.
- Continue to highlight groundwater source and water supply infrastructure through BC Water Week campaigns.

Action 13.3: Improve operational practices for road maintenance to prevent salt contamination of groundwater.

Potential Supporting Actions:

- Implement recommendations identified in Salt Vulnerable Areas Action Plan to reduce impacts of salt on groundwater and surface water sources.
- Raise awareness and improve public outreach on the impacts of road salt on the natural environment.

Action 13.4: Monitor water quality and stream health in urban creeks.

Potential Supporting Actions:

- Implement urban stream monitoring program to monitor temperature, pH, salts, TSS, TOC and algal blooms.
- Identify priority local watersheds with sedimentation issues, erosion, high fish values, and implement restoration measures where applicable.

Supporting Details for Water Supply Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • Higher summer temperatures increasing demand on irrigation systems. • Hotter, drier summers affecting aquifer levels and decreasing water availability in summer months. • Drier summers increasing water restrictions. • Fewer days below -10 °C increasing road salt use, impacting infrastructure and potentially affecting water quality.
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • The City’s Water Conservation Plan updated in 2016 with a target of reducing per capita water consumption. • A Groundwater At Risk of Pathogens (GARP) Assessment was completed in 2019 to assess aquifers vulnerability to contamination by pathogens. • Biannual comprehensive raw water sampling. Sentinel wells installed in 2010 to assist with ongoing sampling. • Capture Zone Analysis, Contaminant Inventory and Preliminary Groundwater Monitoring Plan completed in 2003 and Wells Protection Plan developed in 2016. • Inactive City groundwater wells deactivated to prevent contamination concerns. • Two summer students employed over the summers of 2017 and 2018 provided education of watering restrictions. • The City prepared an updated Salt Management Plan, which included a Salt Vulnerable Areas Action Plan, to reduce impacts of road salt usage on the natural environment. • City staff attend several events annually to share information on water conservation and groundwater protection.

	<ul style="list-style-type: none"> • Schedule D-1 of the Official Community Plan designates Groundwater Protection Development Permit Areas disallows certain types of development to protect the City’s groundwater source.
Municipal Role	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Maintain safe drinking water quality and quantity for residents of Prince George. • Mitigate impacts of municipal operational practices on groundwater source and urban stream systems.
Possible Partnerships	<ul style="list-style-type: none"> • Ministry of Forests, Lands, Natural Resource Operations and Rural Development • Recycling and Environmental Action Planning Society • Ministry of Transportation and Infrastructure • University of Northern British Columbia • Northern Health • Spruce City Wildlife Association
Possible Financing Options	<ul style="list-style-type: none"> • FCM Green Municipal Fund • Infrastructure Planning Grant Program • Disaster Mitigation and Adaptation Fund • Real Estate Foundation of BC
Possible Co-benefits	<ul style="list-style-type: none"> • Reduce burden on engineered infrastructure • Financial savings associated with reduced energy use and maintenance costs • Increased capacity for Wastewater Treatment Plant

Focus Area: Forests and Wildfire Risk

Description:

The City of Prince George is surrounded by forest and the economy has a long history tied to the forestry sector. A changing climate has resulted in hotter summer conditions, decreased soil moisture and warmer winters leading to forest health implications such as the Mountain Pine Beetle (MPB), Douglas Fir Beetle and the Spruce Beetle which have increased the vulnerability of the surrounding forest stand. The Central Interior of British Columbia has experienced significant wildfire events over the past decade, with 2017 and 2018 being the worst wildfire seasons on record. Prince George has a history of proactively managing wildfire risk to protect the community and developed its first Community Wildfire Protection Plan in 2005.

Goal #14: Proactively mitigate wildfire risk at the community scale.

Action 14.1: Reduce community vulnerability to wildfire risk through changes to forest cover and implementing recommendations identified in Community Wildfire Protection Plan 2018.

Potential Supporting Actions:

- Regularly evaluate wildfire risk to the community by reviewing the *Community Wildfire Protection Plan* approximately every 5-10 years.
- Select planting tree species that are more resilient to a changing climate and pose less of a fire risk.

- Continue to seek long term external funding so that the City can support continued wildfire risk reduction recommendations.
- Ensure FireSmart practices are communicated to new builders and developers through Planning and Development Services at City of Prince George and Regional District of Fraser-Fort George (RDFFG).
- Communicate FireSmart practices to City of Prince George and RDFFG park maintenance staff.
- Continue to support the RDFFG in sharing FireSmart resources to private property owners so they can undertake FireSmart practices and effectively communicate FireSmart practices to others in the community.
- Plant tree species that are resilient to a changing climate.

Supporting Details for Forests and Wildfire Risk Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • Higher summer temperatures increasing wildfire risk and damage to infrastructure. • Hotter, drier summers increasing interface wildfires, causing mass evacuation or permanent migration. • Hotter, drier summers lead to increased evaporation and decreased permeability of soils.
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • The City of Prince George updated the Community Wildfire Protection Plan (CWPP) in 2018 which makes recommendations to reduce vulnerability and increase the community’s resilience to wildfire. • The Regional District of Fraser Fort George oversees the FireSmart Education program which encourages homeowners to conduct FireSmart Practices on their own property. • In 2019, the City developed a Wildfire Mitigation Action Plan through the UBCM Community Resiliency Investment which involved developing fuel management prescriptions to lower wildfire hazard in 6 priority areas of the City. • In the mid-2000s, thousands of MPB-affected pine trees were removed from City and private property. • The City of Prince George worked with Industrial Forestry Service Ltd. to disseminate Douglas Fir Beetle traps to reduce impacts of a local infestation. • A list of recommended tree species for planting within the City of Prince George was developed. • The <i>Emergency Response Bylaw</i> provides for the “establishment, administration and operation of an Emergency Response and Recovery Plan” in the event of a wildfire event.
<p>Municipal Role</p>	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Continue to implement recommendations identified in the <i>Community Wildfire Protection Plan (2018)</i>. • Implement wildfire hazard reduction activities in priority areas identified on City-owned properties.

Possible Partnerships	<ul style="list-style-type: none"> • BC Wildfire Service • Regional District of Fraser Fort George • Ministry of Forests, Lands, Natural Resource Operations and Rural Development • Union of British Columbia Municipalities
Possible Financing Options	<ul style="list-style-type: none"> • Union of British Columbia Municipalities Community Resiliency Investment Program
Possible Co-benefits	<ul style="list-style-type: none"> • Removing dead or dying vegetation provides opportunity for new vegetation to grow and sequester carbon. • Reduces wildfire risk to private property and recreational values.

Focus Area: Ecosystems

Description

Residents of Prince George are fortunate to be surrounded by natural forests and live near two major river systems plus numerous freshwater lakes, streams and wetlands that provide habitat to a diversity of vegetation and wildlife species. Known as the “City in Nature,” approximately 65% of Prince George’s land base is naturally forested areas, with 1500 hectares of this land making up public parks and green space that offer a wide array of recreational opportunities. These natural areas contribute significantly to the environmental, social and economic health of the community and provide ecosystem services such as clean air, flood mitigation, groundwater recharge and carbon sequestration. These benefits are typically overlooked in community development and are significantly at risk of a changing climate. Locally natural systems are already experiencing strain from increased urbanization, pest infestations attributed to warmer winters and decreased soil moisture attributed to hotter and drier summer conditions. Protection and enhancement of these natural areas is essential for maintaining resilience to a changing climate and should be viewed equally to engineered infrastructure.

Goal #15: Protect natural assets and enhance ecosystem services.

Action 15.1: Monitor the impacts of climate change on natural systems by implementing Natural Areas Monitoring Strategy indicators.

Potential Supporting Actions:

- Utilize Terrestrial Ecosystem Mapping (TEM) and Sensitive Ecosystem Inventory (SEI) data in decision making processes.
- Assess High Conservation Value Areas approximately every 3-5 years.
- Prioritize the preservation of intact forests and environmentally sensitive areas.
- Implement urban stream monitoring program to monitor temperature, pH, salts, TSS, TOC and algal blooms. Consider developing a Biodiversity Strategy to support the health and resilience of ecological communities on public and private lands by working collaboratively with educational partners and community environmental groups.

Action 15.2: Protect and enhance riparian zones through better protection of river and creek shorelines to better manage storm water runoff and improve stream health.

Potential Supporting Actions:

- Review Riparian Protection Development Permit areas and identify areas for improvement.

- Consider expanding RPDP areas to include wetlands and other water features.
- Implement erosion protection measures along Heritage River Trail and Cottonwood Island Park.
- Choose low impact erosion protection measures over hard surface erosion protection measures whenever possible.
- Purchase land when applicable within riparian areas, including property along the river, urban creeks and wetlands, and dedicate as park space or natural assets.
- Support community-led initiatives to enhance local fish populations where applicable.

Action 15.3: Preserve existing natural areas, including forests and wetlands to protect wildlife habitat and improve stormwater infiltration, protect slope stability and preserve water quality.

Potential Supporting Actions:

- Review Tree Protection bylaws to prevent widespread tree and vegetation removal.
- Balance fuel reduction and wildfire risk reduction strategies with the need for a healthy natural environment.
- Evaluate opportunities to re-naturalize stream systems, wetlands and riparian areas when possible.
- Encourage increased use of natural infrastructure on public and private property.
- Ensure wildlife corridors are preserved in new developments to enable wildlife migration routes and connectivity between natural areas.
- Encourage residents to plant deciduous trees in their yard to absorb carbon, provide home shading in the warm summer months and mitigate wildfire risk.

Action 15.4: Increase public knowledge on the value of ecosystem services.

Potential Supporting Actions:

- Develop public education campaign to raise awareness of social and economic benefits of preserving natural areas.
- Host environmental events such as Tree Day, Clean Air Day, Rivers Day to emphasize the value of ecosystem services.
- Continue to implement educational signage in City parks and include information on a changing climate.

Action 15.5: Assess need for an updated Urban Forest Strategy.

Potential Supporting Actions:

- Expand urban canopy in parks and playgrounds.
- Conduct assessment of urban forest health.
- Set goals for tree canopy cover.
- Enforce infractions under the Tree Protection Bylaw.
- Consider expanding Tree Planting Programs.

Goal #16: Raise awareness of and restrict spread of invasive species throughout community.

Action 16.1: Manage the spread of invasive species through public outreach and education.

Action 16.2: Develop and implement Invasive Plant Management Inter-Jurisdictional Strategy & Action Plan, including maps that identify priority areas and species.

Potential Supporting Actions:

- Prepare public education campaign on influence of climate change on invasive plants for homeowners, school children and commercial businesses.

- Deliver inter-departmental education program for internal staff on invasive species and their roles in prevention, control and reporting.
- Ensure staff receive adequate training in pesticide application, when other Invasive Plant Management strategies are not effective.
- Engage with local greenhouses, and nurseries to restrict the sale of invasive plant species.
- Share educational materials on invasive plants to increase community awareness.

Supporting Details for Ecosystems Focus Area

<p>Associated Climate Change impacts</p>	<ul style="list-style-type: none"> • Rising annual temperatures increasing invasive species and threatening native species. • Rising annual temperatures and drier summers increasing human/wildlife encounters. • Warmer winter temperatures and rising annual temperatures reducing die-off of pests (?). • Warmer summer temperatures decreasing fish stocks and health populations. • Warmer summer temperatures impacting forest health. • Warmer summer temperatures changing patterns of species migrations. • Less summer precipitation decreasing streamflow. • Decreased snowfall/snowpack creating drier summer conditions and lower water levels. • More extreme wildfires disrupting natural systems and affecting biodiversity. • Increase in heavy rainfall events impacting water quality. • Shift in seasonal precipitation patterns affecting vegetation. • Increased extreme wind events increasing tree fall, affecting water retention and slope stability.
<p>What has been completed so far?</p>	<ul style="list-style-type: none"> • The City commissioned a terrestrial ecosystem mapping (TEM) and sensitive ecosystem inventory (SEI) mapping project to create an inventory of the City’s ecological communities in 2010. As a part of this project modelling was performed to understand how these natural systems will be impacted by a changing climate, such as decreasing soil moisture and reduction in wildlife habitat. • The City has been a member and financial partner with the Northwest Invasive Plant Council (NWIPC) since 2007 which provides invasive plant management across jurisdictions in our region. • Development Permit Areas for Riparian and Groundwater Protection allow additional measures to be implemented during development to protect these natural assets. • Private land was acquired by the City to create a new riverfront park in 2017. • Bank stabilization works are planned for the riverfront recreational trails in Cottonwood Island Park and along the Heritage River Trail.
<p>Municipal Role</p>	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • Manage natural areas on City-owned land by restricting spread of invasive plants and caring for natural vegetation. • Effectively manage natural assets that provide municipal services (e.g. Hudson’s Bay Wetland).

	<ul style="list-style-type: none"> • Utilize Development Permit Areas and Tree Protection bylaw to regulate development activities on private and public property to protect environmental sensitivities. • Educate residents on Prince George’s natural assets and native species and ecosystems. • Utilize Environmental Best Management Practices on City capital projects and operational activities.
Possible Partnerships	<ul style="list-style-type: none"> • Ministry of Forests, Lands, Natural Resource Operations and Rural Development • Ministry of Environment and Climate Change Strategy • Regional District of Fraser Fort George • Lheidli T’enneh First Nation • School District 57 • Prince George Naturalists • REAPS • North-West Invasive Plant Council • Tree Canada • Spruce City Wildlife • University of Northern British Columbia • College of New Caledonia
Possible Financing Options	<ul style="list-style-type: none"> • Department of Fisheries and Oceans: various grant programs • Tree Canada • FCM Green Municipal Fund • Investing in Canada’s Infrastructure Fund – Green Infrastructure Stream • Environmental and Climate Change Canada: Environmental Damages Fund
Possible Co-benefits	<ul style="list-style-type: none"> • Natural assets such as trees and wetlands absorb carbon from the airshed and complement carbon reduction efforts. • Greenspaces provide significant physical and mental health benefits to residents. • Retaining greenspace and natural vegetation and landscapes increase property values.





OBJECTIVE 4 | Integrate Climate Change Thinking and Response

Focus Area: Governance and Education

Description

These actions centred on governance and education are often labelled as “enabling actions” and represent actions that are required to build capacity and enable continued integration of adaptation into daily business and decision-making. In other words – not just the “what” but also the “how” – institutionalizing the capacity to do adaptation planning. For the City of Prince George, many of these actions involve incorporating climate change considerations into municipal planning. These include but are not limited to the Official Community Plan, the Asset Management Policy, and the Official Community Plan. Moreover, enabling actions also govern the implementation and monitoring of the actions identified to ensure progress is made, tracked, and reported.

Goal #17: Incorporate climate change adaptation into municipal decision-making processes, policies and plans.

Action 17.1: Integrate climate change language into Prince George’s new and existing plans and policies.

Potential Supporting Actions:

- Some of these plans and policies include:
 - Sustainable Procurement Policy
 - Economic Development Strategy
 - Transit Future Action Plan
 - Emergency Plan
 - Asset Management Strategy

Action 17.2: Include climate change adaptation strategies into annual work plans.

Potential Supporting Actions:

- Include in City’s capital planning and decision-making.

Action 17.3: Engage with the insurance sector to understand what a changing climate will mean for insurance premiums within the City of Prince George.

Potential Supporting Actions:

- Meet with representatives of the insurance sector and assess impacts to the organization.
- Share information from insurance sector to private property owners on how to best protect home and property in a changing climate.

Goal #18: Inspire and track progress of climate action at the City and in the Community.

Action 18.1: Improve communication across Prince George around climate action.

Potential Supporting Actions:

- Develop a Climate Change Communication Strategy.
- Collaborate with other organizations to enhance opportunities for learning about climate change.

- Raise public awareness and communicate to residents the successes (and need for more) implementation of the plan through the City website and social media
- Initiate local contests for schools, businesses, and homeowners around adapting to climate change
- Instill pride throughout organizations on efforts of local climate action
- Frequently provide culturally appropriate and accessible programming (e.g. multiple languages, accessibility compliant, etc.) about extreme weather-related risks, especially for populations most vulnerable to those impacts.
- Work with local agencies to develop materials based on their needs and support creation of user-friendly web pages on their websites that link climate change actions/programs/ opportunities.

Action 18.2: Monitor and track implementation of the Climate Change Strategy and report on progress annually.

Potential Supporting Actions:

- Create an internal and external Implementation Steering Committee to maintain implementation of action items across the community.
- Prepare annual reports to Council and the public to provide an update on the status of implementation. The report should include the status of each action (e.g. Initiated, underway, complete) as well as a brief commentary on what was achieved and what is anticipated in the coming year.
- Include Climate Change Action Plan strategies in annual work plans
- Develop and monitor indicators of climate change adaptation adoption and report on progress.

Supporting Details for Governance and Education Focus Area

Associated Climate Change impacts	<ul style="list-style-type: none"> • All climate change impacts identified.
What has been completed so far?	<ul style="list-style-type: none"> • The Official Community Plan supports the 6 myPG environment goals which include “reduce carbon emissions and adapt to climate change. • Asset Management Policy, Strategy and Roadmap updated in 2019 to incorporate building resiliency to climate change into asset management decisions. • The City’s 2011 Official Community Plan includes significant reference to the 2009 Climate Adaptation Strategy. • Sustainable Procurement Policy 2010 enables the City to recognize businesses that incorporate sustainability into their business practices through procurement decisions.
Municipal Role	<p>It is the responsibility of the City of Prince George to:</p> <ul style="list-style-type: none"> • To lead by example and continually strive to include climate change considerations into decision-making and key documents. • To show community leadership through education and outreach practices on climate change adaptation and preparedness.

<p>Possible Partnerships</p>	<ul style="list-style-type: none"> • Regional District of Fraser-Fort George • Lheidli T'enneh First Nation • School District 57 • Ministry of Transportation and Infrastructure • Emergency Management BC • Chamber of Commerce • University of Northern British Columbia • Northern Health • Insurance Sector • BC Hydro • FortisBC
<p>Possible Financing Options</p>	<ul style="list-style-type: none"> • FCM Municipal Climate Innovation Program (if recapitalized) • Ministry of Environment and Climate Change Strategy [xii], [xiii].



Implementation and Governance

This document is intended to guide the City of Prince George and community partners to prepare for the impacts of climate change. As such, a strong focus on implementation, governance, and monitoring is essential to improving adaptive capacity in Prince George. Planning for implementation improves the likelihood of effective adaptation, provides new opportunities for outreach and engagement, and fosters long-term sustainability.

Changes to federal and provincial legislation and regulations, as well as technological advances, are anticipated; this will impact the long-range strategies, underscoring the importance of periodic review and adjustments to the Climate Change Adaptation Strategies for the Community of Prince George.

Oversight and Governance

It is intended that the Climate Change Adaptation Strategies for the Community of Prince George will be “municipally-led and community supported”. The benefits of this model are that it enables the City to play a leadership role, while working together with community stakeholders for implementation. It also potentially allows for the leveraging of capital of the community for those actions that are beyond municipal responsibility.

These roles and responsibilities will need to be confirmed with community partners, and relevant City departments prior to implementation.

City of Prince George – Environmental Services Division

The Environmental Services Division will be responsible for ensuring the identified actions are incorporated into an integrated Climate Action Strategy for the City of Prince George. This division will be responsible for monitoring and tracking progress on the actions identified and providing adaptive capacity improvements for reporting in the City’s annual support. The Environmental Services Division will take the lead on working with internal municipal departments and community stakeholders to build resiliency to climate change in Prince George.

City of Prince George Administration

Residents of Prince George rely on the City of Prince George to build and maintain safe road infrastructure, provide reliable water, wastewater and storm water systems, support economic development and social health and well-being, and operate recreational facilities and public parks. The City of Prince George will lead by example by implementing climate change adaptation measures into daily operations.

However, the City cannot improve adaptive capacity on its own and will continue to build relationships with community partners and advocate to all local residents to grow a resilient Prince George.

Community Stakeholders and Partnerships

Many different organizations operate and have jurisdictions in the City of Prince George and play important roles in climate change adaptation at the community level. It will be the role of these stakeholders upon further consultation to support and carry out adaptation activities that fall within

their mandates and capacities. Stakeholders offer additional expertise and experience which can contribute additional capacity and support to the City in order to achieve adaptation actions.

As mentioned throughout the Climate Change Adaptation Strategies for the Community of Prince George, community-wide partnerships are essential for building a more resilient community. Strengthening community partnerships will ensure climate change adaptation considerations are embedded across the community. Examples of possible partners are mentioned throughout the action tables that the City intends to engage with to implement the goals and actions of this report. Some of these possible partners include:

Educational Institutions: Prince George has two post-secondary institutions which provide collaborative research opportunities. The City can continue to work with both the College of New Caledonia and the University of Northern British Columbia to engage students and researchers to problem solve and undertake research projects. School District 57 also provides a significant opportunity to educate and engage with youth on climate change actions.

Lheidli T'enneh First Nations: Traditional ecological knowledge is essential for building a resilient community environmentally, socially and economically. Partnerships with local First Nations groups assist in building awareness about climate change and information sharing relating to the environmental values of the region.

Higher Levels of Government: The Federal and Provincial government are taking leadership on climate action initiatives and supporting local governments on improving adaptive capacity. Several Provincial Ministries have engaged with City staff on climate action initiatives and have provided both capacity and financial support.

Health and Social Agencies: The City works closely with health and social agencies on several community issues, and collaborations and information sharing opportunities may present itself to explore how climate change implications can be incorporated into existing programs and services.

Private Sector and Local Business: Extreme weather events and forest fires are already impacting the private sector. Working together with industry and the private sector provides unique case study opportunities that can be shared with other members of the economic community.

Non-Profits: There are several social and environmental non-profit organizations in Prince George that may be able to assist with implementing adaptation strategies and providing volunteer support. These organizations work on the ground with community members and can share information on climate change and empower residents to act on climate change.

Community Stakeholder Working Group

It is suggested that the community stakeholders that came together for the development of this Plan, continue to meet and form a Community Stakeholder Working Group to guide the implementation of adaptation strategies. The group would be composed of representatives from community partners, stakeholders, and Municipal staff. The working group would represent the interests of the partner organizations and would welcome members of the wider community and interested staff members.

It is recommended that the working group would meet throughout the year, with a minimum of two meetings annually. The objective of these meetings would be to: (1) develop the annual work plan and, (2) to report on progress at the end of the year to City council. More frequent meetings may be required during the initial stages of implementation as the process begins.

Coordination

It is recommended that a coordinator position be established as a main point of contact for the CCCAP. This person would act as a liaison between lead and supporting organizations, City Council, Municipal staff and the community. They would convene, facilitate and lead working group meetings as well as assist with the development of the annual report to Council. The coordinator may also be responsible for the preparation of funding applications and the facilitation of education and outreach campaigns related to the Climate Change Adaptation Strategies for the Community of Prince George.

Funding

It is recommended that the City continue to maximize available funding opportunities to advance the implementation of adaptation actions. There are multiple funding avenues that align with the implementation guidelines outlined in this report that are mentioned within the action tables, including but not limited to:

- Federation of Canadian Municipalities (e.g. Green Municipal Fund)
- Canada Revenue Agency tax incentives for industrial investments in energy conservation and clean energy generation
- Clean BC
- Infrastructure Canada (e.g. Investing in Canada Infrastructure Program, Disaster Mitigation and Adaptation Fund)
- The Federal Canadian Industry Program for Energy Conservation (CIPEC)
- Trees Canada (e.g. Community Tree Grants)
- Community Healthy Living Fund (e.g. healthy eating and physically activity programming grants)
- Impact Assessment Agency of Canada (e.g. environmental assessment funding)
- EcoAction Community Funding Program
- Infrastructure Canada's Smart Cities Challenge

As funding opportunities are constantly changing, it will be important for City staff and community partners to continually research and monitor available opportunities to leverage for implementation.

Communication, Education and Outreach

The long-term success of the plan hinges upon an informed and involved community taking part in ongoing conversations about climate impacts and the benefit of climate action. The conversation must translate to action on both the individual and community-level. Integrating climate awareness into the mainstream practices and thinking of all community groups, residents, visitors and municipal staff will be essential in successfully maximizing our resiliency potential.

In order to ensure widespread community support and involvement, multiple mediums of communication and outreach should be utilized. These range from visual mediums (e.g. infographics, advertisements) and written media (e.g. government publications, newspaper articles, brochures, websites) to oral communications (e.g. group dialogue, presentations). Both internal and external communication will help increase public awareness and buy-in surrounding the Climate Change Adaptation Strategies for Prince George and the Climate Action Strategy to follow.

It is recommended that the City of Prince George, working with community partners, develop a communication strategy that keeps residents informed about the progress of the Climate Change Adaptation Strategies for Prince George and the Climate Action Strategy to follow. and provides actions they can accomplish at home and in the community.

Monitoring and Review

Monitoring metrics have not yet been identified for each action. However, for actions that can be led or supported by the City of Prince George, this process will occur as a part of the development of the City of Prince George Climate Action Strategy. Stakeholders and partner agencies are also encouraged to identify and track metrics associated with climate adaptation actions. As implementation progresses, it will be important for the City and its community stakeholders to develop indicators that measure if actions are succeeding in reducing vulnerability to climate change.

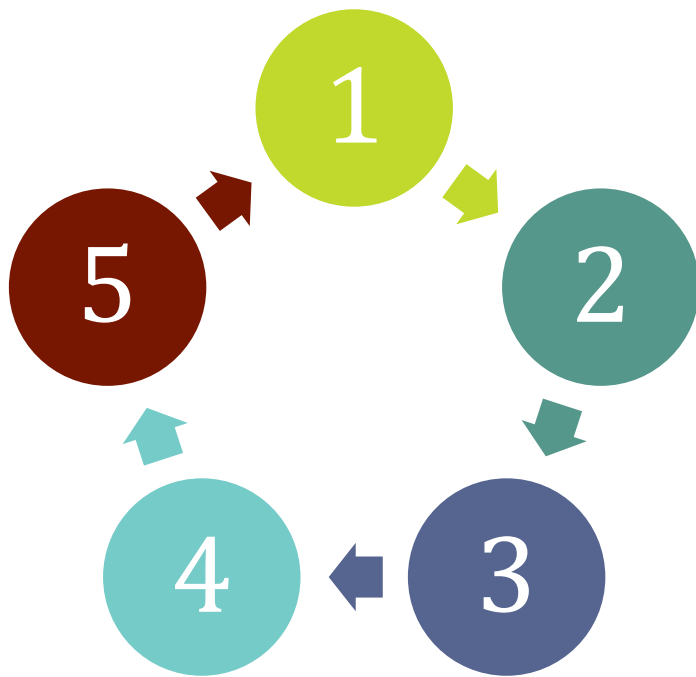
Next Steps

The next steps will be for the City of Prince George to prioritize the actions in this document to guide for implementation in the Climate Action Strategy. Priority will be given to actions that can be mainstreamed into current planning schedules and existing operations. Planning from a budgeting and work plan perspective for the mid-to-longer term actions will also begin.

Plan Review Schedule

As mentioned, the City of Prince George is in the process of developing a Climate Action Strategy which is guided by the Climate Change Adaptation Strategies for the Community of Prince George and the Climate Change Mitigation Plan. Following the completion of the Climate Action Strategy, it is recommended the strategy is reviewed and updated every five years.

Appendix A: ICLEI Canada's Building Adaptive and Resilience Communities (BARC) Framework



MILESTONE ONE - INITIATE

Within this milestone, communities identify stakeholders to review and understand existing knowledge on how the regional climate is changing, followed by a brainstorming exercise to identify potential climate change impacts.

MILESTONE TWO—RESEARCH

The second milestone is meant to further develop a community's understanding of climate change impacts and the major service areas which are likely to feel these impacts most acutely. Within this milestone, a municipality will scope the climate change impacts for the region and conduct both a vulnerability and risk assessment.

MILESTONE THREE - PLAN

The third milestone provides guidance on how to establish a vision, set adaptation goals and objectives, identify adaptation options, and examine possible constraints and drivers to various actions. From there, a community will draft a Local Adaptation Strategy. Baseline data is collected and recorded, financing and budget issues are addressed, an implementation schedule is drafted, implementation responsibilities are determined, and progress and effectiveness indicators are identified in the Plan.

MILESTONE FOUR - IMPLEMENT

In the fourth milestone, communities work to ensure that they have the approval and support of council, municipal staff and the community in order to move forward on implementation. Communities will also make sure they have the appropriate implementation tools to ensure the ongoing success of the Strategy.

MILESTONE FIVE – MONITOR & REVIEW

The fifth and final milestone serves to assess whether the goals and objectives of the Strategy have been achieved, and helps communities identify any problems that have been encountered and develop solutions. Additionally, the fifth milestone helps communities communicate their progress to council and the general public.

Appendix B: Stakeholder Identified Impacts

Built Systems

1. Increase in heavy rainfall events damaging aging/inadequate infrastructure.
2. Increase in heavy rainfall events impacting storm water management.
3. Increase in heavy rainfall events causing transportation disruptions (i.e. highway/bridge washouts).
4. Increase in heavy rainfall events affecting infrastructure management decisions (e.g. Rio Tinto dam).
5. Increase in heavy rainfall events causing river level rise and property loss/damage.
6. Increase in heavy rainfall events causing inflow and infiltration to sanitary and sewer system.
7. Increase in heavy rainfall events causing damage to buildings.
8. Increase in heavy rainfall events causing overland flooding and sinkholes.
9. Increase in heavy rainfall events causing loss of recreational trails along river.
10. Higher summer temperatures increasing wildfire risk and damage to critical infrastructure.
11. Higher summer temperatures increasing demand on infrastructure and energy resources.
12. Higher summer temperatures increasing demand on irrigation systems.
13. Higher summer temperatures affecting sewer effluent dilution in summer months.
14. Higher summer temperatures increasing heat island effect.
15. More frequent and intense drought in summer months affecting industry due to low river levels.
16. Warmer, wetter winters causing road bans in the forestry sector.
17. Warmer, wetter winters increasing sidewalk and road maintenance.
18. Warmer winters changing freeze/thaw cycles causing strain on city infrastructure.
19. Fewer days below -10° increasing road salt use, damaging infrastructure and affecting water quality.
20. Fewer days below -30° increasing overall population, creating more demand on infrastructure.

Natural Systems

1. Increase in annual average temperatures increasing length of growing season.
2. Increase in annual average temperatures increasing invasive species and threatening native species.
3. Increase in annual average temperatures and drier summers increasing human/wildlife encounters.
4. Increase in annual average temperatures accelerating glacier melt.
5. Warmer winter temperatures and increasing average temperatures intensifying beetle infestation and other pests.
6. Warmer summer temperatures decreasing fish stocks and health of populations.
7. Warmer summer temperatures impacting forest health.
8. Warmer summer temperatures impacting species migration.
9. Hotter, drier summers affecting aquifer levels and decreasing water availability in summer.

10. Hotter, drier summers decreasing moisture content in soil.
11. Less summer precipitation decreasing streamflow.
12. Decreased snowfall/snowpack creating drier summer conditions and lower water levels.
13. More extreme wildfires decreasing agricultural production.
14. More extreme wildfires disrupting natural systems and affecting biodiversity.
15. Increase in heavy rainfall events causing riverine flooding and increased sediment deposit in streams and creeks.
16. Increase in heavy rainfall events causing effluent release from industry.
17. Increase in heavy rainfall events causing riverbank erosion and loss of riparian habitat.
18. Increase in heavy rainfall events impacting water quality.
19. Shift in seasonal precipitation patterns affecting vegetation.
20. Increased extreme wind events increasing tree fall, affecting water retention and slope stability.

Human/Social Systems

1. Warmer winter temperatures impacting winter sports and tourism.
2. Warmer winter temperatures causing mobility issues or accidents due to ice.
3. Warmer winter temperatures impacting hunting and trapping, particularly for Indigenous communities.
4. Warmer winters and drier summers impacting forestry industry (e.g. shortening the logging season, no equipment use with fire bans).
5. Warmer winters and hotter summers increasing climate refugees or homeless populations coming to Prince George.
6. Fewer days below -30° increasing the spread of disease.
7. Drier summers increasing water restrictions.
8. Hotter summer temperatures increasing summer tourism (new Okanagan).
9. Hotter summer temperatures increasing UV exposure and heat stress.
10. Hotter, drier summers increasing interface wildfires, causing mass evacuation or permanent migration.
11. Hotter, drier summers increasing particulate matter from dust and smoke, decreasing air quality.
12. Increase in extreme heat events affecting health of vulnerable populations (i.e. homeless, elderly).
13. Hotter, drier summers limiting outdoor recreational activities (e.g. campfires, ATViing).
14. More extreme wildfires increasing demand on emergency management and health services.
15. More extreme wildfires causing loss of holidays and summer vacation.
16. More extreme wildfires affecting food systems.
17. Increase in extreme heat events impacting safety and productivity of outdoor workers.
18. Increase in extreme weather events affecting culturally significant sites.
19. Increase in extreme weather events affecting business continuity.
20. Increase in extreme weather events increasing pressure and demand on social services.
21. Increase in extreme weather events affecting mental health.

Appendix C: Glossary of Terms

Adaptation: Includes any initiatives or actions in response to actual or projected climate change impacts and 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 (including climate variability and extremes), to moderate potential damage, to take advantage of opportunities, or to cope with the consequences.

Climate: The weather of a place averaged over a period, often 30 years. Climate information includes the statistical weather information that tells us about the normal weather, as well as the range of weather extremes for a location.

Climate Change: Climate change refers to 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 Projections: Climate projections are a projection of the response of the climate system to emissions or concentration scenarios of greenhouse gases and aerosols. These projections depend upon the climate change (or emission) scenario used, which are based on assumptions concerning future socioeconomic and technological developments that may or may not be realized and are therefore subject to uncertainty.

Greenhouse Gas (GHG) Emissions: Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation, emitted by the Earth's surface, the atmosphere itself, and by clouds. Water vapour (H₂O), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), ozone (O₃), and chlorofluorocarbons (CFCs) are the six primary greenhouse gases in the Earth's atmosphere in order of abundance.

Climate Impact: The effects of existing or forecast changes in climate on built, natural, and human systems. One can distinguish between potential impacts (impacts that may occur given a projected change in climate, without considering adaptation) and residual impacts (impacts of climate change that would occur after adaptation).

Impact Statement: Climate-related impact statements are concise statements that outline locally relevant projected threats and how those changes are expected to affect the built, natural, social, and economic systems of the municipality.

Mitigation: The promotion of policy, regulatory and project-based measures that contribute to the stabilization or reduction of greenhouse gas concentrations in the atmosphere. Renewable energy programs, energy efficiency frameworks and substitution of fossil fuels are examples of climate change mitigation measures.

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

Risk: The combination of the likelihood of an event occurring and its negative consequences. Risk can be expressed as a function where $\text{risk} = \text{likelihood} \times \text{consequence}$. In this case, *likelihood* refers to the probability of a projected impact occurring, and *consequence* refers to the known or estimated outcomes of a particular climate change impact.

Sensitivity: Measures the degree to which the community will be affected when exposed to a climate related impact. Sensitivity reflects the ability of the community to function (*functionality*) as normal when an impact occurs.

Vulnerability: Vulnerability refers to the susceptibility of the community to harm arising from climate change impacts. It is a function of a community's sensitivity to climate change and its capacity to adapt to climate change impacts.

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

References

[i] United Nations. (2017). Climate Change is the Challenge of Our Generation. UNFCCC. Retrieved from <https://unfccc.int/news/climate-change-is-the-challenge-of-our-generation>

[ii] United Nations Secretary-General. (2018). Secretary-General's Remarks on Climate Change [as delivered]. UN WebTV. Retrieved from <https://unfccc.int/news/climate-change-is-the-challenge-of-our-generation>

[iii] Environment Canada. (2019). Historic Data – Prince George STP. Past Weather and Climate Data. Retrieved from https://climate.weather.gc.ca/historical_data/search_historic_data_stations_e.html?StationID=48370&Month=5&Day=6&Year=2019&timeframe=1&StartYear=1840&EndYear=2019&searchType=stnProx&txtRadius=25&optProxType=navLink&txtLatDecDeg=53.884166666667&txtLongDecDeg=122.6775&optLimit=specDate&selRowPerPage=25&station=PRINCE+GEORGE

[iv] Foord, V. (2019). Current Climate Change in Prince George – Oct 8, 2019 Presentation. Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

[v] City of Prince George. (2019). Financial Data – Wildfire, Catchbasin Streaming. Infrastructure Services and Public Works.

[vi] Government of Canada. (2016). The Paris Agreement. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/climate-change/paris-agreement.html>

[vii] Government of Canada. (2019). Pan-Canadian Framework on Clean Growth and Climate

Change. Retrieved from <https://www.canada.ca/en/services/environment/weather/climatechange/pan-canadian-framework.html/>

[viii] Government of Canada. (2018). Canada's Climate Plan. Retrieved from <https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan.html>

[ix] Government of Canada. (2018). Adapting to Climate Change in Canada. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/climate-change/adapting.html>

[x] Government of Canada. (2018). Expert Panel on Climate Change Adaptation and Resilience Results. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/climate-change/adapting/expert-panel-adaptation-resilience.html>.

[xi] World Meteorological Organization. (2019). World weather information service. Retrieved from <http://worldweather.wmo.int/en/home.html>

[xii] American Meteorological Society. (2018). Climate Change. Retrieved from <https://www.ametsoc.org/index.cfm/ams/about-ams/ams-statements/archive-statements-of-the-ams/climate-change1/>

[xiii] Ye, H., Fetzer, E.J., Behrangi, A., Wong, S., Lambrigtsen, B.H., Wang, C.Y., ... Gamelin, B.L. (2016). Increasing daily precipitation intensity associated with warmer air temperatures over northern Eurasia. *Journal of Climate*, 29, 2, p. 623 – 636. doi: 10.1175/JCLI-D-14-00771.1

[xiv] Zickfeld, K., and Herrington, T. (2015). The time lag between a carbon emission and maximum warming increases with the size of emission. *Environmental Research Letters*, 10, 3. Retrieved from <https://iopscience.iop.org/article/10.1088/1748-9326/10/3/031001>

[xv] Lemmen, D.S., Warren, F.J., James, T.S. and Mercer Clarke, C.S.L. editors (2016). Canada's Marine Coasts in a Changing Climate; Government of Canada, Ottawa, ON, 274p.

[xvi] Bush, E.J., Loder, J.W., James, T.S., Mortsch, L.D. and Cohen, S.J. (2014): An Overview of Canada's Changing Climate; in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, (ed.) F.J. Warren and D.S. Lemmen; Government of Canada, Ottawa, ON, p. 23-64

[xvii] Prairie Climate Centre. (2020). Climate Atlas of Canada: Climate variables. Retrieved from <https://climateatlas.ca/variables>

[xviii] National Round Table on the Environment and the Economy. (2011). Climate Prosperity. Paying the price: The economic impacts of climate change for Canada. Retrieved from <http://nrt-trn.ca/wp-content/uploads/2011/09/paying-the-price.pdf>

[xix] Auditor General. (2016). Report 2 – Mitigating the Impacts of Severe Weather. Reports of the Commissioner of the Environment and Sustainable Development. Retrieved from https://www.oag-bvg.gc.ca/internet/English/parl_cesd_201605_02_e_41381.html

[xx] Infrastructure Canada. (2019). Climate-Resilient Buildings and Core Public Infrastructure Initiative. <https://www.infrastructure.gc.ca/plan/crbcp-irccipb-eng.html>

[xxi] Shu-ren, Y. (2003) Effects of fire disturbance on forest hydrology. *Journal of Forestry Research*. 14: 331-334

[xxii] Picketts, I. et al (2009) Adapting to Climate Change in Prince George: An overview of adaptation priorities. UNBC.