Resilient St. John's

Community Climate Plan

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Terms

Adaptation – The process and actions to manage the actual and projected climate impacts and risk to reduce the effects on built systems, the natural environment and people

Built Infrastructure – The infrastructure of a country, society, or organization consists of the basic facilities such as transport, communications, power supplies, and buildings, which enable it to function.

Climate – Weather conditions prevailing in an area in general or over a long period.

Climate Risk – Risk resulting from climate change affecting natural and human systems

Greenhouse Gases – is any gas in the atmosphere that absorbs infrared radiation, thereby trapping heat in the atmosphere

Mitigation – The processes and actions that stabilize or reduce the greenhouse gas concentration in the atmosphere

Natural Infrastructure – An area or system that is either naturally occurring or naturalized and then intentionally managed to provide multiple benefits for the environment and human well-being.

Resilience – The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow despite chronic stresses (e.g. water shortages) and acute shocks they experience (e.g. floods)

Smart Growth – planned economic and community development that attempts to curb urban sprawl and worsening environmental conditions.

Vulnerability – the state of being exposed to the possibility of being impacted

Weather – The state of the atmosphere at a place and time regarding heat, dryness, sunshine, wind, rain, etc.

Land Acknowledgements

We respectfully acknowledge the land on which we gather as the ancestral homelands of the Beothuk [bee-oth-uck]. We also acknowledge the island of Ktaqmkuk [uk-dah-hum-gook] (Newfoundland) as the unceded, traditional territory of the Beothuk and the Mi'kmaq [meega-magh Meeg-mah]. We recognize all First Peoples who were here before us, those who live with us now, and the seven generations to come.

Contributors to the Plan

Many residents and organizations contributed to the development of the plan throughout the various engagement stages, including public engagement and consultation, membership of the Multi-Stakeholder Sustainability Team, St. John's Environmental and Sustainability Experts Panel, and St. John's Corporate Energy Team. We also want to thank all the residents and organizations who reached out to staff and council, completed the online surveys, hosted do-it-yourself climate change workshops, and attended any virtual sessions or council meetings.

St. John's Environmental and Sustainability Experts Panel

Kieran Hanley
Joel Finnis
Krista Langthorne
Pablo Navarro
Joseph Daraio
Michel Wawrzkow
Dennis Knight

Multi-Stakeholder Sustainability Team

-Government of Newfoundland and Labrador
-Food First NL
-NAACAP
-Healthy City St. john's
-Bike St. John's
-Newfoundland Federation of Agriculture
-Econext (NEIA)
-Memorial University
-CCNL
-Professional Engineers and Geoscientists Newfoundland & Labrador
-Quidi Vidi / Rennies River Development Foundation
-Ducks Unlimited Canada
-CMHC
-Department of Fisheries and Oceans
-AIM network
-Metrobus
-St. John's Airport (YYT)
-Newfoundland Power
-Home Builders Association
-BOMA NL
-NOIA
-Destination St. John's
-St. John's Board of Trade
-Canadian Home Builders' Association
-Grand Concourse Authority
-MUN Botanical Gardens
-Drive Electric NL
-North Atlantic
-Martin Batterson
-East Coast Trail
-FFAW
-Newfoundland and Labrador Public Health Association
-SWANA
-MMSB

We also thank First Voice and First Light for supporting an ongoing conversation of the role of this plan, the environment and climate action in the healing process of the indigenous peoples in our community.

Data Acknowledgements

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Government of Canada, Canada's Changing Climate Report
Climate Atlas of Canada
Newfoundland Power

A Note on COVID19

The COVID-19 pandemic significantly changed the way we live, work and play in our City. The pandemic has had several negative economic and environmental consequences. Many governments, including the Canadian government, are strategizing how economic recovery packages can be used to "build back better" and support an equitable transition to a resilient low-carbon society. It is also in the interest of Municipalities to look at green recovery and supporting initiatives which may help adapt to climate change, reduce greenhouse gas emissions, and increase overall well-being.

Introduction

Responding to the climate emergency

Climate change is an urgent worldwide crisis. The climate science from the Intergovernmental Panel on Climate Change's (IPCC) report "The Special Report on Global Warming of 1.5°C" is clear: allowing global temperature rise to exceed 1.5°C will disrupt global social, economic and ecological systems, with severe consequences for the most vulnerable populations[1]. Global temperatures are likely to reach 1.5°C between 2030 and 2052 if greenhouse gas emissions (GHG) continue to increase at current global rates, and the window to curve this is closing very quickly.

Analysis by the Federal government of Canada, the Government of Newfoundland and Labrador, and the City of St. John's indicates that our community will experience significant changes in climate. We have already observed temperature increases of 0.8°C since 1942, warming of sea surface temperatures, an increase of intensity and duration of some storms, and sea level rise of about 1.9 mm/year since the 1940's.

It is projected that without action temperatures will have increased by 2.7°C by the 2050s, leading to other significant changes in precipitation, winter conditions, and sea level rise. This would make existing risks greater for vulnerable residents, it would disrupt infrastructure systems, and lead to economic impacts. While the global goal is to achieve net-zero GHG emissions by mid-century to avoid many of the worst climate impacts, it is well understood that a certain amount of climate change is now inevitable.

The City of St. John's strives to be sustainable today and for future generations. This is the vision expressed in the City of St. John's Strategic Plan. St. John's City Council declared a climate emergency in November 2019, joining countries and major cities around the globe, including over 500 municipalities across Canada calling for urgent action to avert the climate change crisis by reducing greenhouse gas emissions and adapting to the expected changes.

This report is a component of the City's response to the climate emergency, it outlines the Adaptation portion of the Resilient St. John's Community Climate Plan. This is in line with requirements from programs that the City is part of including FCM Partners for Climate Protection, Global Covenant of Mayors for Climate and Energy, and Cities Raze to Net Zero.

This plan outlines St. John's risks we must adapt to, as well as adaptation goals and actions developed through best practice reviews and local engagement. The next five to ten years are critical to setting St. John's on the path to support national and global efforts to address climate change and to manage the irreversible changes in climate.

[1] https://www.ipcc.ch/sr15/

What is Climate Change?

- **Climate** is the "average weather" in a location, over some time ranging from months up to thousands of years.
- **Climate change** refers to a change in the state of the climate that persists for decades or longer.

In the current time.

- The global climate has changed over long periods of time naturally. Recent and rapid climate change is attributed to human activity, like burning fossil fuels and land use changes.
- The temperature is changing 50 times faster than it did during the time when modern civilization and agriculture developed over 10,000 years ago.
- The temperature on Earth has increased by more than 1^{o} Celsius since 1880. In the past, a -1^{o} to -2^{o} change took the Earth into the Little Ice Age.
- Approx. 20,000 years ago it was a -5^{o} change that caused the Ice Age, burying most of North American under the towering mass of ice that created the fjords in Western Brook Pond, NLs.
- Impacts from current Climate Change are being felt in Canada and around the globe, and the impacts are expected to worsen as more GHGs are added to the atmosphere.

A Community Climate Plan

Municipal governments have various levels of control and influence across the community. For instance, direct control exists on municipal infrastructure, city buildings and fleet; influence exists on transportation mode share, food security and land use; little influence exists on vehicle standards and air travel. The Resilient St. John's Community Climate Plan includes all levels of control and influence, and its implementation relies on strong collaboration with the community.

To ensure the City is maximizing co-benefits of climate action and to prevent maladaptation, the City of St. John's opted to follow the Low Carbon Resilience (LCR) planning framework. This means the plan integrates climate change action that reduce greenhouse gas emissions (mitigation) and those that address risks from change in climate (adaptation). By strategically aligning these two types of climate action (adaptation & mitigation) we can enhance the effectiveness of both strategies, avoid risks, and generate economic, ecological, and social benefits.

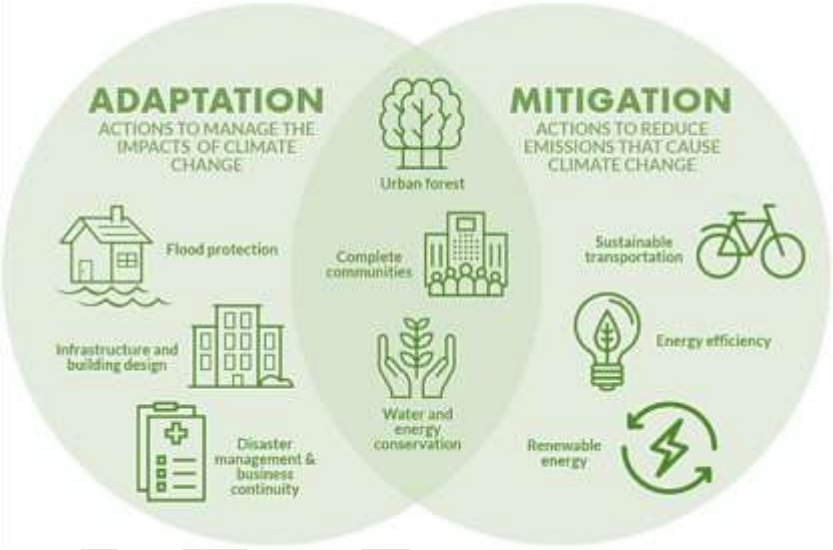


Figure 1 Adaptation vs Mitigation (Source: City of Waterloo Corporate Climate Change Adaptation Plan)

Developing a Plan for Action

The development of this plan followed an evidence based, stakeholder driven, holistic process. This process was guided by the following principles:

Guiding Principles

Commitment: Demonstrate proactive leadership to sustain progress

Inclusiveness: Actively engage and foster shared responsibility for action

Relevance: Develop locally relevant goals and solutions

Integration: Integrate mitigation and adaptation considerations throughout decision making

Evidence Based: Consider current climate science, knowledge, and best management practices, while committing to ongoing learning

Risk-Based: Use a risk-based approach to manage uncertainty in decision making

Process

The plan development was a multi-stages process, which included an early public consultation, stakeholder engagement workshops, technical modeling for business-as-usual and low-carbon scenarios, and scenario-based risk management practices consistent with the ISO 31000:2018 Risk Management for Climate Adaptation & Resilience standard.

Engagement

Figure 2 Engagement groups and roles

The City of St. John's convened a variety of groups including residents, staff, community organizations, businesses, association, and academics to engage in various levels of technical and non-technical discussions. Due to the impacts of COVID-19 most of the engagement was held virtually throughout 2020 and 2021. The St. John's City Guide, City Website News, e-newsletter reaching over 2,831 users, and over 200,000 social media impressions, and Council members interviews with media, were used to raise awareness, and elicit feedback on various stages of the planning process.

A toolkit was developed to support community leaders in hosting conversations about climate change and to provide early feedback. Two train-the-trainer style public sessions were held for anyone interested in using this tool in October 2020. The sessions trained 7 members in our community. Two feedback forms have been provided to the City by the public from community group virtual events using the toolkit.

Prior to finalizing the plan, the City sought additional input from the public, and various Citizen Committees of Council including: Accessibility and Inclusion Advisory Committee, Arts and Culture Advisory Committee, Bike St. John's, Built Heritage Experts Panel, North East Avalon Healthy Communities Alliance, Seniors Advisory Committee, as well as working groups.

What We Heard from Residents

"Well-connected and close-knit group of stakeholders who are acting as champions and are leading the climate action effort."

"St. John's would be a leader that serves as a shining example for other municipalities throughout Newfoundland and Labrador and the rest of Canada. When extreme events associated with climate change occur, we would not face the same disastrous outcome that other communities may face and have been facing."

"St. John's would have complete streets, neighbourhoods; food growing locally in parks and open spaces. There would be more people using public and active transportation systems (less cars on the road). There would be a vast urban forest, instead of fragmented forests across the city. There would be urban greenways, natural environment buffers along roadways, streets, and in neighbourhoods to help with flooding and heat. There would be more electrified vehicles on the road, including buses and city fleet. We would have an easy-to-understand role for everyone from residents to top levels of government.

Adapting to Changes in Climate

It is clear that St. John's has experienced changes in climate, and that more climate change is now inevitable. It imperative that we plan to adapt to these changes, while St. John's plans to do its part in reducing greenhouse gas emissions. Governments, residents, and other stakeholders need to work together to create resilient adapted communities that reduce greenhouse gas emissions and support a high standard of living.

What are Climate Trends and Climate Change?

Climate change is a term used to describe various changes in long-term weather patterns (for example the difference in the general weather conditions experienced in the mid-20th century and the early 21st century). Discussion of climate change often begins with a look at temperature, which has (as a global average) been rising noticeably over recent decades. Consequently, 'climate change' temperature changes are often referred to as 'global warming'. Since the 1880s, the average global average surface temperature has risen by a little more than 1°C. This is a significant change: for reference, the last Ice Age was about 5.5°C colder than pre-industrial temperatures.

The Climate of St. John's is Changing

St. John's Climate Profile report compiled climate information from local, provincial, and federal sources. Climate Change projections indicate that our climate is expected to become more wetter, warmer, and more extreme. Some of these changes have already occurred.

Observed Changes	
Sea Level & Temperature	• Relative sea-level has risen by +1.9mm/year since the 1940's. • Warming in the **sea surface temperature** of 0.13 °C per decade (at the ocean surface), and a warming of 0.02 °C per decade was observed below the surface (0-175m).
Temperature	• Average temperatures have increased by approximately +0.8 °C since 1942.
Extreme Temperatures	• Hottest summer temperature has increased by approximately 1.0 °C. • Coldest temperatures in the winter have increased by 0.5 °C
Freeze-Thaw	• May have seen a very slight decreasing trend in the number of days per year that experience **freeze-thaw** since 1950
Precipitation & Storms	• May have seen a very small reduction in the total amount of precipitation (rain + snow) every year since 1942. However, the intensity and duration of storms is likely to have increased since 1949 (particularly with durations over 30 minutes)
Snow	• It is possible that the total annual snowfall in St. John's may have decreased slightly since 1942. • Satellite imagery suggests that Eastern Canada has seen a decrease in snow cover (-5% to -10%) duration in the months between October-January since 1981.

Future projections for St. John's indicate these changes are expected to continue, and the impacts from associated weather events will become a new normal. The next few pages summarize the changes in climate that St. John's is expected to see by the 2050s and towards the end of the century. There is reasonable confidence on these projections. However, for clarity we have included a scale that helps to show how confident we are on the magnitude and timing of the changes versus others for which we are less confident of their magnitude or timing.

City of ST. JOHN'S
Climate Profile

COLOR OF SIDE BAR SHOWS LEVEL OF CONFIDENCE: HIGH, MEDIUM, LOW

ANNUAL AVERAGE TEMPERATURE

Average, Minimum, and Maximum daily temperatures are projected to increase

9.7 °C **2080s**

7.7 °C **2050s**

5.1 °C **Baseline**

SEASONAL MEAN TEMPERATURE

2.1 °C **2080s**

0.2 °C **2050s**

-3.2 °C **Baseline**

5.3 °C **2080s**

3.4 °C **2050s**

1.8 °C **Baseline**

18.3 °C **2080s**

16.5 °C **2050s**

14.1 °C **Baseline**

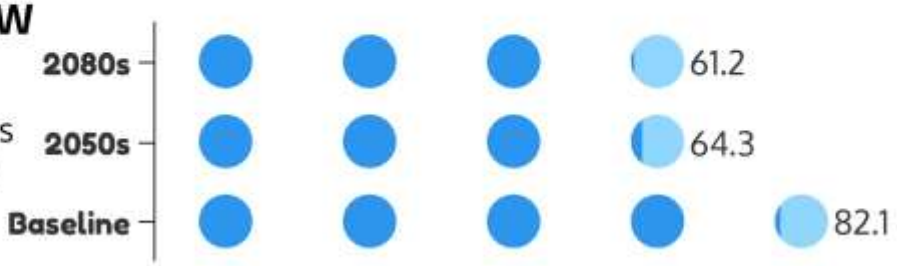
13.0 °C **2080s**

10.9 °C **2050s**

7.6 °C **Baseline**

FREEZE-THAW CYCLES

Freeze-thaw days are projected to decrease



City of ST. JOHN'S
Climate Profile

YEARLY MEAN PRECIPITATION

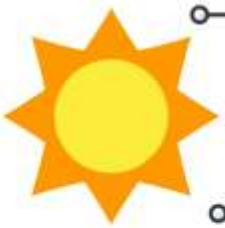
Yearly precipitation is expected to increase.

- 1523 mm **2080s**
- 1408 mm **2050s**
- 1400 mm **Baseline**

SEASONAL MEAN PRECIPITATION

- 462 mm **2080s**
- 440 mm **2050s**
- 408 mm **Baseline**

- 365 mm **2080s**
- 352 mm **2050s**
- 327 mm **Baseline**

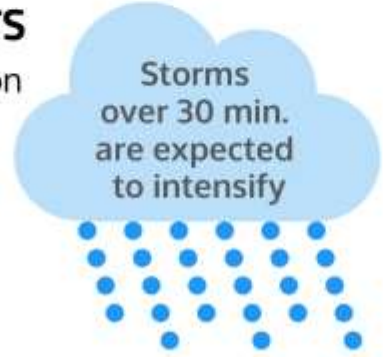


- 277 mm **2080s**
- 274 mm **2050s**
- 267 mm **Baseline**

- 418 mm **2080s**
- 410 mm **2050s**
- 398 mm **Baseline**

STORM EVENTS

Heavy precipitation events are expected to become more extreme.



DAYS WITH OVER 10 mm

- 62.2 **2080s**
- 62.5 **2050s**
- 59.9 **Baseline**

City of ST. JOHN'S
Climate Profile

SNOW

Snowfall is expected to decrease, while freezing rain and winter rain increases.

Surface Snow Thickness is Predicted to Decrease

60% by 2050s

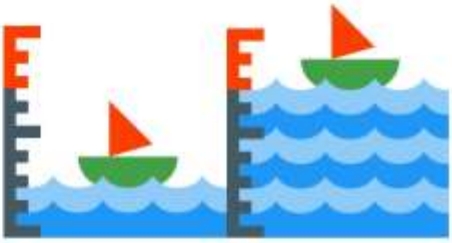
90% by 2080s

FREEZING RAIN

Freezing rain events are expected to increase during winter, with little to no change in November or April.

SEA LEVEL

Sea Level is expected to rise by 75 to 100 cm *by 2100*



WIND & GUSTS

There is significant uncertainty on wind projections

Wind speed are likely to increase

Days With Gusts Over 70 km/hr

54.8 **2080s**

49.6 **2050s**

40 **Baseline**

To read the full report or to learn more about the City's climate change adaptation and mitigation strategies, please visit the Sustainability page at stjohns.ca

ST. JOHN'S

Addressing the Risks

The City of St. John's undertook a strategic risk assessment to inform how changes in climate may impact our community. This process was led by the City and engaged local stakeholders. The assessment identified over 50 impacts across the infrastructure, socioeconomic, and ecological systems of our community. Prioritization was set based on the likelihood of the impact taking place, as well as the consequences it would have across the community's: health, infrastructure, local economy & growth, natural resources, psychological, culture, social cohesion, and consequences to the public administration.

Infrastructure Systems Sea level rise is anticipated to increase erosion and likelihood of storm surges flooding coastal infrastructure. Precipitation changes are expected to increase stress and maintenance requirements on stormwater infrastructure and buildings (e.g., mould, leaks), while water crossings may experience increased vulnerability and potential for failure. Similarly, sport fields may see an increase in required maintenance due to flooding. Warmer summers will increase energy use for cooling, and demand for cooled venues for youth and vulnerable populations, as well as opportunities for gardening. Meanwhile, the increase in winter freeze-thaw cycles may increase maintenance requirements on roads. Increased extreme weather may lead to more frequent outages in communications and power.

Socioeconomic Systems Climate change will have direct impacts on St. John's socioeconomic system. Impacts to our transportation systems (roads, public and active transportation) can impact the local economy by causing delays and disruptions to business operations. Similarly, impacts to the marine ecosystems, agriculture, and energy use can change the food security future of our community. Increased infrastructure maintenance and repair can lead to changes in servicing costs.

Health impacts form climate change have been identified. This includes changes to winter leading to less opportunities for winter activities, increased incidence of vector-borne diseases, injury from extreme weather events, exacerbations to weather dependent health conditions (e.g., respiratory and cardiovascular conditions), and psychological effects of extreme weather impacts

Ecological Systems Warmer temperatures are expected to impact the freshwater and sea temperatures leading to changes in both ecosystems, as well as terrestrial ecosystems, including invasive species. These changes may also impact migratory birds and fish, which can have an impact on recreation and fishing activities. Temperature and precipitation changes are expected to create an extension to the forest fire season. The longer growing season also is expected to bring more pest management demand, but also provide an opportunity for gardening and food production. The impact of wind is uncertain, but if winds do increase (along with intensity of storms) it is expected that more tree blowdowns may take place (contributing to fire risk), and that wind would also impact the number of viable fishing days.

Adaptation Actions

The impacts of climate change are already being felt in St. John's, these are driven by greenhouse gas emissions (GHGs) emitted in the past. These impacts will continue and many of them will become more severe. Adapting to these changes, while reducing GHGs, is imperative to prevent impacts from affecting residents of St. John's. The impacts of climate change do not affect everyone equally. Vulnerable populations feel the impacts from climate change more strongly. Climate adaptation should be implemented to prioritize these populations. Different sectors and assets have different planning horizon (Figure 3), this is why adaptation to climate change needs to start immediately but is understood to be an ongoing process that builds resilience over time

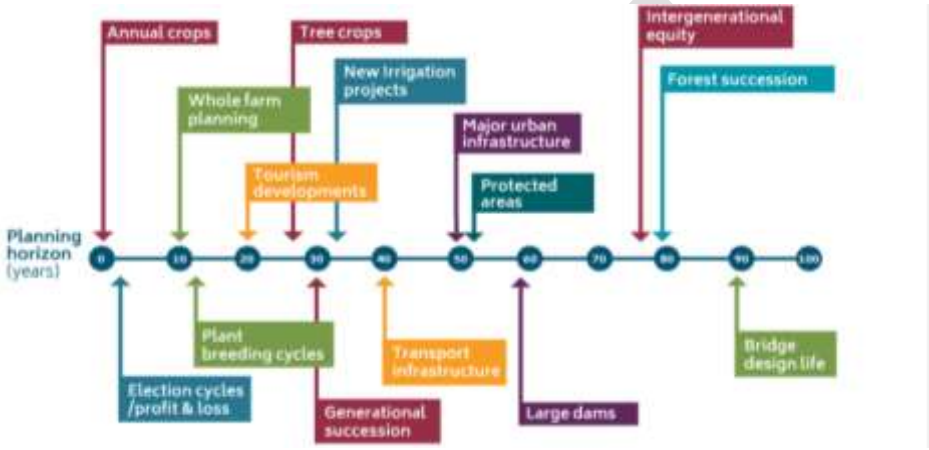


Figure 3 Typical planning horizons (years) for different sectors (Source: Jones and McInnes 2004).

Actions to adapt to climate change were developed based to address impacts rated to be of medium and high risk to our community. Actions are based on best practices from municipalities, informed by local stakeholders, and public engagement.

Actions are presented within themes, each theme includes actions, as well as supporting actions. Each supporting action includes an anticipated timing: Short-term (<2 Years), medium-term (2-5 years), long-term (5+ years), and ongoing.

Themes are (not in order of importance):

- **Smart Growth**
- **Resilient Natural and Built Infrastructure**
- **Thriving Natural Environment and Agriculture**
- **Disaster Resilience and Emergency Preparedness**

Figure 4 Vision for the City of St. John's (Source: Envision St. John's Municipal Plan)

Smart Growth

St. John's recognizes that growth presents many opportunities and challenges. St. John's City Council identified Sustainability ("a city that is sustainable today and for future generations; economically, environmentally and financially") and Climate Change as strategic priorities. Significant strides were achieved through the update of St. John's Municipal Plan (Figure 4 is the vision of our City), which states "the key is to manage growth in a sustainable manner while maintaining the character of St. John's Community".

Growth can result in pressure on the City to provide new and improved infrastructure and an expanded range of services, while presenting challenges to address existing infrastructure deficits. To achieve a low-carbon resilient future, the City needs to manage the ongoing growth and re-development today in a manner that realizes the opportunities of a low-carbon society and addresses the long-term impacts of climate change. Recent and near-term planning efforts are key in addressing infrastructure deficits and ensure ongoing infrastructure investments are already adapted to the changes expected within their useful life. Smart Growth tools for climate adaptation and resilience can help prepare communities for impacts from climate change through land use and development policies.

Smart Growth Actions	
I) Improve the resilience of new buildings, roads, and stormwater infrastructure to extreme weather.	
1) Ensure the timely building core review and adoption to support harmonization of codes (e.g., building and energy codes) at the provincial level and in line with federal's target to harmonize codes by 2025.	Ongoing
2) Continue to use best available climate model information to 'future-size' stormwater system (e.g., rain pipes, catch basins, outlets) and complete sewer separation while future-size storm sewers to current standards as part of renewal (where possible) to reduce risk of sanitary sewer overflows.	Ongoing
3) Explore the development of an integrated stormwater management plan (ISMPs) to inform future development and re-development in each watershed. ISMPs help balance the development needs with the City's sustainability values and the watershed's ecological functions. This may include: • Conducting a study to propose watershed-based water quantity and quality development targets that takes into account cumulative development (based on land-use planning), and aims to prevent water quality and ecosystem degradation. • Consider including mapping and prioritization of high-risk slopes susceptible to slides and evaluating tools/options (e.g., planting, percolation, anchors, retaining walls, deep-water infiltration, etc.) • Consider including opportunities for stormwater detention or storage during park redesign and in new parks (e.g., Blue-Green Infrastructure like resolving barriers that constrain streets draining to parks).	Medium
4) Continue collaborations with academia to research acute and chronic climate hazards and identify potential solutions. • For example, continuing the evaluation of materials to identify what works best for our climate, and incorporating climate projections for changing temperatures and freeze-thaw cycles.	Ongoing
II) Increase the resilience of the City by informing Municipal Plans with the latest Climate data and projections of future extreme weather events.	

1) Continue to integrate climate adaptation and resilience into the municipal plan, master plans, capital improvements, and hazard mitigation plans.	Ongoing
2) Work with provincial departments to ensure St. John's Municipal Act review includes considerations to enable climate action.	Short
3) Establish policy to revise climate change information (Environment Canada and Province of NL) every 5 years and review Adaptation Strategy.	Short
III) Protect and enhance coastal infrastructure from the impacts of sea-level rise and storm surge.	
1) Collaborate with all levels of government to initiate the development of a detailed Sea Level Rise Coastal Flood Risk Assessment (including outfalls) to estimate timelines and the economic, social, and environmental implications of best-practice adaptation solutions that address sea level rise (i.e., infrastructure, land use policy, and development fees).	Medium

Resilient Natural and Built Infrastructure

St. John's relies on a complex network of natural and built infrastructure to support its community including over 1,400 kilometers of streets, over 500 kilometers of sanitary sewer, while our drinking water and fire safety depends on three drinking water treatment plants, over 460 km of water pipes, 3,070 hydrants and over 8,955 valves and other drinking water related systems. In addition, The City of St. John's counts with 61 hectares of gateway park lands and 212 hectares of community park lands which provide recreation, environmental, climate regulating, and overall social and psychological wellbeing benefits to our community.

It is essential for our community's resilience that our built and natural infrastructure is adapted to climate change, so that it can withstand and recover from extreme events, as well as repeated impacts. Although much of existing infrastructure was established during the climate of the past, there are actions that can be taken to reduce the impacts that climate change may bring to our community.

Resilient Natural and Built Infrastructure Actions

IV) Increase household-level climate risks protection (e.g., flood and fire).	
1) Engage citizens on ways they can adapt their households or otherwise prepare for climate change impacts (e.g., promote sustainable drainage techniques, plant appropriate tree species, emergency preparedness)	Short
2) Use tax notices and website to provide information on minimizing severe risk like flooding and fire (e.g., ICLR handbook on reducing basement flooding).	Short
V) Improve the resilience of existing buildings, roads, and stormwater infrastructure to extreme weather and temperatures.	
1) Explore the feasibility of a collaborative education and incentive program to encourage more resilient choices for the renewal of development.	Medium
2) Consider future climate impacts when designing and retrofitting City buildings.	Ongoing
3) Undertake a Low Impact Development demonstration project (e.g., rain garden, rock pit) to test and communicate residential and commercial development of the opportunities to improve flood resilience of existing development and provide guidance on implementation approaches.	Medium
VI) Protect and enhance resilience of parks and open spaces, including habitats from the impacts of climate change.	
1) Continue to implement the City's Urban Forest Management Plan recommendations, while integrating a climate lens by:	Ongoing

• Planting of native species or hardy non-native species. • Reviewing species resilience to future climate change and reflecting findings in City-Land planting efforts, and the Landscaping Development Policy. • Relaying primarily on diversification as the best long-range approach to pest control (Collaborate with stakeholders to ongoingly identify and manage priority invasive species).	
2) Explore the collaborative development of an addendum for the City's Open Space Master Plan that details impacts from climate change research, corporate knowledge, opportunities, and best practices related to sustainable and functional horticulture in St. John's including soil management, prevention and management techniques for invasive species and pests.	Medium

Thriving Natural Environment and Agriculture

The City of St. John's has development control of four watersheds which supply its drinking water (including the Broad Cove River and Windsor Lake, Bay Bulls Big Pond and Petty Harbour Long Pond). The City also counts with more than 10,000 wetlands (bogs, fens, swamps, marshes and areas of open water within wetlands), ponds, and many kilometers of streams with their respective floodplains and buffer areas. Development pressures ongoingly place various levels of stress on St. John's natural environment. It is important that strategies continue to be explored and applied to protect natural assts (like existing watershed, wetland, and floodplain protection policies) under the understanding that these assets provide significant value to our community, known as "ecosystem services", which include:

- regulating our environment (temperature, wind, water, pollinators, and pests),
- providing goods (food, fuel, natural resources),
- supporting community services (water cycle, soil, nutrients, habitat), and
- cultural benefits (recreation, aesthetics, and overall well-being).

Climate Change also poses a threat to local and global food systems and agriculture. However, opportunities exist to create resilience to impacts on the global food chain, while reducing greenhouse gas emissions, and improving local food availability.

Thriving Natural Environment and Agriculture Actions

VII) Protect surface and ground water quality and quantity.	
1) Explore incentives for residents to purchase and utilize water conserving appliances/toilets and/or rainwater harvesting technologies on private properties.	Short
2) Incorporate Climate Change in water assessments and management plans.	Ongoing
3) Enhance and uphold watershed and wetland protection to limit human influence or impact on drinking water sources and habitat.	Ongoing
4) Engage residents in water efficiency education campaigns including its role in climate resilience in residential and commercial settings (e.g., share lessons from Metrobus' rainwater reuse system), including Continue Water Conservation Order enforcement.	Short
5) Explore improvements to salt handling, storage, and application and explore alternatives to optimize ice management by the City, businesses, and residents.	Ongoing

	• Hold a promotional campaign to begin at the start of every winter maintenance season and continue throughout the season that will help educate the public about salt application best management practices and the City's winter maintenance program. May include promotional materials in the local newspaper, informational pamphlets, ads through City run social media outlets, etc.	
VIII)	**Enhance the resilience of ecological assets from climate change.**	
1)	Collaborate on forensic studies to determine climate thresholds by partnering with stakeholders, associations, and local academic institutions to continue learning about impacts to human and ecological health.	Ongoing
2)	Identify eco-assets and incorporate these in the Municipal Asset Management Plan.	Medium
3)	Explore the development of a Privately-Owned Tree Management Strategy to encourage more tree planting and better tree maintenance	Long
IX)	**Improve local food security by supporting food and agriculture sector.**	
1)	Continue to support local food production, including community gardens, backyard farming, regenerative farming, greenhouses, farmers markets, and vertical farming.	Ongoing
2)	Collaborate to identify and showcase local agricultural best management practices and impacts to support timely adaptation.	Medium
3)	Continue to support protection of agricultural lands, natural features and water resources through planning and zoning policies.	Ongoing
X)	**Monitor and plan for the spread of invasive species and infectious disease.**	
1)	Develop a monitoring program for residents to report invasive species.	Medium
2)	Encourage health agencies and collaborate with research institutions to anticipate, monitor, and reduce the impact of climate change on the spread of infectious disease.	Long
3)	Continue the naturalization program through pilot projects, public education, and awareness to support to support a resilient aquatic and terrestrial ecosystem (e.g., pollinators, trees, etc).	Ongoing

Disaster Resilience and Emergency Preparedness

The City of St. John's is responsible for ensuring that mitigation measures, response and recovery plans are in place for all hazards including natural, technological, and human caused disasters. However, being a prepared and a resilient community is a shared responsibility. Climate change and its impacts can be lessened by reducing greenhouse gas emissions, but already existing greenhouse gas levels mean that we need to prepare for dangerous changes in climate. It is essential that projections for more intense and frequent extreme weather events, and lessons from past events are integrated into disaster, business continuity, and emergency management planning, while contingencies and flexibility is considered when dealing with these events. Actions can be taken to ongoingly improve our community's preparedness to climate-related disasters.

Disaster Resilience & Emergency Preparedness Actions

XI)	**Improve resilience and preparedness of key services and businesses to extreme weather events.**	
1)	Prioritizing several of the highest ranked risks (e.g., storm surge, power & telecom outages, urban flooding, ice storms) to the City, assess the risks and	Short

interconnections to critical infrastructure "lifelines for resilience". Consider the PIEVC framework and New Zealand lifeline study examples[2].	
2) Ensure climate change considerations are incorporated into the City's Hazard Identification and Risk Assessment framework, as well as business continuity planning's review process and training.	Medium
3) Work with stakeholders and associations to support building awareness so businesses can analyze their vulnerability to climate change and take action.	Long
4) Explore the implementation of a system to record and map climate related incidents specially during extreme events (e.g., flooding, wildfire, extreme snowfall).	Medium
XII) Improve resilience and emergency preparedness of residents to extreme weather events.	
1) Engage with stakeholders and experts to timely share locally relevant education materials like Fire Smart to reduce home's risks to wildfire. • Share materials on City website and seasonally through communication tools. • Integrate materials with the Residential Fire Prevention Awareness Program	Short-Medium
2) Engage Residents in emergency preparedness and response: • Explore establishing a buddy systems/help-you-neighbour programs to implement during extreme weather events • Incorporate climate change into existing emergency preparedness programs/outreach efforts targeted towards residents	Short-Medium
3) Explore options to establish registry of community groups that work with vulnerable populations to support coordination of resource distribution and best practices.	Short
4) Work with key partners to integrate climate change messaging into communication materials related to public health and safety including connecting to resources and programs to mitigate risks (e.g., rapid assessments for businesses, incentive programs, emergency preparedness guidance).	Ongoing

[2] https://pievc.ca/; https://www.civildefence.govt.nz/cdem-sector/lifeline-utilities/lifelines-reports-and-resources/

Implementation and Governance

The adaptation of St. John's will require leadership, collaboration, resources, and the creativity that characterizes our community. The City of St. John's will play a lead and coordinating role in the implementation of the plan, supporting community efforts to identify and secure financial support. The City will work to support sharing of ideas and project lessons learned and to advocate to all levels of government for enabling policy to realize the vision of a climate change resilient St. John's.

The City will explore the integration of climate change adaptation considerations in its decision making process to support St. John's City Council's decision making and leadership, along with a carbon budget that informs action and progress towards greenhouse gas mitigation efforts.

The implementation of this plan will take a collaborative, integrated approach. This plan recognizes that adaption is a shared responsibility and an ongoing process which requires integration, evaluation and continual improvement.

Implementation and Governance Actions	
1) Increase staff resources for plan implementation	Short
2) Establish a formalized, multi-stakeholder climate change adaptation working group supporting the Environmental and Sustainability Experts Panel to guide implementation of the Resilient St. John's Climate Plan.	Short
3) Engage regionally with other municipalities, indigenous peoples, and vulnerable populations representatives on the implementation of the Resilient St. John's Climate Plan.	Ongoing
4) Collaboratively seek funding, investment, and partnership opportunities to enhance the speed and quality of adaptation initiatives.	Ongoing
5) Advocate to all levels of government for enabling climate policy and legislation, as well as financial support for municipal action.	Ongoing
6) Integrate climate change into capital and business planning and asset management.	Long
7) Monitor and track implementation of the Community Climate Change Adaptation Plan and report on progress annually through CDP tool.	Ongoing
8) Update Resilient St. John's Climate Plan's Adaptation actions every 10 years, with a mid-point review every 5 years.	Medium

Appendix A: Climate Change Community Strategic Risk Assessment

Setting the Context

- **Goal:** To conduct a Strategic Level Community Climate Change Risk Assessment for St. John's
- **Scale:** Municipal Boundary of St. John's
- **Timeframe in Mind:** 2050's, with 2080's in mind
- **Emission Scenario**: RCP8.5
- **Objectives of Adaptation Action. To Minimize**…

Natural Resources	Loss of Natural Resources
Economic Vitality	Loss of Economic Productivity
	Loss of Infrastructure services
Health	Loss of Life
	Morbidity, Injury, Disease, or Hospitalization
Social Functioning	Psychological Impacts
	Loss of Social Cohesion
Cultural Resources	Loss of Cultural Resources
Governance	Cost to Municipal Government

Figure 5 Visualization of the path from climate trends to actions

St. Johns' Climate Trends: Adaptation planning began by the review of historical and future climate for the City of St. John's. This included literature review and compilation of the main sources of climate information for the City (e.g., Environment Canada, Provincial Government of Newfoundland and Labrador, and other met-ocean reports locally available). The purpose was to characterize current and future climatic hazards. The St. John's Climate Profile Report and subsequent stakeholder engagements served as the foundation for the plan.

Impact Identification: Impacts to the City of St. John's were identified through a series of stakeholder workshops and public engagements. Each impact was formulated in a IF-SO format.

IF – if a particular projected change in climate take place.

SO – then the following impact is expected to take place in our community.

The impacts identified through The City of St. John's RVA were then ranked based on their likelihood of occurrence and severity of the consequences that would result from the impact.

Likelihood identification

Likelihoods for each of the impacts becoming a reality was estimated in collaboration with the City's Environmental and Sustainability Experts Panel. The likelihoods were assigned using a scale from 1-5.

Rating		Description	Numerical Description
5	**Almost Certain**	The Impact will occur	90-100% probability
4	**Likely**	The impact will probably occur	55-90% probability
3	**Possible**	The impact could occur	30-55% probability
2	**Unlikely**	The risk may occur	5-30% probability
1	**Rare**	The risk will occur only in exceptional circumstances	Less than 5% probability

Consequence Ranking:

Consequences across eight categories were assessed. Standard definitions for each severity of the consequence were developed and agreed upon through review with the City's Environmental & Sustainability Experts Panel, as well as the stakeholders Sustainability Team.

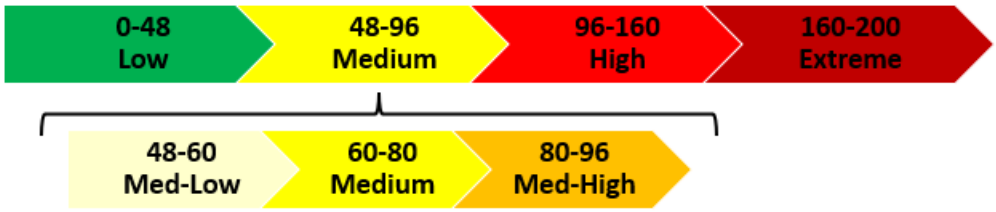
Rating	Health	Psychological	Social Cohesion	Cultural Resources	Natural Resources	Local Economy & Growth	Infrastructure Damage	Public Administration
5 Catastrophic	1,000 people affected, and/or **loss of life of 10+ people**	**Widespread** and severe disturbance resulting in **long-term** psychological impacts (e.g., post-traumatic stress disorder)	**Months-long** disruption to daily life. Widespread, permanent loss of livelihoods or way of life. Severe, widespread erosion in public confidence in government in the medium term. Erosion of community institutions and community cohesion	Resource can **never recover**; destruction is permanent and irreversible (e.g., destruction of an irreplaceable artifact or knowledge)	Resource can **never recover**; destruction is permanent and irreversible (e.g., extinction of a species, permanent loss of water resource)	Potential direct and indirect economic losses of **over $20 million**; **Months**-long disruption **or long-term** loss of an economic sector and associated job losses	**Months-long** disruption in infrastructure services Major impediment to day-to-day life	Public Administration would **struggle to remain effective** in the short term and take a **couple of years** to re-build.
4 Major	100-1000 people affected and/or **loss of life of 1-10 people**	**Localized** severe disturbance resulting in **long-term** psychological impacts (e.g., loss of home, identity, or sense of place)	**Weeks-long** disruption to daily life. Localized, permanent loss of livelihoods or way of life Moderate, medium-term erosion of public trust in government or community cohesion	Recovery of the resource will take **decades**	Recovery of the resource will take several **decades**	Potential direct and indirect economic losses of **up to $20 million**; **Weeks**-long disruption to a major economic sector and associated job losses	**Weeks-long** disruption in infrastructure services Major impediment to day-to-day life	Public Administration would be under **severe pressure** on several fronts for **several months** (cost directly to municipality of up to $10M)
3 Moderate	10-100 people affected and/or high **potential for loss of life**	**Widespread moderate** disturbance resulting in temporary psychological impacts (e.g., feeling of fear and anxiety)	**Days-long** disruption to daily life. Short term loss of livelihoods or way of life. Minor interruption of public trust in government or community cohesion	Recovery of the resource will take **years**	Recovery of the resource will take several **years**	Potential direct and indirect economic losses of **up to $10 million**; **Days**-long disruption to a major economic sector and employment	**Days-long** disruption in infrastructure services Major impediment to day-to-day life	Public Administration would be **under pressure** on several fronts for **several weeks** (cost directly to municipality of $5 - $10M)
2 Minor	Less than 10 people affected and/or **low potential for even a single loss of life**	**Localized moderate** disturbance resulting in temporary psychological impacts (e.g., feeling of fear and anxiety)	**Hours-long** disruption to daily life. Low potential for erosion of public trust in government or community cohesion	Recovery of the resource will take **months**	Recovery of the resource will take **months**	Potential direct and indirect economic losses of **up to $5 million**; **Hours**-long disruption to a major economic sector and employment	**Hours-long** disruption in infrastructure services	**Minor instances** of Public Administration being **under more than usual stress** (cost directly to municipality of up to $5M)
1 Insignificant	**No possibility of loss of life**, injury, disease or hospitalization	**Minimal** expected reactions of fear, anxiety, or disruption to daily life	**Minimal** disruption to daily life (e.g., inability to access employment and/or education, forced displacement). Trust in government or community cohesion remains unchanged	Little impact or resource can recover within **days**	Little impact or resource (e.g., air, soil, vegetation, water, ecosystem function) can recover within **days**	Potential direct and indirect economic losses **less than $1 million**	Temporary **nuisance**	**No real stress** on Public Administration

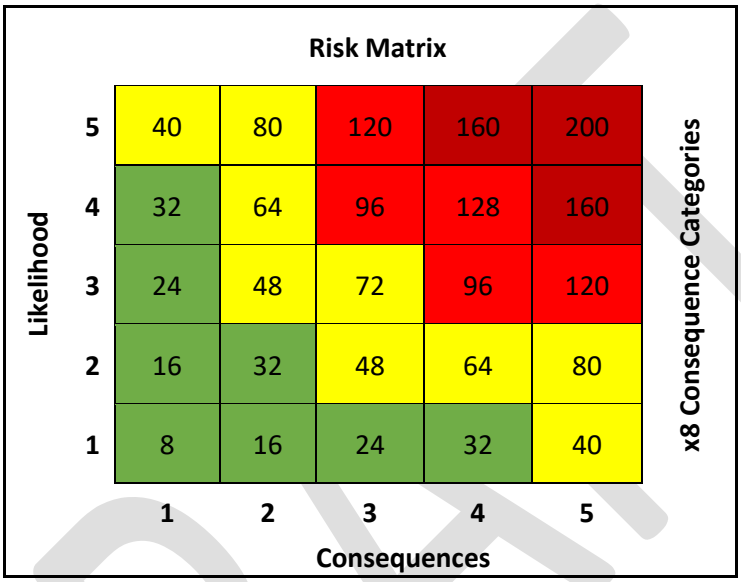
Risk Ranking: Overall risk was estimated across all eight categories of consequences to enable prioritization of the identified impacts. Severity across consequence categories, particularly the highest consequence category was also considered as part of the development of proposed actions.

Risk is defined in the following way: *Risk = Sum Consequences x Likelihood*

Most impacts were found to be Medium risks, therefore, an additional level of differentiation for the purpose of action planning was temporarily implemented (Med-Low, Medium, Med-High). The Best

practice review aimed to find actions that directly address High and Medium High risks, while keeping Medium and Med-Low risks in context. This sub-categorization does not have an impact on the overall risk categories, but instead was used as a lens to support action planning.





Action Identification: Actions were developed to address all high risk and considerations given to all medium risks for St. John's. They were based on best practices from other municipalities and refined through public and stakeholder feedback.

Action Design Charrette: Stakeholders were engaged to discuss risks, best practices, and implementation considerations to develop the draft action plan.

Public Consultation: The draft action plan was shared with the public for consultation and to elucidate any additional implementation considerations.

Appendix B: Climate Change Community Strategic Risk Assessment Results

Table 1 Complete Impact List, Likelihood and Consequences Ranking

#	Impact	Cultural Resources	Health	Infrastructure Damage	Local Economy & Growth	Natural Resources	Psychological	Public Administration	Social Cohesion	Sum Consequence	Max Consequence	Likelihood	Risk Score (Sum of Consequences)	Risk Ranking
1	Sea level rise, storm surge & coastal erosion	2.4	2.7	3.9	3.3	3.1	2.7	2.4	2.4	22.9	3.9	5	114.7	High
2	More telecommunication & power disruptions	2.4	2.4	1.7	3.6	4.1	2.4	2.1	2.0	20.9	4.1	5	104.5	High
3	More urban flooding	1.7	2.1	3.9	2.5	2.1	2.1	2.9	2.1	19.5	3.9	5	97.7	High
4	Temperature impacts to marine food chain	1.4	2.9	1.6	2.0	3.0	2.6	2.7	1.9	18.0	3.0	5	90.2	Medium
5	More frequent precipitation damage (e.g., mold, leaks)	2.4	1.6	3.4	2.4	3.3	1.6	2.0	1.4	18.0	3.4	5	90.0	Medium
6	More water crossings failure & flooding	1.3	2.7	1.7	3.0	1.4	2.7	2.0	2.3	17.1	3.0	5	85.7	Medium
7	Impacts to migratory birds	1.5	2.0	3.4	2.0	1.7	1.9	2.6	1.8	16.9	3.4	5	84.4	Medium
8	More ice and wet snow on roads and sidewalks	3.0	2.1	1.5	3.9	3.9	2.5	2.0	2.1	21.0	3.9	4	83.9	Medium
9	Increased pest management demand	2.0	2.0	2.6	1.7	1.4	2.0	2.3	2.7	16.7	2.7	5	83.7	Medium
10	Longer gardening season and demand for spaces	3.8	1.8	2.3	2.8	4.0	2.3	2.0	2.0	20.8	4.0	4	83.0	Medium
11	Plant ecological composition impacts	1.3	2.3	3.0	2.2	1.0	2.1	2.4	2.2	16.5	3.0	5	82.4	Medium
12	More demand for cooled venues for youth	1.9	1.7	3.4	2.8	1.1	1.7	2.1	1.6	16.3	3.4	5	81.4	Medium
13	Less opportunity for winter outdoor activities	3.3	2.0	3.0	2.0	3.5	2.5	2.0	2.0	20.3	3.5	4	81.0	Medium
14	More power outages	2.0	3.0	3.0	3.0	1.5	2.5	3.0	2.0	20.0	3.0	4	80.0	Medium
15	More sport fields damages	1.4	2.5	3.4	2.3	3.0	2.4	2.3	1.9	19.1	3.4	4	76.5	Medium
16	I&I increase	1.3	2.4	1.3	1.8	1.3	2.5	1.9	2.4	14.9	2.5	5	74.6	Medium

17	Longer forest fire season	2.5	2.4	2.6	2.1	3.3	1.7	1.9	2.0	18.5	3.3	4	73.9	Medium
18	More flight disruptions	2.1	2.0	3.3	2.3	2.6	2.0	2.4	1.7	18.4	3.3	4	73.8	Medium
19	More hurricane/tropical storms	1.7	3.6	1.3	2.3	2.1	2.9	1.9	2.3	18.0	3.6	4	72.1	Medium
20	Increased incidence of weather-health conditions	4.3	2.3	2.0	3.8	4.3	2.8	1.5	3.3	24.0	4.3	3	72.0	Medium
21	More wet snow affecting planted landscapes	3.0	2.8	3.8	3.5	4.3	3.0	2.0	1.8	24.0	4.3	3	72.0	Medium
22	Marine ecosystem and fisheries impacts	1.3	2.1	1.9	2.0	2.6	1.6	1.7	1.1	14.3	2.6	5	71.5	Medium
23	More precipitation related vehicular accidents	1.3	2.4	2.9	3.0	1.6	2.4	2.5	1.7	17.8	3.0	4	71.2	Medium
24	More uprooting of large trees from wind gusts	3.8	2.3	2.0	3.3	4.0	3.0	2.0	3.0	23.3	4.0	3	69.8	Medium
25	More vulnerable riverine species	1.6	2.0	3.0	2.0	2.8	1.9	2.3	1.8	17.2	3.0	4	68.9	Medium
26	Changes to spring-thaw pattern	1.4	2.7	1.4	1.8	1.6	3.0	2.0	3.1	17.1	3.1	4	68.3	Medium
27	Increased river undermining & landslides	1.3	2.0	3.3	2.3	1.9	1.7	2.1	1.4	16.0	3.3	4	64.2	Medium
28	More winter Freeze-thaw impacts	2.3	1.9	1.4	3.0	2.6	2.0	1.3	1.6	16.0	3.0	4	64.1	Medium
29	Increased violence due to heat	2.1	2.6	3.4	2.7	3.8	2.4	2.4	2.0	21.4	3.8	3	64.1	Medium
30	More vector borne diseases incidence	2.3	2.5	1.0	2.0	1.1	2.9	1.1	2.8	15.7	2.9	4	62.6	Medium
31	Increased need for active tree canopy management	1.3	2.1	1.9	1.9	1.3	2.7	2.3	2.1	15.6	2.7	4	62.2	Medium
32	More rain-on-snow flooding	1.4	2.4	2.9	2.4	1.6	1.7	1.7	1.3	15.4	2.9	4	61.8	Medium
33	Thinning pond ice	1.0	1.6	1.7	1.4	2.0	1.2	2.0	1.2	12.1	2.0	5	60.5	Medium
34	Need for public transportation shelters	1.4	1.9	1.4	3.3	1.0	2.1	1.6	2.3	15.0	3.3	4	59.9	Medium
35	More wind related infr. damage	2.2	2.3	3.2	3.2	3.6	2.0	1.7	1.8	19.9	3.6	3	59.6	Medium
36	Marine transportation disruptions	1.1	2.3	2.9	1.7	1.4	1.6	2.3	1.1	14.5	2.9	4	57.9	Medium
37	Pond water quality decrease	1.3	1.7	2.6	1.7	1.4	1.9	2.1	1.3	14.0	2.6	4	56.1	Medium
38	Less viable fishing days (wind)	2.3	2.3	3.0	2.0	3.3	2.0	1.8	1.5	18.0	3.3	3	54.0	Medium
39	More water demand (drinking & irrigation)	1.1	1.6	2.6	1.8	1.3	1.7	2.0	1.3	13.5	2.6	4	53.8	Medium
40	Aggravated respiratory health issues	2.0	2.3	1.8	2.8	3.5	2.0	1.8	1.5	17.5	3.5	3	52.5	Medium
41	Reduced salmon survival rates	1.9	2.3	1.0	1.1	1.4	2.0	1.3	2.0	13.0	2.3	4	52.0	Medium
42	Increased demand for homelessness services	1.4	3.0	1.0	1.9	1.1	3.0	1.7	2.9	16.0	3.0	3	48.0	Medium
43	More wind blowing solid waste	1.3	2.4	2.0	1.6	1.0	3.0	1.7	2.9	15.8	3.0	3	47.5	Low
44	More ice build-up (roof & power lines)	1.0	1.3	2.6	1.6	1.3	1.3	1.8	1.0	11.8	2.6	4	47.2	Low
45	More forest blow-downs	1.5	2.0	2.5	1.8	2.0	2.0	2.3	1.5	15.5	2.5	3	46.5	Low
46	Leaky buildings increasing energy demand on windy days	1.3	2.1	1.7	3.1	2.7	1.9	1.3	1.3	15.4	3.1	3	46.2	Low

47	More hail damage	1.3	3.0	1.0	1.5	1.0	3.0	1.7	2.9	15.4	3.0	3	46.1	Low
48	Higher risk of avalanches	1.8	2.2	2.3	1.7	1.7	1.7	1.5	1.5	14.3	2.3	3	43.0	Low
49	More river erosion and sedimentation	1.0	1.5	1.0	1.5	1.6	1.3	1.4	1.3	10.7	1.6	4	42.8	Low
50	Increased heat stress incidence	1.1	3.4	1.1	1.3	1.1	3.0	1.4	1.6	14.1	3.4	3	42.3	Low
51	Increased soil erosion	1.3	2.0	1.5	1.6	1.0	2.2	2.6	1.7	13.9	2.6	3	41.7	Low
52	Impacts to fish migration & fishing season	1.3	1.7	1.9	2.0	2.2	1.2	2.0	1.2	13.4	2.2	3	40.2	Low
53	Reduced crop yields (flooding)	1.3	2.3	1.6	1.4	1.0	1.9	1.7	1.9	13.0	2.3	3	39.0	Low
54	Increased risk during construction activities	1.2	1.9	2.8	2.6	1.6	2.1	2.1	2.1	16.3	2.8	2	32.7	Low
55	More incidence of injury due to snow (back & heart)	1.1	2.4	1.1	1.1	1.0	1.4	1.1	1.3	10.7	2.4	3	32.0	Low