Weathering What's Ahead:

Climate Change Risk and Nova Scotia's Well-being

NOVA SCOTIA

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Appendices, including references, can be found at climatechange.novascotia.ca

Executive Summary

Overview

We are at a global crossroads with climate change. Human activities over the past 150 years have caused climate change. The world is now feeling the effects of greenhouse gases emitted in the past. We will continue to live with these effects well into the next century. We have a short time to make the changes needed to avoid some of the worst effects. We also need to act now to respond and prepare for our well-being.

With reliable scientific information, Nova Scotians can develop strategies to do two things:

- Address the effects of climate change.
- Protect the resources that contribute to our well-being.

A climate change risk assessment helps us to understand how the climate is changing. It also helps us to understand issues of concern and opportunities to act.

To update our understanding of Nova Scotia's risks from climate change, the Department of Environment and Climate Change worked with a consulting firm, ESSA Technologies Ltd., technical and community advisors, and experts from other provincial government departments.

Climate Change Risk Assessment

This report explains the risk assessment process. It explores what is at risk and the different effects of climate change on the well-being of Nova Scotians.

This report does not offer solutions. It is meant as a resource that will help different levels of government to set priorities, plan, and act. Businesses can use it to plan with climate change in mind. And all Nova Scotians can use it to work with each other, governments, and businesses.

Background Research

We began by looking at existing studies and data that show how the climate is changing in Nova Scotia. We looked at how climate change affects the well-being of Nova Scotians, particularly those who are already disadvantaged in our society.

New Research and Key Findings

We developed an index for well-being at risk in Nova Scotia.

The results of this analysis help to paint a picture of top concerns:

- Across the province.
- Between regions.
- For vulnerable groups.

Insights, Priorities and Next Steps

The results show us:

- Where we can act on opportunities.
- Where there are gaps in the research.

These will guide future research and next steps.

This assessment used a framework of climate risk developed by the Intergovernmental Panel on Climate Change to explore these questions:

- How is Nova Scotia's climate changing?
- What are the potential harmful effects?
- How will this affect the well-being of Nova Scotians?
- How will climate change affect different groups and areas of the province?
- What are the priorities to reduce risks and take advantage of opportunities?

What Was Learned

Our Climate Will Continue to Change

Climate scientists use models to explore different possible climate futures. They base these models on amounts of greenhouse gas emissions. With continued high global emissions, Nova Scotia can expect these climate changes:

- Temperatures will continue to rise.
- We will have less snow and more rain.
- The rain will be more intense.
- Storms will be more frequent and intense.
- The sea level will continue to rise.
- Ocean temperatures, oxygen, and acidity levels will change.

Different Top Hazards Will Emerge Over Time

Climate hazards of top concern change over time. We need to plan and prioritize based on these changes. Under a high emissions scenario, these are the top concerns:

2030s: Flooding poses the top concern.

2050s: Warmer temperatures make wildfires the biggest threat.

2080s: Extreme temperatures and their potential to harm food production, infrastructure, human health, and ecosystems.

Adaptation Needs Differ Between Regions

The climate change risk assessment analyzed how climate change will affect Nova Scotia's 18 census divisions differently. All areas will need to address the effects of climate change. But the following areas have the highest need to adapt to reduce risks and take advantage of opportunities: Annapolis, Cape Breton, Colchester, Cumberland, Digby, Halifax, and Pictou.

Not All Nova Scotians Will Be Impacted Equally

The impacts of climate change are not the same for everyone. People already facing disadvantages will be at greater risk. This includes racialized and marginalized groups: African Nova Scotians, Mi'kmaq, immigrants, women, older Nova Scotians, individuals living on low incomes, and individuals living with disabilities.

This research showed that improving health, education, housing, income, and social supports can help reduce vulnerability to climate change. We need to do more research into this complex issue.

Priorities

Climate Opportunities Come with Trade-Offs

Climate change creates some opportunities to improve well-being. However, these opportunities also come with challenges. Here are some examples of opportunities and challenges for warming temperatures.

Opportunities	Challenges
Longer growing season, increased food supply	Risk of drought and agricultural pests and disease
Less energy needed to heat buildings	More energy needed to cool buildings
Longer summer and warm-weather tourism and recreation season	Less snow, shorter winter tourism and recreation season

Continued Attention

We need to focus on areas that are already affecting us and will only increase:

- Inland flooding, sea level rise, and coastal flooding.
- Higher temperatures that can affect our ability to produce food.

Explore Further

This assessment identified specific areas that are worth exploring further. All are at risk from multiple climate threats and very important to Nova Scotians.

- Housing is essential to well-being and our ability to withstand climate threats like flooding, storms, and heat extremes. If housing is vulnerable, we are vulnerable.
- Healthcare could see more physical and mental health challenges. Extreme events could lead to more heat-related illnesses and poorer mental health. Poorer air quality could lead to more respiratory illnesses.
- Forest and wetland ecosystems and the species that live in them face a range of hazards and other environmental pressures. This can affect their ability to provide clean air and water, recreation, and support livelihoods.

Looking Forward

While Nova Scotia is a small part of the global climate crisis, we all need to do our part.

Nova Scotians have demonstrated strength, resilience, and innovation. We can continue to build on accomplishments to date, such as through the *Environmental Goals and Climate Change Reduction Act*.

This research shows that we must do three things:

- Continue to address the causes of climate change.
- Adapt to what is already happening.
- Plan for the changes to come.

Climate change is going to continue to change Nova Scotia, but the future is ours to shape.

For more information, please refer to the technical Synthesis Report of the climate change risk assessment research is available at climatechange.novascotia.ca.

Introduction

We are at a global crossroads with climate change. Human activities over the past 150 years have released greenhouse gases into the atmosphere[1]. Greenhouse gases, such as carbon dioxide and methane, throw off the Earth's natural balance by trapping heat within the atmosphere, warming the planet, and changing our climate. According to climate change experts from around the world[2], we have a rapidly closing window to make the significant changes needed to avoid some of the worst effects.

The Province of Nova Scotia has made a commitment to reduce greenhouse gas emissions—a vital part of the global effort to slow climate change. However, even if we turned off the greenhouse gas emissions tap today, our future climate will be very different from the past. Greenhouse gases stay in the atmosphere for decades to hundreds of years, which means we're feeling the effects of the gases already emitted. And we'll continue to live with the effects well into the next century[1].

Examples of human activities that release greenhouse gases and contribute to climate change:

- Using oil, coal, and natural gas to heat homes, generate electricity, and fuel vehicles.
- Manufacturing and other industrial activities.
- Changing landscapes and land use, such as farming and land development.

While climate change is among the most challenging issues facing us today, the good news for Nova Scotia, and the world, is that reliable scientific information exists to help us understand how the climate could change. This information will help us to develop sound strategies and actions to address its effects.

Understanding Climate Risk in Nova Scotia

—Climate Change Risk Assessment

Nova Scotians are adaptable people. But the pace and scale of climate change brings unique challenges. We need solid evidence to help us to respond and proactively adapt. A provincial climate change risk assessment helps us to understand how the climate is changing, the threats and opportunities to our collective well-being, and priorities for action.

The Province of Nova Scotia completed a provincial climate change risk assessment in 2005[3], followed by a series of smaller assessments, that resulted in government department action. Risk assessments are an ongoing process because we're always learning, science is advancing, and our society and climate continue to change. That's why it was time to update the high-level provincial picture with a new climate change risk assessment.

This report does not spell out solutions. It provides an evidence-based platform for ongoing teamwork and action. It's a resource to engage all Nova Scotians, governments, businesses, and communities in conversations and action to address climate change.

The Province of Nova Scotia has worked alongside municipal and federal partners, sectors, and communities to respond and prepare for the realities of the changing climate. Examples include:

- Currently upgrading 60 km of vulnerable dykes to protect tens of thousands of residents, businesses, historical and world heritage sites, Mi'kmaw communities, and more than 20,000 hectares of farmland.
- Currently helping municipalities to reduce flood risks through a new Municipal Flood Line Mapping Project—a common and significant problem for municipalities identified through provincially-supported Integrated Community Sustainability Municipal Climate Change Action Plans.
- Studied options to protect vital transportation corridors in the Chignecto Isthmus that are vulnerable to coastal flooding.
- Investments that help farmers evaluate new practices that could help them adapt to climate change.
- Developed a Heat Alert Response System that communities can use to help reduce heat-related illnesses and death during extreme heat events.
- Created the 2019 *Coastal Protection Act*, which will help avoid building in areas prone to flooding or too close to the coast.

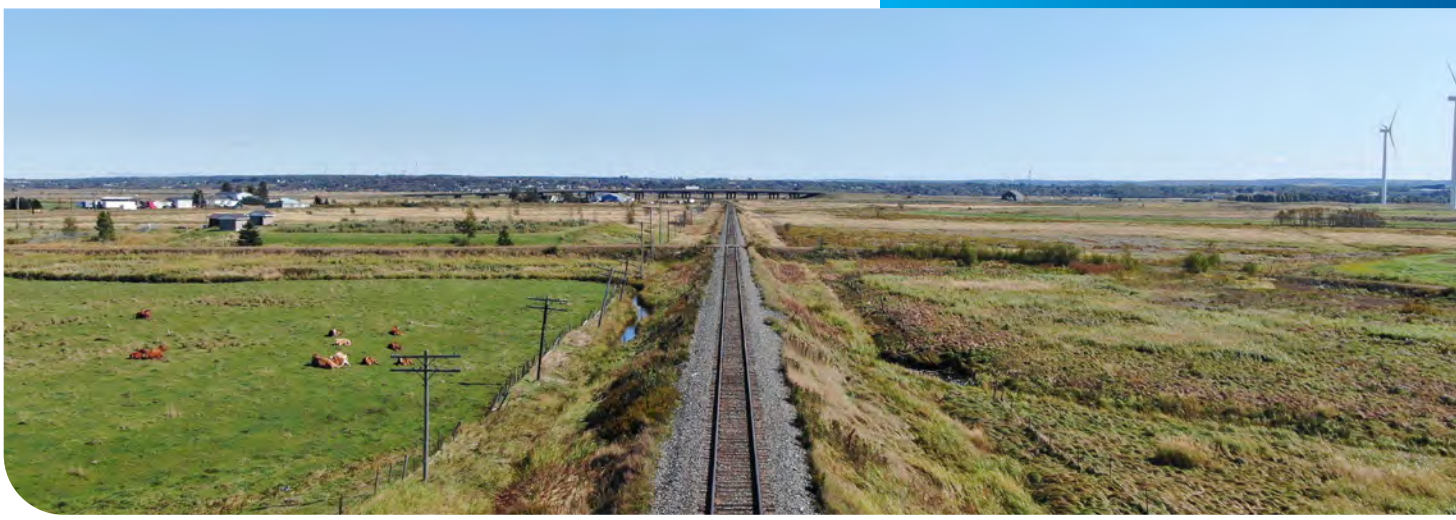
Two Ways to Respond to Climate Change

Address the source of the problem by reducing the amount of greenhouse gases released into the atmosphere that cause climate change (mitigation).

- Insulate homes to improve comfort and use less energy.
- Switch to solar or wind power to create electricity instead of burning coal.
- Explore active transportation to get around, where possible.

Act to reduce risks and take advantage of opportunities from the effects of climate changes that are already happening and prepare for future changes (adaptation).

- Plant trees.
- Support communities to minimize damage from extreme weather events and help them recover.
- Change farm practices to take advantage of new crop opportunities suited to warmer temperatures.



Approach

Nova Scotia's Department of Environment and Climate Change worked with the consulting firm ESSA Technologies Ltd., as well as technical and community advisors and subject matter experts in provincial departments, to develop the approach to assess climate risks in relation to the well-being of Nova Scotia. Work took place between 2020 and 2022.

We may not think about our climate often, but weather is something Nova Scotians talk about a lot. Weather refers to conditions over short periods of time. It is what you see when you look out the window or decide which coat to wear. Climate reflects long-term weather patterns and trends that tell us what a typical winter or summer are like as opposed to whether it will rain today. Nova Scotia's ecosystems and species have evolved under past climatic conditions. Those past conditions are also what we've used to plan and design buildings, communities, and infrastructure.

See *Weathering What's Ahead: Appendices* for more details. A technical Synthesis Report of the climate change risk assessment research is available at climatechange.novascotia.ca.

What is Climate Risk?

We are all familiar with the concept of risk. We consider risk in many everyday decisions, like buying insurance or whether to travel in bad weather. But thinking about risks from climate change is a bit different. Climate risk is the potential for things that we value to be lost or harmed through the effects of climate change.

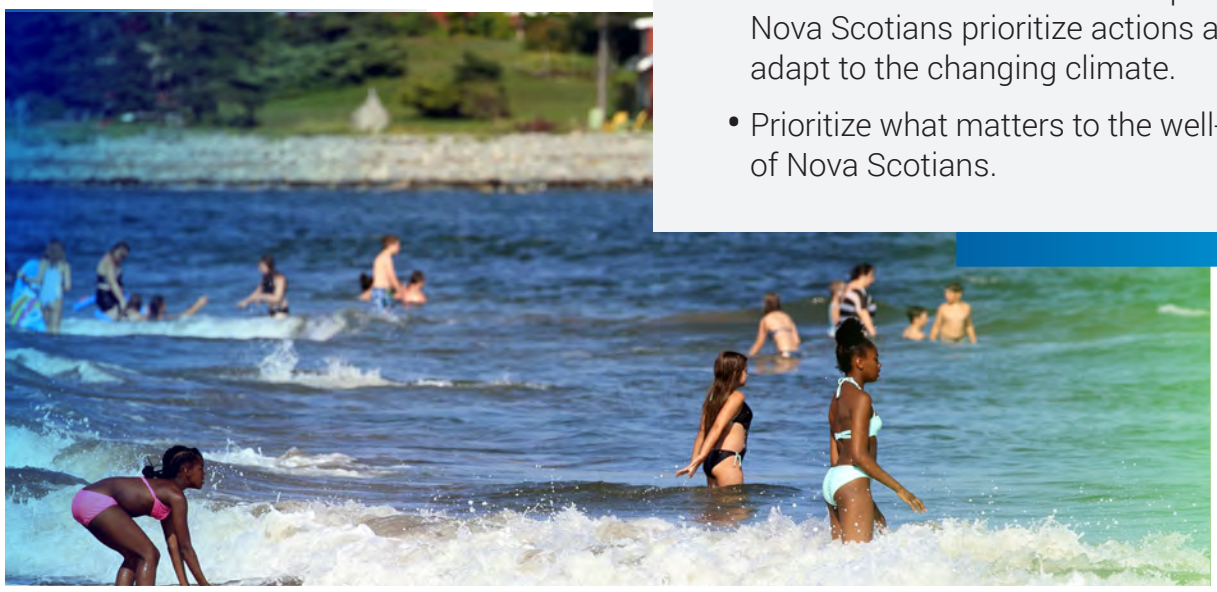
This climate change risk assessment uses the risk framework developed by the Intergovernmental Panel on Climate Change (IPCC)[4,5] to assess climate risks in relation to the well-being of Nova Scotians.

Understanding climate risk involves exploring how the climate will likely change in Nova Scotia and the potential for harmful impacts on our society, environment, and economy. What is exposed to the climate impact? How sensitive is it? And what is our ability to cope or adapt to the change?

Answering these questions can help us to understand what is at risk and why in order to prioritize action and reduce risks.

Aims of the Climate Change Risk Assessment:

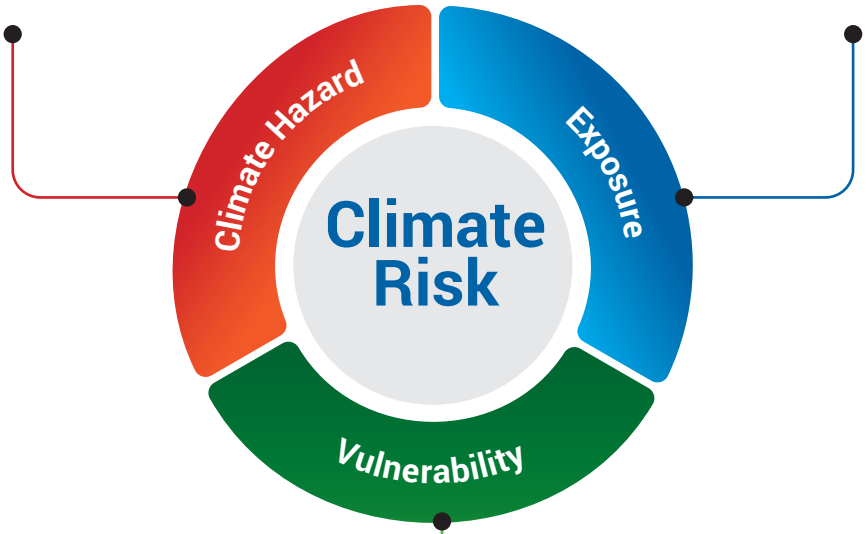
- Use the best available evidence and scientifically sound methods.
- Build an approach that can be used to track changes in risk over time and that can be improved.
- Consider equity to avoid decisions that could reinforce disadvantages.
- Offer useful information to help Nova Scotians prioritize actions and adapt to the changing climate.
- Prioritize what matters to the well-being of Nova Scotians.



Climate risk is the interaction between:
Likelihood of climate hazard ♦ Exposure to the hazard ♦ Vulnerability

Climate Hazard is the likelihood of a climate-related event or trend based on projected changes to the climate that can cause harmful impacts. Some changes may offer benefits and are called **climate opportunities**.

Exposure is the presence of anything in places that could be affected by a climate hazard or opportunity, such as people, homes and other buildings, roads, sites of cultural importance, beaches, and freshwater resources.



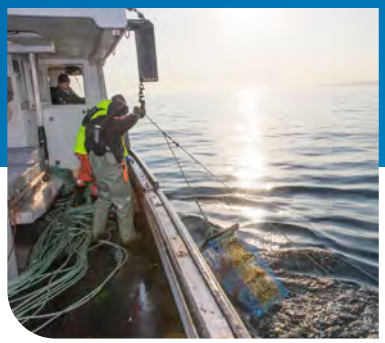
Coping capacity refers to the ability to manage changing climate conditions over the short to medium term using available resources, such as skills, information, or money. For example, someone without home air conditioning could cope with a heat wave by going to a nearby community centre to cool off.

Sensitivity refers to the degree to which something is affected by a climatic change. For example, someone with an underlying health condition will be more affected by high temperatures and heat waves than someone with no health concerns, so they are considered to be more sensitive.

Vulnerability is the combination of sensitivity and capacity to cope and adapt.

Coping capacity reflects the immediate options available to help people and communities manage a climate hazard. Adaptive capacity involves acting now to improve the future ability to cope and reduce risks.

For example, in 2019, Hurricane Dorian swept through Nova Scotia leaving damage to homes and buildings and many people across the province without electricity. People coped by relying on neighbours, friends, and family. Organizations adapted by putting plans in place to prepare for future events to reduce risks for vulnerable people and infrastructure. This assessment is focused on current coping capacity based on the availability of data. Future research will look at long-term adaptive capacity and its role in risk management.



What is Well-being?

Well-being is about a good quality of life for everyone, including future generations. This climate change risk assessment explores how climate change might affect the ability to make improvements to the individual and collective well-being of Nova Scotians, such as progress on social, environmental, and economic goals.

The term well-being is most often associated with health, but this assessment draws on a broader notion. Research indicates that the foundation for current and future quality of life and well-being rests on five interconnected building blocks, relating to the natural environment, human and social dimensions, financial elements, and manufactured resources, like critical infrastructure.

See *Weathering What's Ahead: Appendices* for definitions and more on well-being.

Understanding Future Climate

Scientists have created sophisticated mathematical models of the Earth's climate system, including how the atmosphere, oceans, and ecosystems interact. These powerful models are used to explore how the climate could change under different conditions, such as the amount of greenhouse gases in the atmosphere.

Climate models explore different possible futures using climate scenarios called Representative Concentration Pathways or RCPs. This assessment studied the risks for a high emissions scenario (RCP8.5) and a lower emissions scenario (RCP4.5).

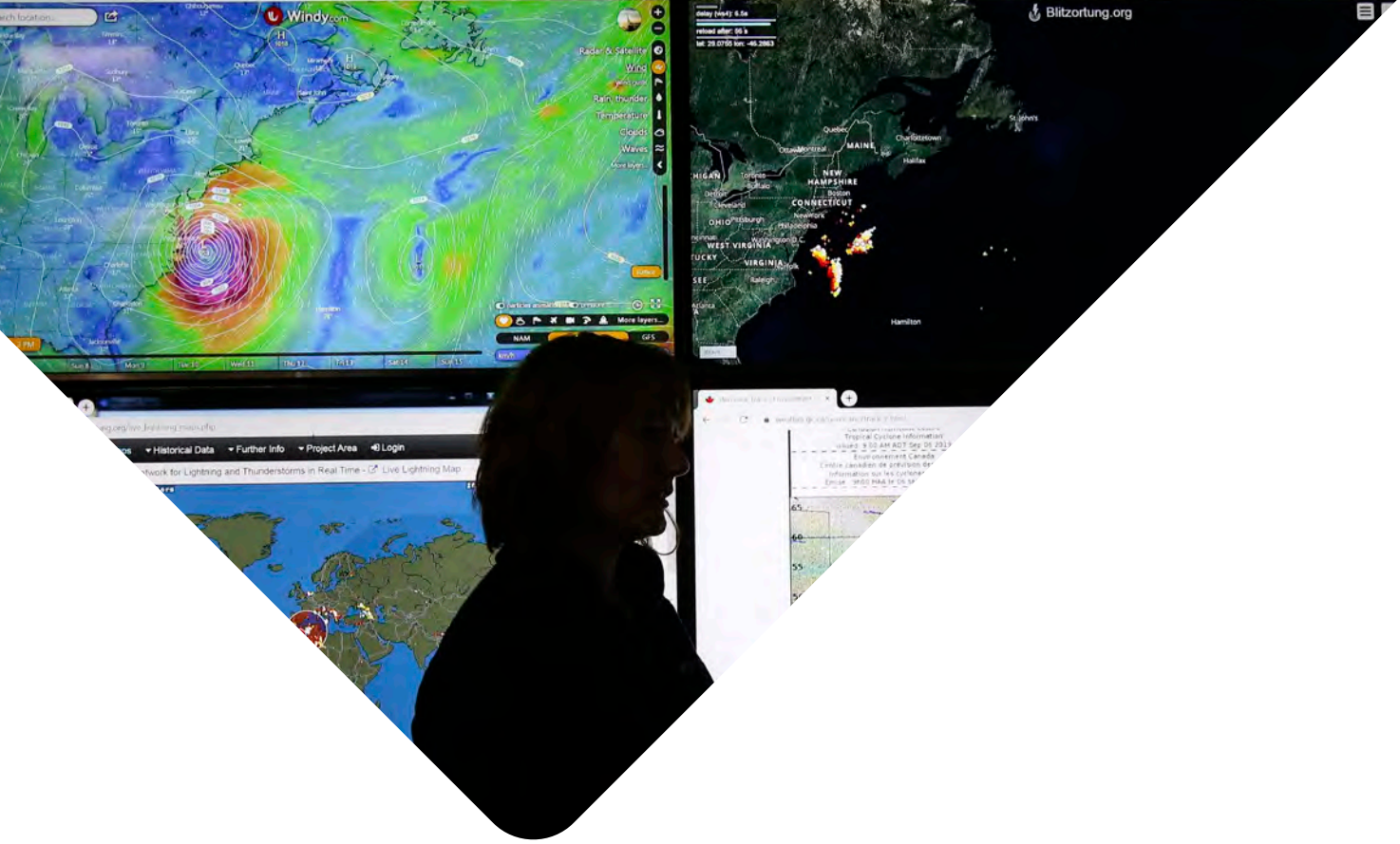
Scientists look at climate over several decades because it gives enough long-term information to confidently understand historical patterns and model future ones.

This assessment compared the average historical patterns of 1981-2010 (baseline) with the averages for three future 30-year time periods:

2030s or near-term (2015-2045).

2050s or mid-century (2035-2065).

2080s or end-century (2065-2095).



This report presents findings from the high emissions scenario (RCP8.5) for two reasons:

- Recent and current emissions have already set us on the path of climate change. Until mid-century, the differences between higher and lower scenarios are not significantly different, and the higher emissions pathway most closely aligns with the path the world has been on to date.
- Using a higher emissions scenario shows more significant risks through the end of the century that are important for long-term planning.

There are other pathways. Nova Scotians already contribute to global efforts to change our climate future and work towards setting us on a lower emissions pathway.

Weathering What's Ahead: Appendices includes a high-level comparison of the differences in hazards and risks we'd face under a lower emissions scenario (RCP4.5) and information on climate projections used in this report.

Background Research

This assessment began by setting the foundation for how the climate has already changed in Nova Scotia, how the climate is projected to change, and the known impacts of climate change on the resources of well-being for Nova Scotians.

Nova Scotia's Changing Climate

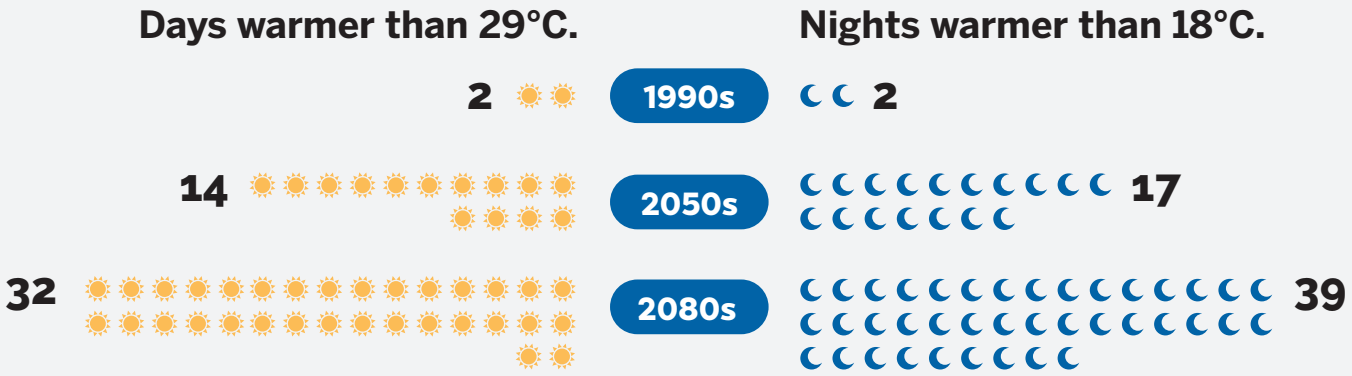
Nova Scotians need to be concerned about climate change now. In fact, the province has been feeling the effects of gradual and extreme changes for some time[6,7]. More severe storms like Hurricanes Juan and Fiona have hit harder than ever before. These patterns are projected to continue and worsen over the century[8]. The next few pages outline some of the projected changes in Nova Scotia's climate in the coming decades (under RCP8.5, median values).

It's Getting Warmer

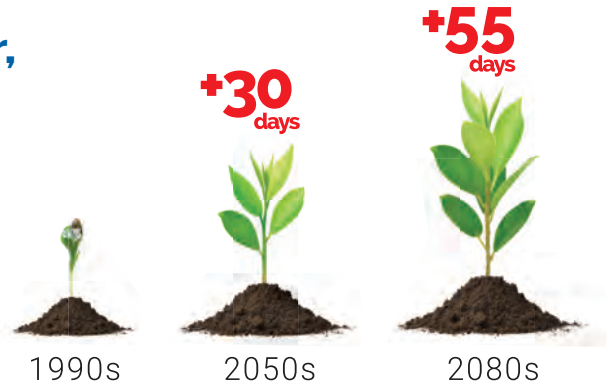
Climate projections under a high emissions scenario (RCP8.5) indicate that Nova Scotians could expect the average annual temperature to increase by 2.6°C by mid-century and 4.5°C by the end of the century. Extreme heat will become more common with an annual average of one month of extremely hot days projected for the end of the century. Growing seasons will be longer affecting ecosystems and agriculture[8].

Winter temperatures are warming the most rapidly of any season. Days with extreme cold temperatures will be much rarer. Average winter temperatures are projected to increase to above freezing by the end of the century, resulting in less snow cover and sea ice[8-10].

Days and nights will be more uncomfortable.



Growing seasons will be longer, which could be an opportunity and a challenge.



Precipitation Patterns are Changing

Precipitation is projected to increase province-wide, especially in the winter and spring[8], but with a shift to less snow and more rain overall. By the end of the century, projections indicate that we could see as little as two weeks of days with snow all winter[8]. Another big shift is that we can expect heavier precipitation over shorter periods of time[11]. But more total precipitation will not necessarily result in more available freshwater. More intense rain can increase water runoff and warming temperatures will increase evaporation.

Annual precipitation is projected to increase by the end of the century. **+10%**

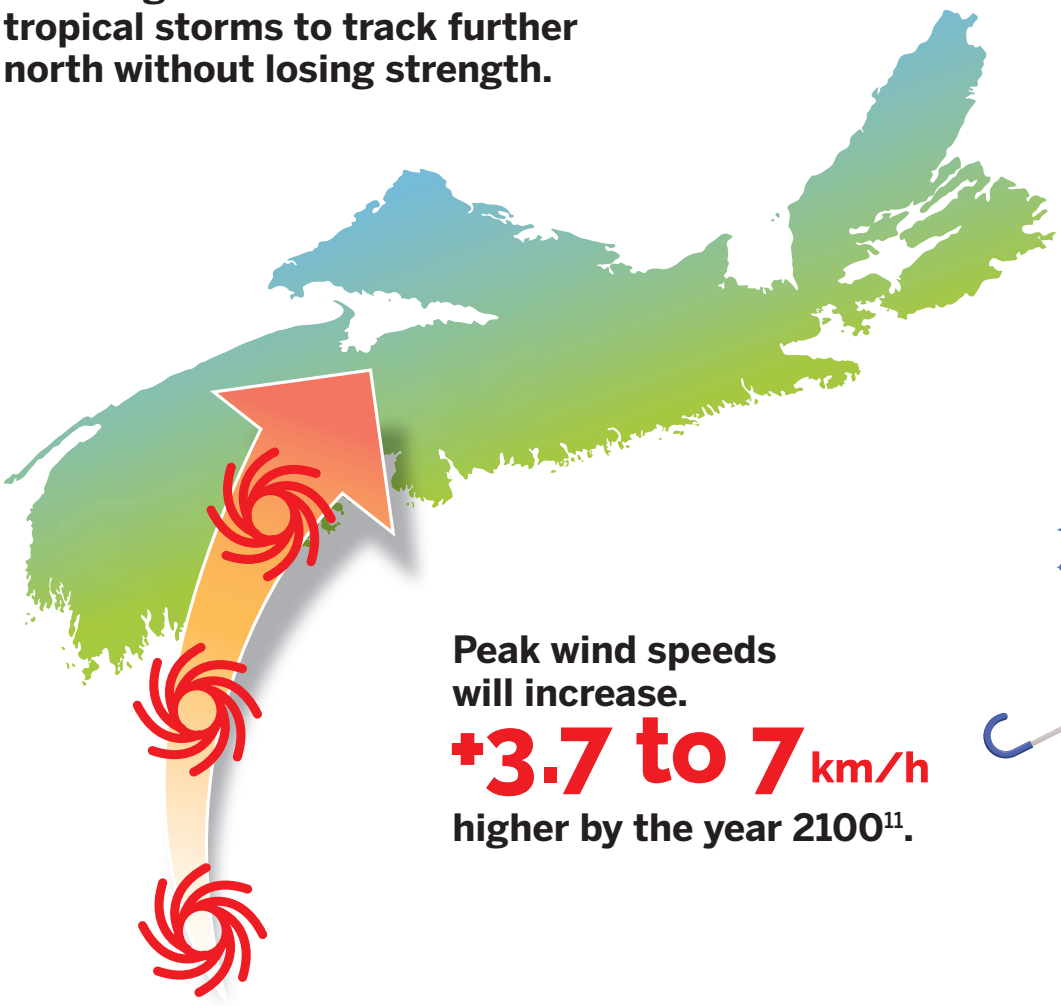
Expect more rainy days		Expect less snowy days
112	1990s	39
124	2050s	25
132	2080s	17

More Frequent and Intense Storms are Expected

Nova Scotians weather our share of storms[3,12]. Climate projections indicate that we can expect tropical storms more often, bringing more intense rainfall and stronger winds. These storms can travel further north without weakening due to warming ocean waters around Nova Scotia. More intense storms will bring more powerful and destructive storm surges[3,12].

It will be more likely for larger storms to hit NS.

Warming oceans will enable tropical storms to track further north without losing strength.



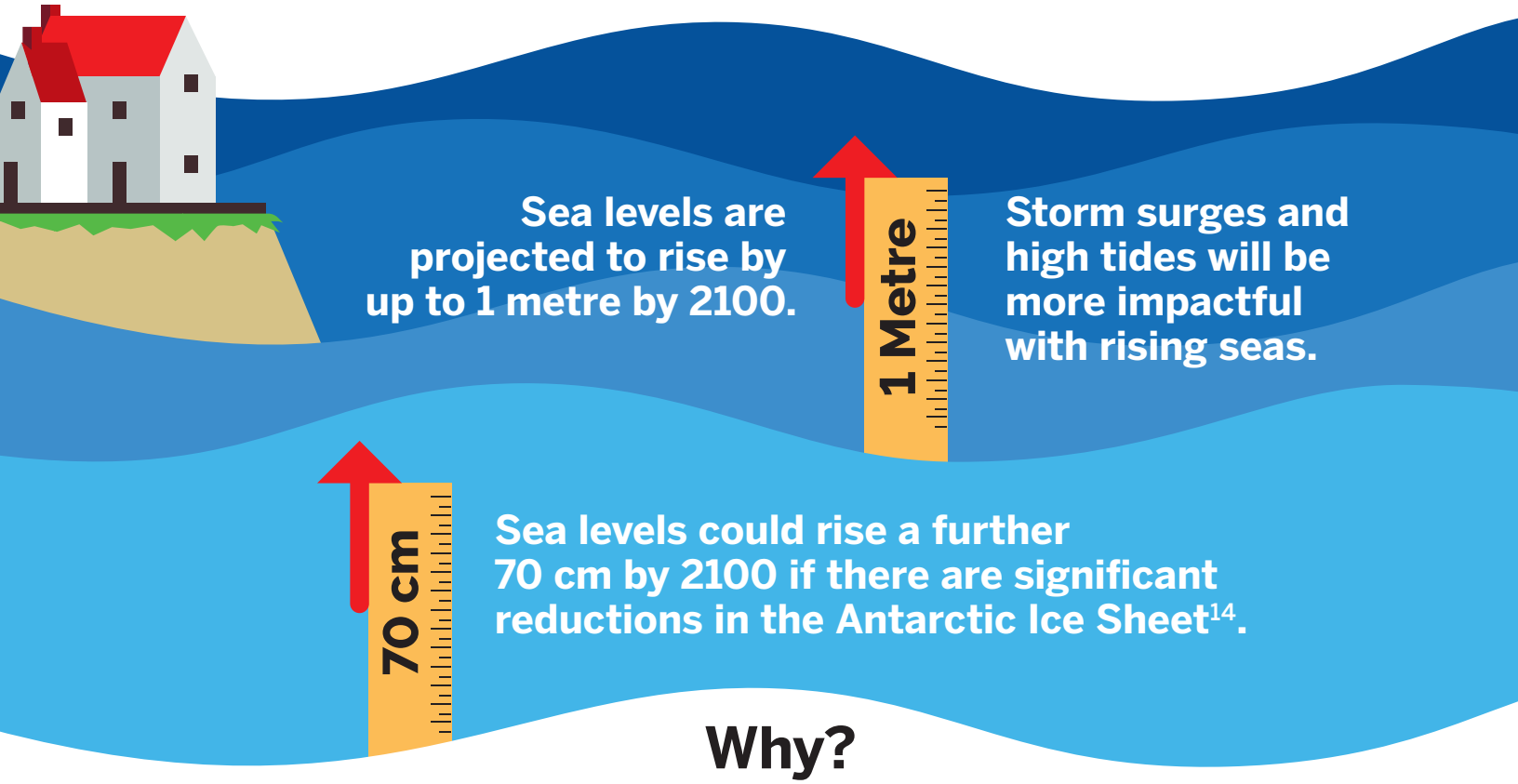
Peak wind speeds will increase.

+3.7 to 7 km/h

higher by the year 2100[11].

Sea Levels are Rising

Nova Scotia has 13,300 km of coastline, including the Bras D'Or Lake, and 70% of Nova Scotians live in coastal communities[13]. Climate change is causing sea levels to rise. Sea level rise projections Nova Scotia indicate an increase of between 68 and 100 cm in sea levels around different parts of our coasts by 2100 under RCP8.5[14]. Storm surges and high tides will be more impactful with rising seas[3,12].



Why?

Warming temperatures cause seawater to expand in volume

Melting land ice increases runoff into oceans

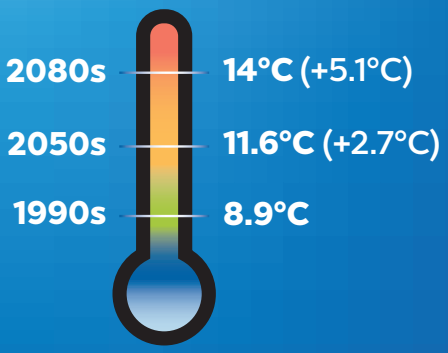
Land is sinking

Changing ocean currents

Other Ocean Conditions are Changing

In addition to sea level rise, surface and deep ocean water temperatures are getting warmer with more frequent and intense marine heat waves[15]. Changing ocean conditions, like higher acidity and lower oxygen levels, will also make it harder for our current ocean life and coastal ecosystems to thrive[16,17].

Sea surface temperature is projected to increase.



Decreasing oxygen levels

Warmer temperatures make oxygen less available.

Ocean acidification

Carbon dioxide dissolves in the ocean, which lowers pH and increases acidity.

Climate Change Impacts on Well-being

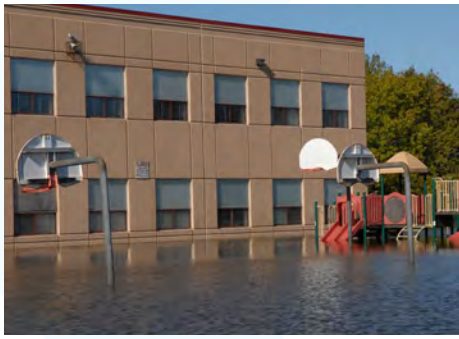
Environmental Impacts

Climate change will put more pressure on the environmental resources that are essential for Nova Scotia's well-being. The availability of fresh water will be affected through changing precipitation patterns and temperatures increases, as well as saltwater contamination of groundwater aquifers through sea level rise[12,16]. More severe storms will blow down trees and increased wildfires will damage and disturb forested areas[3,19]. Rising temperatures and habitat changes will shift species ranges, including creating more advantageous conditions for pests, diseases, and invasive species that cause damage[3,11,20]. As marine ecosystems change, so too will the species found off our shores[21].

Infrastructure Impacts

Nova Scotia has some of the oldest infrastructure in Canada—from the roads we drive on and the houses we live in to the hospitals, schools, and power generation stations we rely on[32-33]. To add to the challenges of age, a lot of infrastructure is near the coast increasing the potential damage from sea level rise, storm surge, and coastal flooding[19, 31, 34]. Smaller, rural communities may have fewer alternatives to cope in the short-term if the main schools, roads, emergency services, or hospitals are affected[35-36]. Physical damages are costly to repair and can disrupt business operations, affecting business revenues and employment incomes[25, 37]. In extreme cases, entire communities could face tough decisions and the burden of relocation in the coming decades due to climate change[38].

A bright spot is that regular maintenance and upgrades to existing infrastructure can help it better withstand the effects of climate change[6,39]. New infrastructure can be located and designed with projected climate changes in mind. By doing both, Nova Scotia will be better protected and that's better for our well-being.



Financial Impacts

Financial resources make it possible for us to support ourselves and contribute to Nova Scotia's economy. They also mean we have the choices and resources we need to reduce risks. Climate change will bring losses and opportunities for financial resources. Warming temperatures will extend growing seasons, which could increase revenues. But the potential for drought, floods, and insect infestations could offset benefits[19].

Fishing and forestry incomes are anticipated to decline due to climate change but changing industry practices could take advantage of new opportunities as ecosystems shift[3,15,16,20,40]. Small to medium-sized businesses, such as tourism, the cultural sector, and retailers could also face disruptions and damage from extreme weather events[25,34].

Human Impacts

Climate change will reduce mental and physical health due to exposure to heatwaves, extreme weather events like flooding, and illnesses transmitted by insects[19, 22-26]. Poorer air quality caused by smog and wildfire smoke affect health too, worsening asthma and other breathing difficulties[19, 27]. Decreased food and water security is a real possibility through changes to precipitation patterns and high temperatures that affect food and water supplies[25]. The overall impacts will be worse for people with underlying health conditions like heart disease or those already facing barriers to affordable housing, food and water security, healthcare, and emergency response services[19, 28, 29].

Social Impacts

Climate change will test the strength of Nova Scotia's social fabric in new ways. It may be harder to provide aid following extreme events, particularly to reach those in greatest need. And it may stretch community and government supports[30,34]. These difficult situations will put more pressure on relationships and could contribute to a sense of loss of place and identity through changes to the landscape[24]. Extreme temperatures can trigger increased aggression. Social inequities mean those facing social and economic disadvantages don't have the same access to resources to respond and adapt[31].

Climate Change and Inequities

Some people will be impacted by climate change more than others. Systemic inequities profoundly affect the well-being of African Nova Scotians, Mi'kmaq, racialized peoples, immigrants, individuals living on low incomes, individuals living with disabilities, older adults, youth, 2SLGBTQI+, and women. These inequities interact and shape where people live and their social and economic circumstances. This can increase their exposure and vulnerability to climate hazards[41-46].

The Mi'kmaq have experienced losses of tradition, knowledge, culture, language, and ways of living through the effects of systemic anti-Indigenous discrimination and racism[47-49]. This has negatively affected many aspects of their well-being, including livelihoods and income, health, education, and housing[48-52]. Mi'kmaq are building on strengths to create positive change, but climate change brings added concerns. Many Mi'kmaw communities are in areas prone to flooding, putting homes and infrastructure at risk. Climate change is affecting access to traditional foods, medicines, and artisan materials[53]. Sea level rise and coastal erosion threaten important cultural, archaeological, and spiritual sites[54].

African Nova Scotians have faced centuries of racism. This has created inequities in access to health, education, and social services[55-57], which community champions are working to overcome. Some African Nova Scotian communities are located close to environmental pollutants. Others still struggle with substandard infrastructure such as roads and drinking water that are not up to the challenges of tomorrow's climate conditions[57].

Resources needed for quality of life and well-being directly affect people's ability to cope, prepare, and respond to climate change. For example, racialized peoples, including some immigrants, and individuals living with disabilities experience inequitable access to education and discrimination in getting good jobs[58-61]. This affects their income opportunities and financial resources needed to adapt. Many experience barriers to health care and social supports, creating further disadvantages[62-64]. For racialized women or women living with disabilities, it can be impossible to separate how gender, race, and disability intersect to shape lived experiences.

Nova Scotians living on low incomes, including many seniors[65], struggle to afford the basics such as nutritious food[66-67]. Living with a disability can also be expensive,[68] and mobility limitations make it much harder get out of harm's way, such as during storms or floods.

New Research and Key Findings

A Well-being-at-Risk Index was created to rapidly screen priorities for action based on potential risks and benefits to well-being and identify opportunities to adapt. It uses the concepts of climate risk and well-being to explore relationships between climatic changes, hazards or opportunities, and potential harm or benefit to the resources needed for the well-being of Nova Scotians.

This quantitative approach combines climate projections for Nova Scotia with social, environmental, and economic indicators to explore what is exposed to each climate hazard, how sensitive it is, and the general ability of Nova Scotians to cope. The Well-being-at-Risk Index compares the 18 census divisions of Nova Scotia, aligning with the boundaries of the province's 18 counties.

For more information on indicator selection, data sources, methods, and how the Well-being-at-Risk Index was calculated, please refer to *Weathering What's Ahead: Appendices*.

This is the first Well-being-at-Risk Index prepared for Nova Scotia. All research results are based on assumptions and data available when this research was being completed. Future climate change risk assessments will use updated information and improve on the model.

Climate Hazards

The first step assessed a range of possible climate hazards. Thirteen climate hazards were selected for the assessment that have increasingly negative effects on the well-being of Nova Scotians. Selections were based on how much the climate is projected to change, evidence, and expert knowledge.

- Pluvial flooding, or overland flooding from heavy rainfall.
- Fluvial flooding when rivers, lakes, or streams overflow because of heavy rain or melting snow.
- Vector-borne diseases, like Lyme disease, that affect humans.
- Sea level rise and coastal flooding.
- Wildfires in forested and grassland areas.
- Combination of climatic changes that can increase agricultural pests and diseases.
- Combination of climatic changes that cause shifts in habitats and species composition that change the characteristics of ecosystems.
- Heat extremes that can damage agricultural crops or harm animals.
- Heat extremes that can damage transportation infrastructure, such as roads or rail lines.
- Heat extremes that can damage ecosystems.
- Heat extremes that can damage human health.
- Increased demand for energy to cool buildings.
- Drought where the availability of freshwater is significantly reduced.

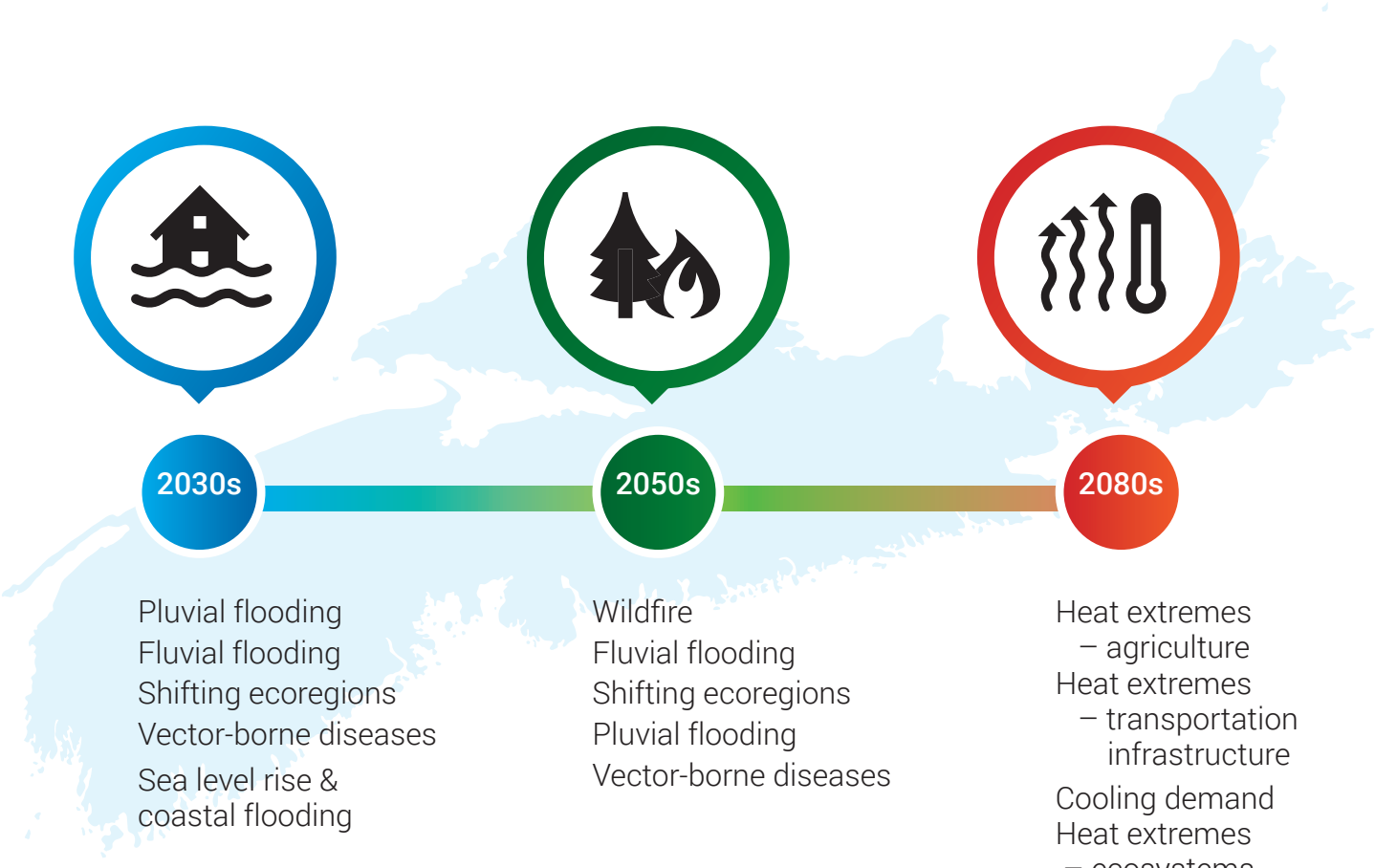
Due to limitations in available climate data, this assessment was unable to explore storms as a climate hazard, although tropical storms, like hurricanes, can cause a lot of damage and put the well-being of Nova Scotians at risk.

The climate hazards of top concern change over time. Flooding from heavy rainfall and in rivers, lakes, and streams pose the most potential harm to well-being from climate change by the 2030s. Compared to other climate hazards, exposure is relatively high and there are more regions of the province with higher sensitivity and lower coping capacity.

By mid-century, the 2050s, wildfire becomes the highest-ranked climate hazard. There is a large projected increase in weather conditions that could lead to wildfire and relatively low capacity to cope.

Increases in temperature, particularly heat extremes, are the most concerning for well-being across the majority of Nova Scotia by the end of the century, the 2080s.

The figure below lists the top five ranked climate hazards to the well-being of Nova Scotians over the 21st century when compared to the historical climate (1981-2010).



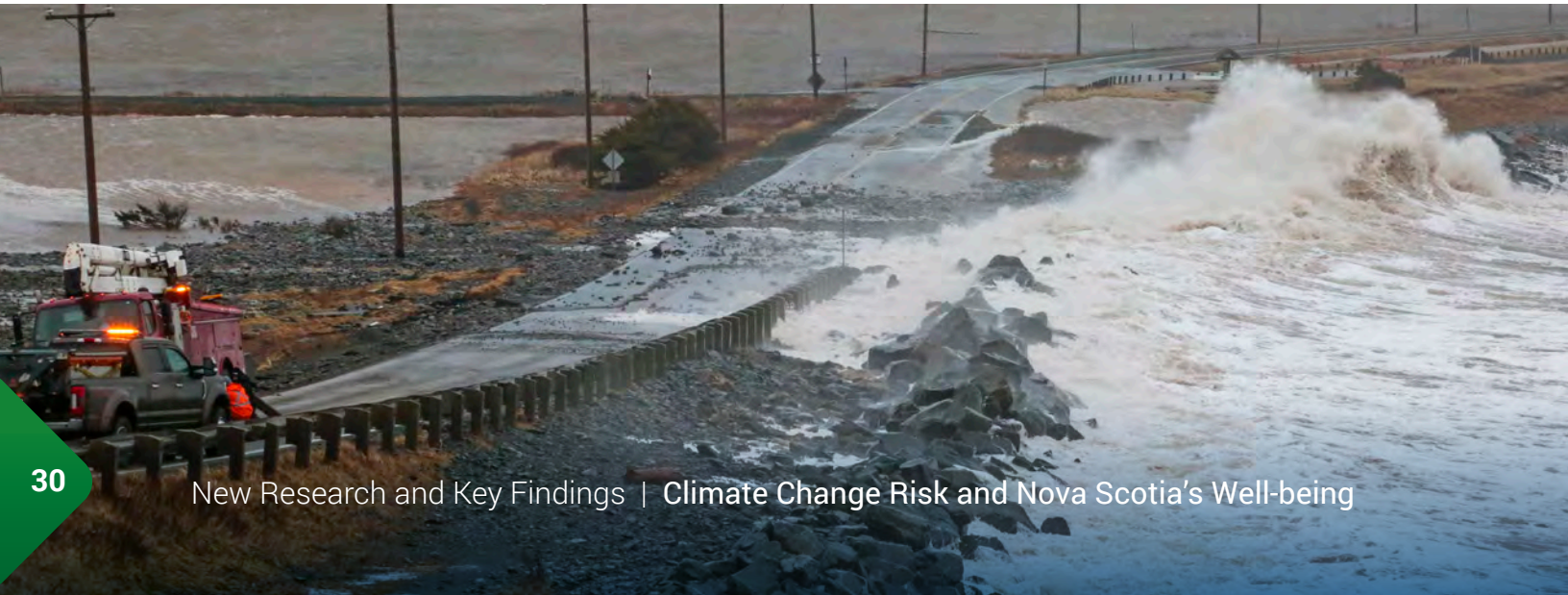
Regional Adaptation Needed

While every region of Nova Scotia will be impacted by climate change, some have a higher need to adapt to respond to risks or take advantage of opportunities. It's important to remember that we need to be able to take advantage of the opportunity for it to offer any real benefit. These census divisions are Annapolis, Cape Breton, Colchester, Cumberland, Digby, Halifax, and Pictou.

This research was able to explore each climate hazard and opportunity across time periods to see which regions had higher Well-being-at-Risk scores and why. For example, with the largest population and largest area, the risks to well-being in Halifax are most influenced by the amount of what is exposed to climate hazards. Cumberland is an area of concern for climate hazards, because the projected climatic changes are greater than in other census divisions and Cumberland has relatively high vulnerability and exposure. These results were cross-checked by looking at the similarities across census divisions and how often each region is in the top ranks for a specific climate hazard.

Every region in Nova Scotia has rural and urban communities. This brings a unique mix of strengths and difficulties in coping and adapting to climate change. While some community strengths are included in the Well-being-at-Risk Index, the regional picture is not detailed enough to present a complete picture at the local level.

Special attention is needed to explore disproportionate impacts for marginalized and racialized groups within every region. For example, Halifax has the highest population of African Nova Scotians. The population of older adults in Cumberland and Annapolis is higher than the provincial average.



Disproportionate Impacts

This assessment was able to explore some statistical differences in climate vulnerability for groups facing inequities: women, older adults, individuals self-identifying as Black, and individuals self-identifying as Indigenous. However, the research was limited by a lack of data for marginalized and racialized groups in Nova Scotia. For example, we lack information at the census division or community level about people living with disabilities and are restricted to categories determined by Statistics Canada.

The average coping capacity of women, older adults, and individuals who identify as Indigenous or Black is lower than that for Nova Scotia's overall population. This will make it harder to respond to threats and take advantage of opportunities. Even within census divisions, systemic inequities mean disadvantaged groups face higher exposure to climate hazards.

Additional analysis suggests that diversifying employment and income opportunities for these groups, along with the importance of health and improvements to educational outcomes, housing quality, voice in decisions, and sense of belonging could reduce vulnerabilities to climate change.

Climate Opportunities

This assessment explored five different kinds of climate impacts that present opportunities to benefit the well-being of Nova Scotians. These were grouped into two categories:

- Changes that can improve well-being: Opportunities for summer tourism and recreation and longer growing seasons for agricultural crops and other plants could improve well-being through climate change.
- Changes that can lessen negative effects: While negatively impacting well-being now, heavy snowfalls, freeze-thaw cycles, and heating demand for buildings will lessen as the climate changes. This lessening of impact can improve well-being.

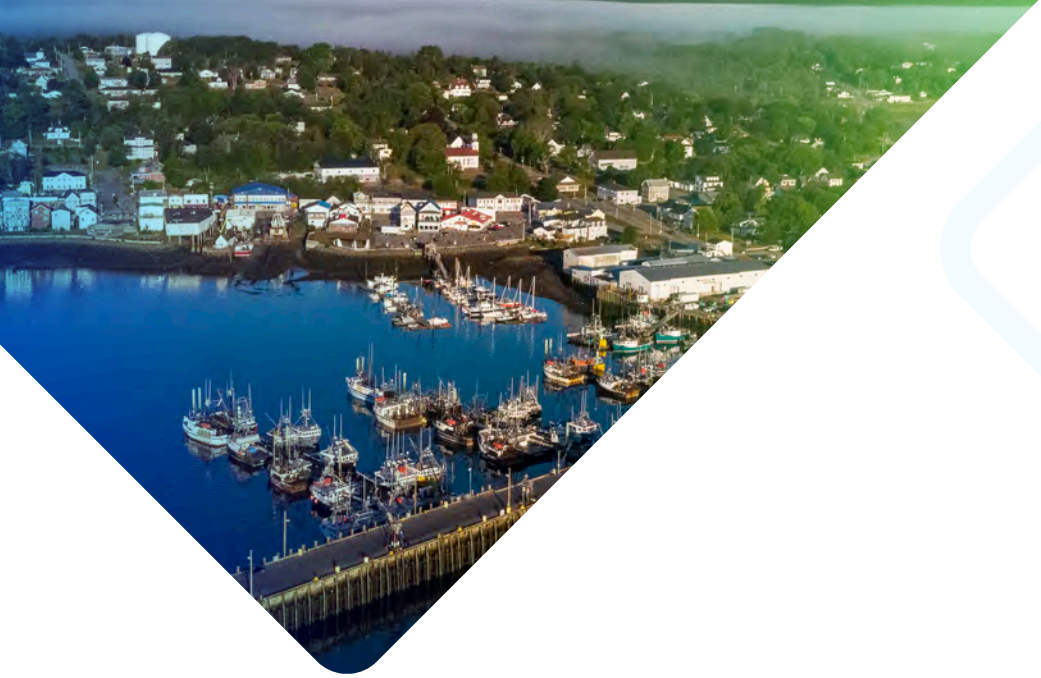
Across all time horizons, longer growing seasons and reduced heating demand show the most potential to improve well-being, because more regions in Nova Scotia are better able to take advantage of the lengthening growing season or have high heating demands now, which will lessen through climate change.

These climate benefits don't occur on their own. Actions will need to address the interaction of opportunities and challenges to realize any benefits. For example:

- Longer growing seasons will be experienced at the same time as increased heat stress for crops and ecosystems, increases in pests and diseases, and shifts in habitats and ecosystems.

- Warming temperatures will reduce the energy needed to heat buildings, but high temperatures will increase the need for energy to stay cool.

Similarly, opportunities for improvements to summer tourism and recreation will need to be balanced with reduced opportunities for winter tourism and recreation due to warming temperatures and less snowfall.



Insights, Priorities, and Next Steps

The findings provide insight into gaps, where more research is needed, and opportunities for action.

Insights

Cross-cutting Approach

This research affirmed that we need to take a holistic, integrated approach in all actions to adapt to the changing climate. We need to recognize the complex relationships and interdependence between people, human societies, animals, plants, and the environment, and how they interact for our well-being[2].

What does socially just climate adaptation look like?

Adaptation needs to consider the causes of systemic injustice and take a long-term approach. Research suggests those most affected by climate change should have the opportunity to be involved in adaptation decisions that affect them[69].

This recognition also honours the Mi'kmaw concept of Netukulimk* —a way of knowing and being in the world that guides relationships and actions. Integrating ecological and social knowledge for action can help foster well-being for a changing climate, such as by respecting traditional Mi'kmaw knowledge** and using a Two-Eyed Seeing approach called Etuaptmumk.

As discussed, some groups will be impacted more and differently by climate change because of the inequities they already face. Climate adaptation efforts will need to address the root causes of the inequities and how they intersect. This will help to ensure that adaptation actions are in harmony with long-term sustainability and our collective well-being.

Research and Knowledge Gaps

This assessment revealed several important gaps in research and knowledge that cover a range of areas, such as more specific information about particular sectors, vulnerable populations, and new opportunities for Nova Scotia. Partnerships between different levels of government, researchers, community groups, businesses, and underrepresented communities will be vital to fill these knowledge gaps.

- There is a significant lack of research and data for Nova Scotia that uses an intersectional approach and considers the experiences of climate change within marginalized and racialized communities.
- More information is needed to better understand the magnitude and severity of climate threats and how they interact.
- More information is needed to understand risks at a local level, such as through mapping that could help to identify people, natural features, and infrastructure that are particularly vulnerable.

*For more information about Netukulimk, please visit: https://www.uinr.ca/programs/netukulimk/ and https://curriculum.novascotia.ca/sites/default/files/documents/resource-files/Netukulimk_ENG.pdf.

**Traditional Mi'kmaw knowledge contains deep understanding of these lands and waters and insights gained over 12,000 years in Mi'kma'ki and experience in adapting to change.

Priorities

Opportunities to Act

Understanding the nature of climate risk offers insights into strategies to adapt. Several high-level strategies exist to manage risk and reduce exposure. One example is to change land use practices and consider climate change when deciding where things are located. This could mean avoiding building in areas prone to flooding or too close to the coast. Other practices and decisions can also help to reduce exposure. For example, altering work hours for outdoor workers to avoid the hottest times of the day during heat waves.

Climate hazards interact with each other, and they vary over time. They also depend on not just what Nova Scotia does, but how successful the world is in reducing overall greenhouse gas emissions. Nova Scotia's best strategy is to build the capacity to adapt to all hazards—not just specific ones. This offers us the best opportunity to be prepared for whatever comes our way.

This assessment focused on exploring how climate change might affect the well-being of Nova Scotians, but it also shows how well-being can reduce risk. Additional analysis showed that improvements to a range of factors, such as public trust in government, work-life balance, higher incomes, and educational outcomes would help position Nova Scotians to better cope with climate-related impacts today and prepare for the impacts of tomorrow.

Monitor, Assess, and Evaluate

Monitoring changes in the capacity to cope and adapt can help us learn what makes it easier and harder to adapt and identify where more support is needed. This information can also help to track changes in risk and differences across regions and communities in Nova Scotia. Evaluating how effective actions are, and how they affect the well-being of Nova Scotians, will help us to learn what actions work and what actions have unintended consequences.

Continued Attention on Key Risks

Two areas stand out as important risks already affecting Nova Scotians. The good news is that Nova Scotians are already taking action. But this assessment shows that the potential negative impacts to well-being could worsen without additional efforts.

- Nova Scotians already experience the effects of sea level rise, coastal flooding, and flooding from heavy precipitation. These climatic changes will continue to have widespread, harmful impacts to homes and critical infrastructure, sensitive ecosystems like beaches and dunes, and sites of cultural importance. We will need to build on the work already underway to reduce risks like investigating the full range of options to support those most vulnerable.
- Higher average temperatures and heat extremes will increasingly affect food production in Nova Scotia. These hazards will interact with increases to agricultural pests and disease, longer growing seasons, and changes in freshwater resources. Farmers and the agricultural sector are already adapting to these changes but will need ongoing support and expanded attention across our food systems to support the food security of Nova Scotians.

Further Explore Potential Areas of Concern

This assessment has identified specific areas of concern that are worth exploring further. All are of high importance to Nova Scotians and vital to our well-being now and into the future. But they are also at risk from multiple climate threats. Further exploration would shed light on who or what is most vulnerable and on the specific opportunities to improve their ability to withstand these climate threats in the short and longer term.

- Ecosystems and species face a range of pressures from development, other environmental issues, and climate change but they are essential for well-being. They are needed for a healthy planet and are of cultural significance. They also support the livelihoods of Nova Scotians. This assessment identified that forest and wetland ecosystems in Nova Scotia, and the species that live in them, face multiple climate impacts from flooding, heat stress, shifting ecoregions, invasive species, and longer growing seasons.

- Where we live and the state of housing can help or hurt our well-being. It can affect our ability to withstand climate threats like floods, storms, and heat extremes.
- The health system supports physical and mental health for all. It too will face additional challenges from flooding, extreme heat, wildfires, and vector-borne illnesses. This will add to the challenges already faced by those with existing health concerns or experiencing health inequities.

Next Steps

Next Steps for Climate Risk Assessments and Research

In addition to sharing the results of this climate change risk assessment widely, the following have been identified as potential next steps that governments, researchers, and communities could do to help fill research gaps:

- Build partnerships to research intersectional impacts to well-being from climate change for marginalized and racialized groups and explore options for socially just adaptation approaches.
- Conduct in-depth research to better understand adaptive capacity in Nova Scotia. This work could include exploring how to build on existing strengths and knowledge, such as traditional knowledge within Mi'kmaw communities.
- Conduct additional research into the severity of climate risks and how risks worsen when they interact.
- Partner to explore risks at local levels, including rural-urban differences and for specific sectors.
- Explore risks from storms and coastal flooding once improved data is available.
- The Province of Nova Scotia has committed to update the climate change risk assessment in 2025 with the latest climate information and improved methods. As we learn more about how the climate is changing, there is a pressing need to continually re-assess risks, along with changes in ecological, economic, and social limits, and to identify new areas of concern.

Conclusion

The climate crisis demands urgent attention from all of us. This climate change risk assessment is intended to serve as a resource for different levels of government so it can set priorities and plan action. Business sectors can use it to alter their practices and plans. And all Nova Scotians can use it as a basis for conversations and collaboration. It can feel overwhelming and too big to tackle, but we can make a difference. This research demonstrates the importance of continuing to act to slow climate change and reduce the worst effects. It also demonstrates the need to respond to changes already here and prepare for the future. **The biggest uncertainty isn't how the climate will change, but what we do about it. The future is ours to shape.**

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