

**WORKING GROUP ON  
ADAPTATION AND  
CLIMATE RESILIENCE**

**FINAL REPORT**

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# EXECUTIVE SUMMARY

Climate change impacts are being felt across Canada and pose significant risks to communities, health and well-being, the economy, and the natural environment. These impacts will persist and worsen, even with a concerted effort to reduce greenhouse gas emissions. Mobilizing action on adaptation will help protect Canadians from climate change risks, build resilience, and ensure that society thrives in a changing climate. Adaptation can also play an important role in Canada's clean growth and climate change agenda by creating green jobs, spurring innovation, and reducing emissions.

Addressing the magnitude of this challenge requires a fundamental shift in the approach used to manage risks and protect people, the economy, and the natural environment. In the new climate reality, significantly reducing risks demands a sustained and ambitious approach to adaptation. This approach must build on existing efforts while also creating a new culture of resilience where climate change risks and vulnerabilities are factored in as part of routine planning and decisions.

The impacts of climate change do not respect political or sectoral boundaries. No single region, sector, order of government, or organization can build climate resilience alone; collaborative and coordinated action is essential. From a government perspective, Environment Ministers are championing this effort, but building climate resilience will require leadership in every portfolio, from the economy to health. Furthermore, these efforts must extend beyond government to all aspects of Canadian society. Given the interconnected sectors and systems that Canadians rely on (e.g., health, food, water, trade, energy, transportation, natural environment), adaptation efforts must also be holistic, integrated, and systems based. Indigenous Peoples, given their holistic worldview and unique relationship with the land, have valuable perspectives and experience in this regard, and should be strong partners and leaders in adaptation going forward.

The Pan-Canadian Framework on Clean Growth and Climate Change represents an opportunity to make significant advances in adaptation across the country. In response to the Vancouver Declaration, the Working Group on Adaptation and Climate Resilience has developed a number of options that can build climate resilience in Canada. In order to deliver on these options, the Working Group has identified four key requirements: a Canada-wide commitment to action, authentic and sustained Indigenous engagement, sustained funding to enable long-term planning and action, and strong governance through formalized collaboration.

The options developed by the Working Group are organized into two broad categories: options that build a foundation for ongoing action and those that address specific opportunities or vulnerabilities. The options for foundational action can drive adaptation efforts across all sectors and regions over the long term. They are, in many ways, prerequisites for both broad and targeted actions, and include:

- Supporting decision-making with knowledge and information by ensuring all Canadians have access to authoritative, accessible, and actionable information on changing climate conditions, impacts, and risks and improving observation, monitoring, and surveillance networks
- Building capacity to translate knowledge into action by creating climate resilience centres that can advance on-the-ground adaptation efforts, as well as by supporting efforts to raise awareness, foster adaptation leaders and champions, and increase training and skills development

The options for action in priority areas represent areas where there is currently a window of opportunity to build resilience and influence decisions or address immediate vulnerabilities:

- Building resilience through infrastructure by ensuring that climate change is considered in infrastructure decisions, promoting nature-based solutions, and investing in infrastructure projects that are specifically designed to address climate change impacts

- Promoting healthy ecosystems and healthy people by advancing ecosystem resilience as an adaptation solution, integrating climate change considerations into natural resource management and biodiversity conservation decisions, promoting integrated planning, and taking targeted action to improve the health and well-being of Canadians in the face of climate change
- Supporting particularly vulnerable regions, specifically Canada's coasts and the North, by understanding changes in these environments and implementing concrete adaptation actions
- Reducing climate-related hazards and disaster risks, such as floods, wildfires, drought, and extreme wind and heat, by ensuring that disaster planning considers climate change, advancing work to deal with specific hazards, and improving collaboration across practitioner communities

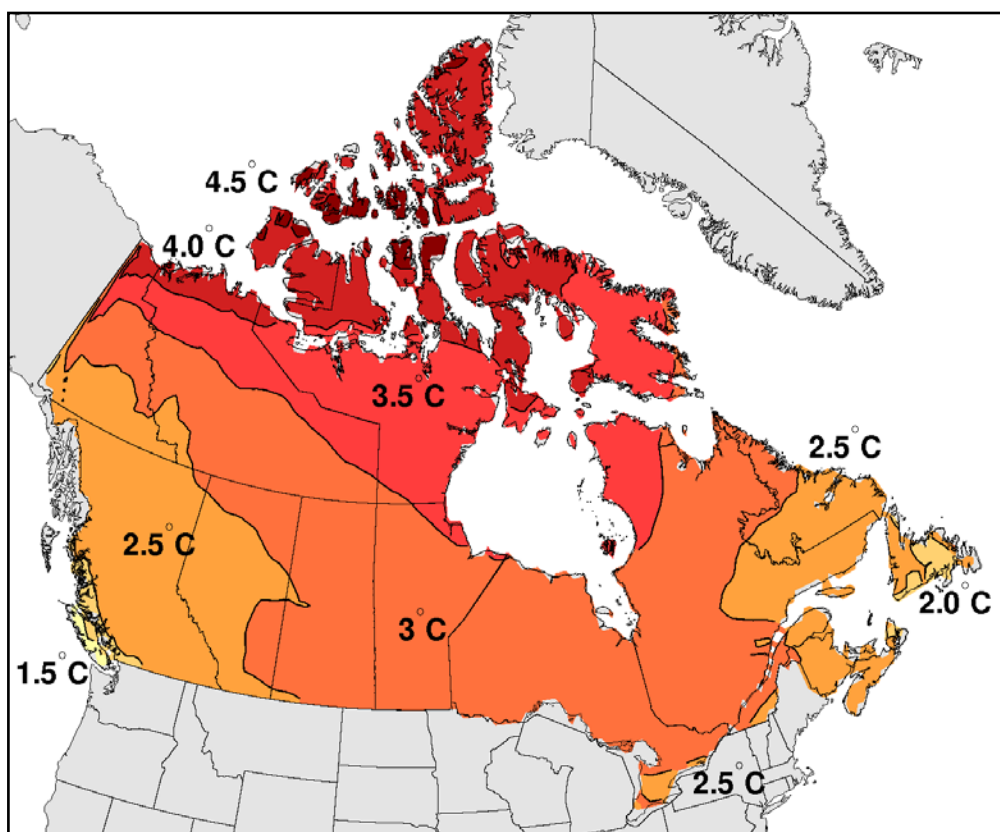
Key requirements for sustained, ambitious, collaborative action	
<ul style="list-style-type: none"> <li>▪ A Canada-wide commitment to act on adaptation</li> <li>▪ Authentic and sustained Indigenous engagement</li> </ul>	<ul style="list-style-type: none"> <li>▪ Sustained funding to enable long-term planning and action</li> <li>▪ Strong governance through formalized collaboration</li> </ul>
Options for foundational action	
<b>Supporting decision-making with knowledge and information</b> <ol style="list-style-type: none"> <li>1. Establish a multi-stakeholder Canadian Centre for Climate Services</li> <li>2. Assess climate risk and the state of resilience</li> <li>3. Improve observation, monitoring, and surveillance networks</li> </ol>	<b>Building capacity to translate knowledge into action</b> <ol style="list-style-type: none"> <li>4. Establish a network of climate resilience centres</li> <li>5. Promote investments in training, skills, and capacity development</li> <li>6. Work with partners to mobilize Canadians</li> </ol>
Options for action in priority areas	
<b>Building resilience through infrastructure</b> <ol style="list-style-type: none"> <li>7. Develop Canada-wide guidelines, codes, standards, and best practices for climate-resilient traditional and natural infrastructure</li> <li>8. Revise government procurement policies, where appropriate, to ensure consideration of climate change and co-benefits in infrastructure decisions</li> <li>9. Make natural infrastructure a priority</li> <li>10. Provide dedicated funding, top-up funding, or other financial incentives for advancing climate resilience through infrastructure</li> <li>11. Include climate change adaptation in land-use planning, transportation, and demand-side management policies that affect infrastructure demand</li> </ol>	<b>Promoting healthy ecosystems and healthy people</b> <ol style="list-style-type: none"> <li>12. Promote ecosystem resilience as an adaptation solution</li> <li>13. Integrate climate change considerations into all natural resource management decision-making, including biodiversity conservation efforts</li> <li>14. Advance integrated landscape- and watershed-level planning</li> <li>15. Help Canadians adapt to the health impacts of climate change</li> </ol>
<b>Supporting vulnerable regions</b> <ol style="list-style-type: none"> <li>16. Develop and implement a coastal adaptation initiative</li> <li>17. Develop and implement a Northern Adaptation Strategy to drive adaptation in Canada's North</li> </ol>	<b>Reducing climate-related hazards and disaster risks</b> <ol style="list-style-type: none"> <li>18. Integrate future climate considerations into disaster risk planning, management, response, and recovery policies and strategies</li> <li>19. Address specific hazards</li> <li>20. Improve collaboration across practitioner communities, government institutions, and Indigenous organizations</li> </ol>



# 1 IMPACTS AND ADAPTATION IN CANADA

Climate change is a defining challenge of the times. Its impacts and Canada's response—the transition to be a resilient, low-carbon society—will touch every aspect of life. This is the new reality.

The Paris Agreement aims to hold the increase in global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the increase to 1.5°C in order to reduce the risks and impacts of climate change. This target represents a global average; as a northern country, this will mean a much higher temperature increase here at home. Average temperatures in Canada have already increased by 1.6°C since 1948 and are projected to rise by an additional 1.5°C–4.5°C by 2070, according to combined international model results that considered both low and very high greenhouse gas (GHG) emission scenarios.



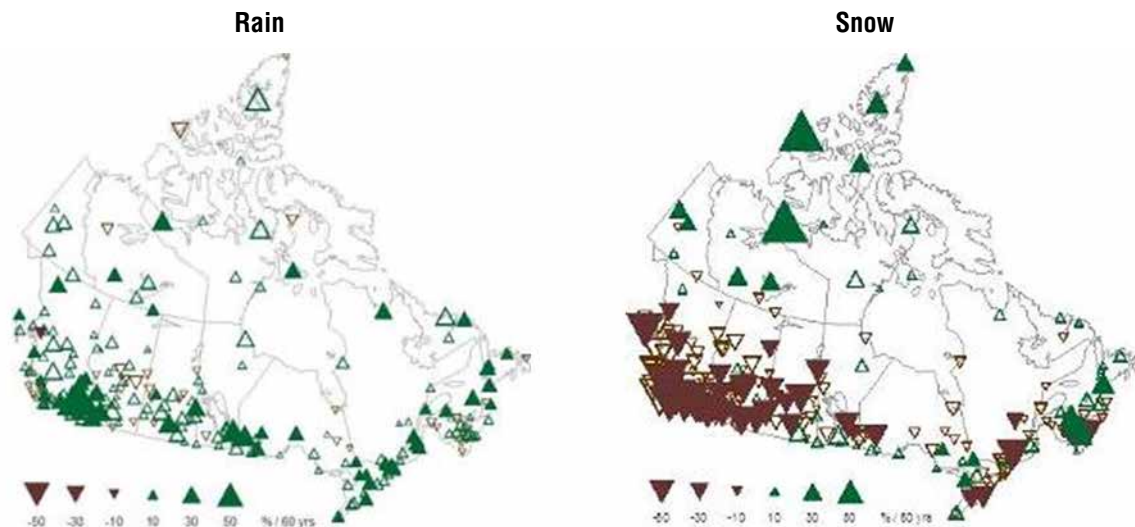
**Projected increase in annual average temperature, 2041-2070 (relative to 1976-2005).** (*Ouranos, 2015*)

The warming being experienced in Canada will require ambitious action to meet the objectives set out in the Paris Agreement; however, the response to climate change cannot be limited to reducing GHG emissions. It must include action to build climate resilience. This is not an admission of defeat; it is a necessary response to the impacts of climate change.

The impacts being observed today are the result of historical emissions, and the increase in emissions in recent decades will lead to more severe impacts in the coming years. Even with a successful transition to a carbon-neutral society, the impacts of rising temperatures will continue to touch all regions, sectors, communities, and ecosystems for decades to come. Significant work to reduce emissions is necessary and will help to avoid unmanageable situations in the future; however, equally ambitious efforts are needed to adapt to the unavoidable impacts of climate change that Canada is already experiencing and will continue to experience.

## 1.1 CLIMATE CHANGE IMPACTS IN CANADA

Canada's climate is changing; overall, it is becoming hotter, wetter, and the frequency of extreme events is changing. Temperatures in Canada have been increasing at roughly double the global rate and annual average precipitation has increased, with strong regional and seasonal variability.



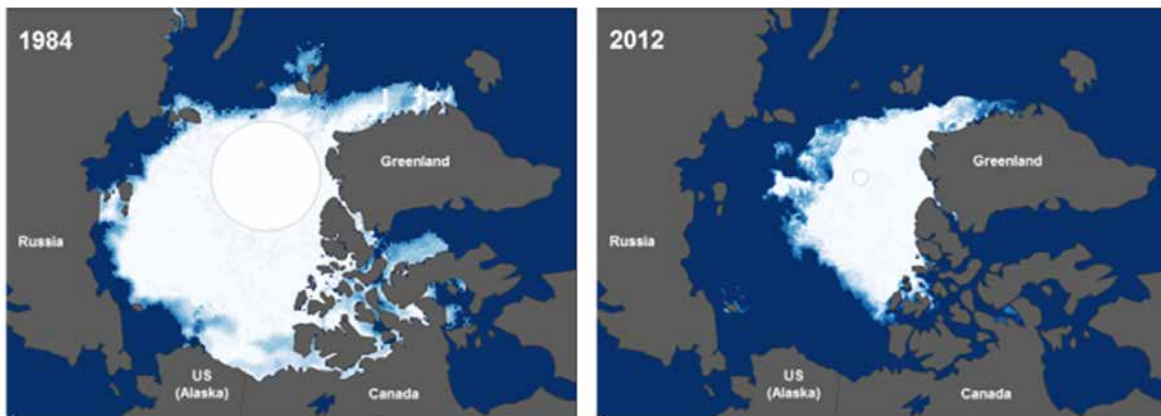
**Annual rainfall and snowfall trends (1950–2009)** – Triangles indicate the direction and magnitude of change. (*Mekis and Vincent, 2011*)

The consequences of these changes are evident across the country, and include threats to the natural and built environments, as well as to the health, socio-economic, and cultural well-being of Canadians. These impacts have high human and financial costs, and are already causing rapid and irreversible change in Canada's North and coastal regions. These threats are often more acute for some Indigenous Peoples, who live closer to the land and have a strong spiritual connection to it.

### 1.1.1 CANADA'S NORTH

While Canada's temperature increases are outpacing the global average, temperatures are rising even faster in Canada's Arctic and northern areas. For example, Inuvik in the Northwest Territories has warmed by almost 4°C, on average, since 1948. The rapid warming of Canada's North is leading to significant losses of sea ice and permafrost.

The volume and coverage of sea ice have decreased significantly since observations began in 1979, with approximately 300 km<sup>3</sup> of sea ice currently lost per year. If this trend continues, the Arctic Ocean will have ice free summers in 20 years, which will have wide ranging implications in Canada's North, as well as globally. Northern Arctic ice shelves have undergone significant changes in the last 100 years, eroding from one large ice shelf that spanned the entire northwest coast of Ellesmere Island into three smaller ice shelves. Since 2005, the total remaining area of ice shelves has decreased by more than 50%.



**In 2012, sea ice coverage across the Arctic, and specifically in the Northwest Passage, reached record lows. Ice levels in 2016 are closely tracking those experienced in 2012. (NASA Earth Observatory)**

Sea ice provides critical transportation in parts of the North, and its rapid loss is having a profound impact on communities that rely on ice to access hunting grounds and traditional sites, as well as on seasonal ice roads that provide access to food and supplies from the South. As Simeonie Amagoalik, an Elder from Nunavut, recalls: “I used to go egg hunting but now it is too dangerous to travel by ice so I cannot go to the places that I used to go to. I think it is mainly the ice on the sea that has affected me the most.”

The loss of sea ice also alters animal ranges (e.g., seals, walrus, salmon, whales) and opens new pathways for disease (e.g., a seal-killing virus previously seen only in the Atlantic Ocean was found in a population of Pacific sea otters in Alaska). These impacts are particularly felt by Indigenous communities that depend on these animals for sustenance and cultural survival. While reduced ice cover is increasing access to the North for resource development, shipping, and tourism, these activities bring with them new risks of accidents and spills, which put people and ecosystems at risk and place additional stress on limited search and rescue and disaster response capacity.

Warmer temperatures, along with other factors such as fire, increased rainfall, and erosion, are causing permafrost to thaw and degrade. The loss of permafrost is causing irreversible changes to the landscape, including slumping, erosion, ground instability, and forest mortality. Habitat is changing and for some species being lost altogether. Since permafrost impacts how far water can penetrate into the ground, permafrost degradation leads to: changes in drainage patterns; expansion or drainage of ponds, lakes, and wetlands; changes in water

### **THAWING PERMAFROST IN PANGNIRTUNG**

In June, 2008 a major rain and flooding event in Pangnirtung, Nunavut, caused the town's only bridge to collapse. The community declared a state of emergency.

The bridge collapse, caused by the flood water that rapidly thawed and eroded the permafrost along the riverbanks, bisected the community. This caused two halves of the community to be cut off from each other, with the only source of fresh water located on one side, leaving the other side without fresh water delivery or sewage removal. Heavy winds prevented bridge engineers and geotechnical experts from landing for a significant period of time, leaving the community isolated and vulnerable.



quality; and shifts in the timing of peak and minimum flows in rivers and streams. For example, in the summer of 2015, a large permafrost thaw slump caused rapid drainage of a tundra lake near the Mackenzie Delta in the Northwest Territories. This event was driven, in part, by rising temperatures and increased rainfall.

Northern infrastructure, including roads, buildings, communications towers, energy systems and facilities, community landfills, sewage lagoons, and large-scale waste containment sites (including berms around tailings ponds), often depend on stable permafrost. Degradation causes costly damage and unsafe or unstable conditions.

Remote and Indigenous communities and isolated economic sites often depend on a network of winter roads for critical shipments of medical supplies, food, fuel, and equipment. Climate change continues to affect the length of time that winter roads can be operational and whether they are viable at all, making these communities and sites more reliant on air transport. This significantly impacts the cost of living and doing business in the North, affecting the ability to attract investment, the prosperity of local businesses, and the strength, health, and well-being of remote and Indigenous communities.

### 1.1.2 COASTAL COMMUNITIES, INFRASTRUCTURE, AND ECOSYSTEMS

Canada has one of the longest coastlines in the world, and many coastal areas are of great economic, social, historical, and environmental significance. Through relative sea-level rise, rising water temperatures, increased ocean acidity, and loss of sea ice and permafrost, climate change is posing considerable challenges for Canada's coastal areas.

Coastlines projected to experience the greatest relative sea-level rise are the Atlantic provinces, the Gulf of St. Lawrence, the Beaufort Sea, Haida Gwaii, parts of Vancouver Island, and other parts of the British Columbia coast. Relative sea-level rise will negatively impact coastal ecosystems (including dunes, wetlands, tidal flats, and shallow coastal waters) and the services they provide. When combined with high winds, storms, and high tides, sea-level rise causes storm surges to reach higher elevations, affecting both natural shorelines and human built coastal infrastructure.

#### **NORTHERN COASTAL EROSION**

Tuktoyaktuk, Northwest Territories, is a community of fewer than 1,000 people on the shores of the Arctic Ocean that has experienced coastal erosion rates nearing 2 metres per year. Even with investments of nearly \$6 million over the last 10 years in shoreline protection initiatives, the community has had to relocate a school and the Royal Canadian Mounted Police headquarters.

Sea ice acts as natural protection against waves and storm surges. The loss of sea ice further increases storm surge risks and coastal erosion in the Beaufort Sea and Atlantic region. Along the northern coast, the additional challenges posed by the loss of permafrost are contributing to unprecedented rates of erosion that are effectively redrawing Canada's coastline.

Coastal communities are experiencing challenges that include: unstable shorelines; flooding damage to property and agricultural lands; permanent loss of archaeological sites and cultural heritage landmarks; contamination of water supplies; increasing costs for protection, maintenance, and insurance; disrupted transportation and trade routes and infrastructure (e.g., small craft harbours); and impacts on human health (e.g., water-borne diseases). Increases in water temperatures and ocean acidity also impact fisheries, traditional foods, iconic species (e.g., salmon), and food and water safety (e.g., harmful algal blooms).

In some cases, ensuring the continued safety of coastal communities will require considerable effort and resources, and in others it will be necessary to relocate. Given the strong ties to land and place, relocation is likely to have social, cultural, and mental health impacts.

### 1.1.3 INDIGENOUS PEOPLES AND COMMUNITIES

Indigenous Peoples have a strong cultural connection to the land, water, and air. While this increases their exposure and sensitivity to climate change impacts, it is also a source of strength, understanding, and resilience.

Indigenous Peoples are among the most vulnerable to climate change and experience unique challenges. A range of factors, largely related to historical legacies, contribute to this vulnerability, including: exposure to isolated and hazard-prone areas; reliance on the natural environment for livelihoods; socio-economic challenges, including disproportionate fiscal and population pressures; sub-standard infrastructure; and limited access to professional services, such as land-use planning and asset management expertise. Indigenous communities also face challenges of access to climate change adaptation resources, programs, and tools. While a special focus on northern regions is needed, there is a growing awareness of the unique vulnerabilities of Indigenous communities located in the southern regions of Canada.

Unprecedented changes to the environment are now challenging traditional ways of knowing and Indigenous Peoples' ability to maintain practices, languages, and culture. In the face of these challenges, Indigenous Peoples are changing the way they live and interact with the environment and each other, and are taking tangible steps to become active drivers of change. Building resilience in Indigenous communities is fundamentally about food, water, and energy independence, where communities are self-sufficient in all means needed for survival and expression. Indigenous communities and the holders of Traditional Knowledge have a long history of and deep understanding about adapting to changes in climate and the land. With support, they can contribute to the development of new and innovative solutions that benefit all Canadians and act as wayfinders on the path to resilience.

### 1.1.4 FOOD AND WATER SECURITY

Climate change is impacting agricultural productivity and access to traditional food sources (e.g., game, berries, mushrooms). Risks are directly related to increased incidence of drought, floods, storms, and heat waves, as well as changes to plant lifecycles and productivity, shifting plant and animal ranges, permafrost thaw, the spread of invasive species, and the emergence and spread of pests and disease. Higher temperatures and potentially longer growing seasons may present some opportunities for agricultural production in certain areas.

In the North and in Indigenous communities, changes in seasonal weather and climate conditions impact the transportation of food and other supplies and have made some traditional travel and hunting routes unsafe,

#### LOSS OF HISTORICAL AND HERITAGE SITES

Archaeological sites play a critical role in the cultural identity and heritage of many coastal areas and generate economic value through cultural tourism. One-fifth of all coastal archaeological sites in three regions of Newfoundland are highly vulnerable to sea-level rise, storm surges, or coastal erosion over the next 15-50 years, including sites of national and global historical significance. The UNESCO World Heritage Site at L'Anse aux Meadows is one such site, located on low-lying coastal land. This 11<sup>th</sup> century settlement is the only internationally-recognized site established by Vikings in North America and represents the earliest evidence of European settlement on the continent.



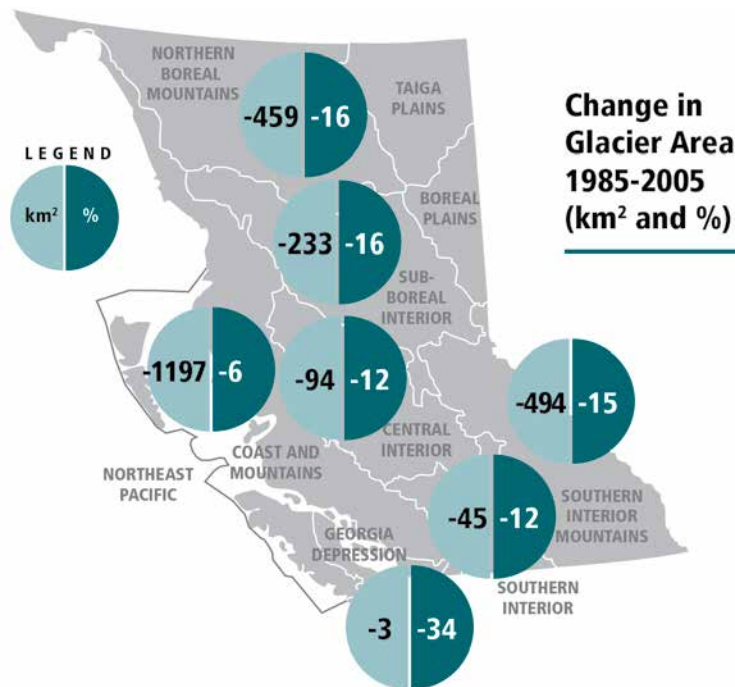


thereby deepening existing food security challenges. For example, climate change is affecting the timing of freeze- and break-up on rivers used for transportation and gathering food through hunting, trapping, and fishing. Reduced access to country foods is increasing reliance on expensive store-bought foods with negative effects on health (e.g., diabetes, obesity) and cultural identity. Costs for transporting food and other supplies have also increased, especially in areas that are increasingly dependent on shipments by air.

Water flows, availability, and quality are also changing due to temperature increases and precipitation changes. Rising temperatures are leading to a rapid loss of glaciers, impacting water flow and temperature in glacial-fed streams and rivers. In the short term, the melt will provide additional water and potentially benefit hydroelectric power generation, recreation, irrigation, and fisheries. However, in the long term glacier retreat will mean less water volume, especially during the summer months.

## EXTREME WEATHER EVENTS AND FOOD SECURITY

Produce shelves in Whitehorse, Yukon, were almost empty three days after flooding closed the South Alaska Highway in June 2012. Several landslides and washouts prevented ground transportation, limiting grocery and fuel supplies.



From 1985 to 2005 the glacier coverage in British Columbia decreased by 2,525 km² (Bolch et al, 2010)

Water availability, in terms of both the amount of water and the times of minimum and peak flows, is also impacted by changes in spring precipitation and reduced snow accumulation. These changes in the timing and amount of water have consequences for agriculture, industrial activities, power generation, and ecological function. For example, in 2015 a small winter snowpack resulted in insufficient stream flow to generate hydropower in the Northwest Territories, requiring unanticipated costs of approximately \$20 million in diesel to ensure continued electricity supply.

Higher water temperatures (and less available oxygen) and higher acidity in the water threaten marine life and habitats, impacting commercial and subsistence fisheries and aquaculture activities. Shorter seasons of ice cover, higher water temperatures, and changing precipitation patterns affect lake water levels, impacting shipping, tourism, and water quality, particularly in the Great Lakes.

### 1.1.5 EXTREME AND CATASTROPHIC EVENTS

Climate change is impacting the severity and frequency of extreme events, including the likelihood of flooding, droughts, storm surges, high winds, and heat waves. Changes in temperature and precipitation patterns have made the wildfire season longer, while drought- and pest-stressed forests, woodlots, and rangelands are increasing the severity of wildland fires. Sea level rise is increasing the frequency and height of storm surges, causing flooding in higher, previously unaffected areas and more frequent flooding in low lying areas.

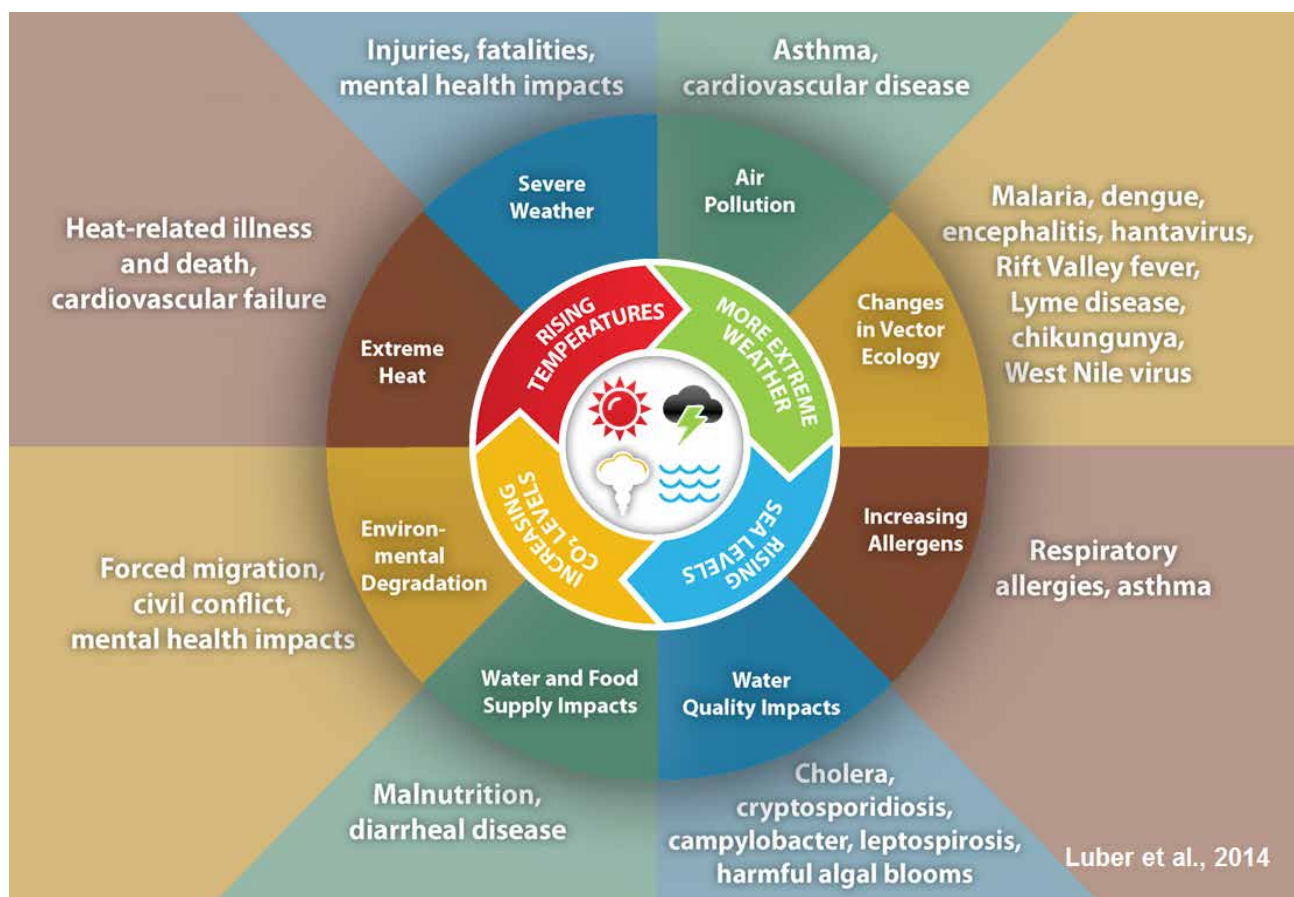
Recent examples demonstrate the potentially devastating effects of these events. The 2016 Fort McMurray wildfire displaced 90,000 people, destroyed about 2,400 homes and other buildings, and caused disruptions in local economic activities. With insured losses in excess of \$3.5 billion, this fire was the costliest natural disaster in Canada. The 2013 floods in the Toronto region resulted in stranded cars, flooded basements, and widespread power outages, with insured losses of about \$850 million. Flooding of one transmission station caused 500,000 power outages at the storm's peak. The 2013 floods in southern Alberta caused the evacuation of about 100,000 people and damaged 14,500 homes, 80 schools, and 10 health facilities. Thirty different communities were impacted in the region, which directly affected the operations of 3,000 local businesses. The insured damages were reported at \$1.7 billion, though some estimates have placed total economic damages in the range of \$6 billion, a significant portion of which was borne by governments.

Without additional efforts to reduce risks, the increased frequency and severity of extreme weather events could lead to increased hardship for many Canadians and potentially unsustainable losses for governments and the financial sector.

### 1.1.6 HEALTH AND WELL-BEING

Climate change impacts affect the health and well-being of Canadians in many ways, both directly and indirectly. More frequent and severe extreme weather events increase the risk of physical injury, illness, and death. Health systems are challenged and health care facilities can be impacted, with consequences for patient care, safety, and health care costs. In addition, the impact of natural disasters and changing landscapes, the loss of property and cultural heritage sites, and the inability to attend work or school have a negative impact on public health, including mental health, and can diminish individual and community resilience. This can have a significant impact on people, their families, communities, and the functioning of society as a whole.

Heat waves can cause heat-related illness and death, as well as exacerbate existing conditions, such as respiratory and cardiovascular diseases. Higher temperatures also contribute to increased air pollution and production of pollens, worsening allergies and asthma and exacerbating some existing health conditions. Smoke from wildland fires also impacts air quality. Increased contamination of drinking and recreational water by run-off from heavy rainfall can cause illness and disease outbreaks (e.g., acute gastrointestinal illness, E-coli).



**Overview of the ways in which climate change affects health and well-being. (Luber et al., 2014)**

Climate change is likely to increase the risks associated with some vector-borne diseases, and may result in the emergence or re-emergence of diseases that are currently considered to be rare in or exotic to Canada (e.g., malaria, chikungunya, Zika virus). For example, higher temperatures and changes in precipitation can make the environment more hospitable for insects, such as ticks and mosquitoes, increasing exposure to vector borne diseases like West Nile Virus or Lyme disease that were previously unseen in parts of Canada.

More broadly, climate change affects the various social determinants of health (e.g., food security, availability of potable water, housing, working conditions, income) and reduces resilience. Household food insecurity has been associated with a range of poor physical and mental health outcomes, including multiple chronic conditions and depression.



### 1.1.7 ECONOMIC PROSPERITY

Canadian industries are affected by climate change in various ways. The loss of permafrost, coastal erosion, changes to freeze-thaw cycles, and extreme weather contribute to road, bridge, port, rail, and airport disruptions, and increased costs for infrastructure repair and maintenance. Disruptions in productivity, critical trade infrastructure, electricity generation, and supply chains have broad consequences for many economic sectors, services to consumers, and businesses. Tourism and recreation activities that rely on weather conditions are particularly sensitive to climate change.

Climate change impacts in Canada and around the world affect global food and water security issues, commodity prices, trade, supply chains, conflict, and displaced people, which will have consequences for Canadian immigration, defence, and private sector prosperity. As an example of climate change impacts on global supply chains, the 2011 flooding in Bangkok, Thailand, caused a shortage of key components, which stalled production at many Ontario automotive factories.

Canada's resource economy is vulnerable to the impacts of climate change. The forestry and agriculture sectors have been affected by increased incidence of drought, floods, storms, heat waves, wildfires, and pests and diseases (e.g., mountain pine beetle and spruce budworm), which has consequences for productivity, the quality of the harvest, and work opportunities. Mining, oil and gas production, hydroelectric power generation, transportation, and agriculture are all affected by variable water levels. Access to mine sites in the North is restricted when winter roads are not available and mine infrastructure can be vulnerable to permafrost degradation. Increased temperatures, changing precipitation patterns, and increased frequency and intensity of extreme weather events are creating risks and operational challenges for agriculture and aquaculture production, though rising temperatures could also increase growing days and present opportunities for new crops or species in some regions.

#### **THE CHIGNECTO ISTHMUS: AN IMPORTANT TRANSPORTATION CORRIDOR**

The Chignecto Isthmus joins Nova Scotia with New Brunswick and the rest of Canada. The Isthmus was dyked in the 1700s for agriculture; since then, significant infrastructure has been built in the area, including the Trans-Canada Highway, the CN Railway, and electricity transmission lines. Disruptions due to climate change (e.g., sea-level rise, storm surge) pose risks to these infrastructures and the economic activity they sustain. Trade flows through the Isthmus, both by road and rail, carry an estimated value of \$50 million per day and \$20 billion annually.

#### **MOUNTAIN PINE BEETLE OUTBREAK IN BRITISH COLUMBIA**

The Mountain Pine Beetle outbreak in British Columbia was the largest outbreak recorded in North American history, killing nearly 60% of the pine in the province by 2016. The related reductions in annual harvests are expected to be approximately 12 million m<sup>3</sup>, or greater than 20% of harvests in the interior of British Columbia before the outbreak. This translates to annual losses of \$240 million along with mill shutdowns and resulting loss of employment. Although the outbreak has collapsed in British Columbia, it has moved east and north into the boreal forest.

## 1.2 THE IMPORTANCE OF ADAPTATION AND CLIMATE RESILIENCE

Climate resilience is the ability to survive and prosper in the face of the new climate reality. Adaptation is a key tool to achieving climate resilience, and is about making informed, forward looking decisions. Implementing effective adaptation measures will save lives, minimize damages, and lower costs over the long term for individuals, businesses, organizations, and governments.

Adaptation is fundamentally about finding creative solutions to a persistent, growing, and complex problem. Investing in adaptation will spur innovation, promote clean growth and jobs, and reduce GHG emissions.

There is the potential for Canada to create an export market for its adaptation solutions, as well as opportunities for Canada to contribute expertise internationally. These opportunities could be related to food production in northern climates, agricultural practices that increase resilience while reducing emissions, the assessment of infrastructure vulnerability, coastal zone management, water management, and sustainable forest management, among others.

Efforts to reduce the environmental footprint of individuals, communities, organizations, and businesses will contribute to greater resilience by reducing resource use (e.g., water conservation contributes to resilience against drought) and strategically managing natural spaces, which act as a buffer against impacts. Furthermore, increasing resilience can have positive benefits for the conservation of nature, health, safety and security, economic prosperity, and disaster risk reduction.

Canadians routinely manage risk and make decisions in the face of uncertainty, with incomplete and imperfect information. Adapting to climate change will take the same skills, and will require a shift in values to prioritize investments of time, money, and effort now, in order to avoid future losses. In some cases, incremental changes to existing processes will be sufficient. In other cases, transformational change to decision-making and priority-setting at all levels will be required.

### **1.3 ADAPTATION ACTION IN CANADA**

Adapting to climate change impacts is a shared responsibility. Governments, communities, the private sector, academia, the non-profit sector, professional organizations, and individuals all have important roles to play in building resilience to climate change.

In Canada, there is growing awareness of the impacts of climate change and the value of adaptation, and there are examples of initiatives being advanced across the country. However, these typically address or react to risks from the current climate and do not look ahead to future changes. Generally speaking, there are relatively few examples of specific and proactive actions to reduce vulnerability to climate change.

At the federal level, efforts to encourage and support adaptation decision-making have been made in a number of areas, such as: producing climate research and foundational knowledge on impacts and adaptation; developing northern infrastructure standards; delivering targeted programming in key areas (e.g., health and well-being, northern and Indigenous communities, key economic sectors); and convening partners and stakeholders to discuss shared priorities and best practices.

Many provinces and territories have recognized the need to adapt either through stand-alone plans or strategies or as part of broader climate change plans or strategies and have made investments to support adaptation decision-making. While the scope and scale of efforts vary across the country, provincial and territorial activities include: implementing adaptation strategies; funding for research, pilot projects, and regional risk and vulnerability assessments to support adaptation planning and decision making; action to strengthen land-use planning processes, infrastructure investments, and building codes through the inclusion of climate change considerations; efforts to increase awareness about impacts and adaptation options for communities; and the development of tools to help integrate adaptation into all levels of decision making. (See Annex 2 for summaries of each jurisdiction's adaptation activities.)

At the local level, cities and communities are actively planning for climate risks, for example, through the development of adaptation strategies that inform city planning and infrastructure and encourage action by homeowners and businesses. While there is increasing awareness and a willingness to act in many communities, action is often limited by a lack of capacity. There is a need to address the unique challenges faced by large urban centres, as well as the capacity issues encountered in smaller, rural, remote, and Indigenous communities. In Indigenous communities, adaptation action is taking the form of, for example,

the development of community plans and hazard maps, greenhouse initiatives that contribute to food security, and specific actions to maintain cultural practices and engage youth.

In the private sector, companies are also integrating climate considerations into their investment, planning, and operational decisions in order to improve their long-term resilience and competitiveness. Professional associations (e.g., engineers, planners, accountants, insurers, foresters) are working to inform and equip their members to be able to address a changing climate in their professional practice.

Given the range and magnitude of projected impacts, there is a need to scale up collective efforts and move beyond planning and project-based actions. Through public submissions and a workshop with key Canadian organizations, the Working Group heard a clear call for action to mobilize all Canadians to take significant and sustained action to prepare for the impacts of climate change. A summary of engagement activities and key messages is provided in Annex 1.

## **2 A PAN-CANADIAN APPROACH TO ADAPTATION AND CLIMATE RESILIENCE**

Adapting to climate change is a long-term challenge that implicates all facets of society. It requires a sustained and ambitious approach. The Working Group has put forward a vision to connect the range of actions that are being and will be taken across the country to a collective goal, as well as principles to guide adaptation efforts in all sectors, regions, and communities.

### **2.1 VISION**

*A Canada where policy and action, from the local to the national scale, enhance the resilience and prosperity of communities, the economy, and the environment in the face of a changing climate.*

### **2.2 GUIDING PRINCIPLES**

- Adaptation should be undertaken proactively at all levels, from the local to the national
- Adaptation initiatives should prioritize the most vulnerable populations and regions
- Adaptation actions must respect existing roles and responsibilities and build on the commitments and actions already taken by the federal, provincial, and territorial governments
- Adaptation actions must respect the constitutional, treaty, and internationally recognized rights of Indigenous Peoples
- Adaptation should be integrated into decision-making
- Decision-making should be supported by the best available evidence, including science, data, and local and traditional knowledge
- Adaptation approaches should be flexible, scalable, and reflect unique regional circumstances
- Adaptation planning should consider the interconnected nature of social, environmental, and economic systems
- Adaptation is a shared responsibility and requires collaborative action
- Adaptation actions should maximize health, social, ecological, and economic benefits

## 2.3 AREAS OF FOCUS

The options developed by the Working Group span six areas of focus, which are divided in two groups. Options for **foundational action** will promote adaptation action across all sectors and regions and are prerequisites for action in other areas. The options for **action in priority areas** represent areas where there is currently an opportunity to build resilience and influence decisions or address immediate vulnerabilities. Long-term adaptation action will require that the areas of focus, particularly the priority areas, be revisited on a regular basis and adjusted as needed.

### 2.3.1 OPTIONS FOR FOUNDATIONAL ACTION

1. Supporting decision-making with knowledge and information by ensuring all Canadians have access to authoritative, accessible, and actionable information on changing climate conditions, impacts, and risks and improving observation, monitoring, and surveillance networks
2. Building capacity to translate knowledge into action by creating climate resilience centres that can advance on-the-ground adaptation efforts, as well as by supporting efforts to raise awareness, foster adaptation leaders and champions, and increase training and skills development

### 2.3.2 OPTIONS FOR ACTION IN PRIORITY AREAS

1. Building resilience through infrastructure by ensuring that climate change is considered in infrastructure decisions, promoting nature-based solutions, and investing in infrastructure projects that are specifically designed to address climate change impacts
2. Promoting healthy ecosystems and healthy people by advancing ecosystem resilience as an adaptation solution, integrating climate change considerations into natural resource management and biodiversity conservation decisions, promoting integrated planning, and taking targeted action to improve the health and well-being of Canadians in the face of climate change
3. Supporting particularly vulnerable regions, specifically Canada's coasts and the North, by understanding changes in these environments and implementing concrete adaptation actions
4. Reducing climate-related hazards and disaster risks, such as floods, wildfires, drought, and extreme wind and heat, by ensuring that disaster planning considers climate change, advancing work to deal with specific hazards, and improving collaboration across practitioner communities

## 2.4 KEY REQUIREMENTS FOR SUSTAINING AMBITIOUS COLLABORATIVE ACTION

In order to deliver on the foundational and priority areas outlined above, there are several fundamental requirements that should be in place: a Canada-wide commitment to action, Indigenous engagement, sustained funding, and strong governance.

### 2.4.1 A CANADA-WIDE COMMITMENT TO ACT ON ADAPTATION

The adaptation challenge is bigger than any one individual or organization. All of Canadian society must be engaged in these efforts to adapt, including governments, Indigenous Peoples, the private sector, academia, non-governmental organizations, and individuals. Although all Canadians need to be involved in building a climate resilient Canada, governments can provide leadership by making their own assets and operations resilient and ensuring that their programs, policies, and actions promote and facilitate adaptation beyond government.

While Ministers of the Environment champion adaptation efforts within the federal, provincial, and territorial governments, adaptation is far broader in scope than the environment. The impacts of a changing climate have implications for every government portfolio. It will be important for all Ministers to take action to adapt and build resilience, including those responsible for health, Indigenous affairs, emergency management, infrastructure, local government, natural resources, forests, agriculture, fisheries, energy, economy, and innovation. The Working Group on Adaptation and Climate Resilience encourages all ministries, departments, and agencies to identify climate change as a priority for urgent and sustained action, ensure climate risks are being considered, and engage in concerted efforts to address those risks.

## 2.4.2 AUTHENTIC AND SUSTAINED INDIGENOUS ENGAGEMENT

Although Indigenous peoples are among the most vulnerable to a changing climate due to their close relationship with the environment and its resources, they are not merely passive recipients of climate change impacts. Rather, they are active drivers and agents of change who contribute vital knowledge, experience, and leadership to adaptation efforts across the country.

Going forward, efforts on adaptation must be more inclusive and meaningful and move toward a model of collaborative decision-making. To fulfill Canada's commitment to a renewed, nation-to-nation relationship with Indigenous Peoples, sustained and meaningful collaboration must recognize the rights and interests of Indigenous Peoples as set out in Canada's Constitution. This approach will also advance the implementation of the United Nations Declaration on the Rights of Indigenous Peoples, of which the Government of Canada is a full supporter, without qualification, and which includes the principle of free, prior, and informed consent. Collaboration must also recognize the treaty rights of Indigenous Peoples to make laws and manage resources on their Settlement Lands where comprehensive land claim agreements have been signed. This engagement should be community led, regionally facilitated, and nationally coordinated.

## 2.4.3 SUSTAINED FUNDING TO ENABLE LONG-TERM PLANNING AND ACTION

Taking action to adapt to current and future impacts will require targeted investments; however, the cost of delayed action or inaction is much greater. Building climate resilience is an ongoing challenge. Strategic, long-term planning and action requires a strong commitment to act, supported by sustained investments. These investments must reflect the scope and magnitude of the challenge.

The current funding approach—too often, fragmented, short-term, and project-based—is insufficient to meaningfully address the adaptation challenges Canada is facing. Sustained government funding can allow jurisdictions to identify and act on their own adaptation priorities, with targeted support for the most vulnerable communities and regions, including Indigenous Peoples. The impacts of climate change affect all aspects of society, and the costs of adapting cannot be borne by governments alone; the private sector and civil society can also make important contributions, including through innovative partnerships.

## 2.4.4 STRONG GOVERNANCE THROUGH FORMALIZED COLLABORATION

Sustained and strategic collaboration on adaptation is essential. Sustained leadership by the Canadian Council of Ministers of the Environment (CCME) would advance action on adaptation across all jurisdictions. An adaptation-specific committee under CCME could be responsible for providing advice on strategic adaptation policy and for reviewing progress and priorities at regular intervals. It could also facilitate engagement with other Ministerial tables (e.g., health, Indigenous affairs, emergency management, forestry, transportation, agriculture, fisheries and aquaculture, energy and mines, and conservation, wildlife, and biodiversity).

While interjurisdictional collaboration is important, collaboration on adaptation must go beyond federal, provincial, and territorial governments. There are a number of existing fora that support this broad intersectoral and interdisciplinary collaboration. For example, Canada's Adaptation Platform has established a base for collaboration and for sharing information and knowledge, including with the private sector and professional associations. Complementary to the Platform, the Climate Change Adaptation Community of Practice facilitates information sharing among researchers, experts, policy-makers, and practitioners from across Canada. The Disaster Risk Reduction Roundtable brings together stakeholders from the public and private sectors, academia, non-governmental organizations, and Indigenous groups to coordinate leadership and action on disaster risk reduction activities, and will be important in aligning efforts on climate change adaptation and disaster risk reduction.

Other fora at the provincial and territorial level also bring together adaptation practitioners (e.g., a health community of practice in Quebec, the Regional Adaptation Collaboratives, the Pan-Territorial Adaptation Partnership). At the international level, the United Nations Framework Convention on Climate Change and other fora (e.g., the World Health Organization, North American Climate Change and Human Health Working Group) offer opportunities for Canada to strengthen and disseminate research and science, share best practices and lessons learned about climate change, engage Indigenous Peoples, and assist developing countries in increasing their resilience.

### **3 OPTIONS FOR ACTION**

For each area of focus, a range of options is presented to advance adaptation across Canada. It is not necessary for each jurisdiction to implement every option. Jurisdictions will choose which options to implement based on their own circumstances, needs, priorities, funding levels, and partnership opportunities. Some jurisdictions have already implemented one or more of the options presented here.

The options outlined in this report are not meant to limit action, either now or in the future. They should be seen as inclusive and evolving, to be updated as Canada continues to make progress on adaptation.

#### **3.1 OPTIONS FOR FOUNDATIONAL ACTION**

##### **3.1.1 SUPPORTING DECISION-MAKING WITH KNOWLEDGE AND INFORMATION**

Resilient people, communities, infrastructure, ecosystems, and economies rely on authoritative, accessible, and actionable information on changing conditions, the consequences of those changes, and existing solutions. This information is the foundation for adaptation planning. It underpins decision making across all sectors, including health, infrastructure, transportation, agriculture, natural resource and ecosystem management, manufacturing, tourism, insurance, water- and land-use planning, conservation, and disaster management.

Foundational information provides the basis needed for further analysis, such as climate risk assessments, which apply data, climate scenarios, and information (including socio-economic factors) to understand the specific risks posed by climate change broadly across the country or to a particular region, sector, or asset. Risk assessments support the identification and evaluation of priority areas for action and enable adaptation planning. Furthermore, long-term, systematic surveillance and monitoring, including local observation and citizen science, is essential to understanding and managing risks and supporting decision-making across sectors.

The landscape of climate and related information is complex. Information and services are required by a variety of users with a range of needs, including information at various geographic and time scales. Data and information are collected, generated, and delivered by a range of partners. Providing the knowledge, information, and tools necessary to support adaptation decision-making is a shared responsibility. It requires collaboration within and between the federal, provincial, and territorial governments, as well as partnerships with Indigenous Peoples and governments, research consortia, non-governmental organizations, academia, local governments, the private sector, and international governments and organizations. It must also value and harness the experience and knowledge of Indigenous Peoples, which can play an important role in informing adaptation action, not only in Indigenous communities, but more broadly in Canada. The incorporation of Traditional Knowledge must be done in a meaningful, inclusive, and equitable way that respects issues of ownership, values the cultural practices and traditions to which this knowledge is inherently tied, and treats it as a living, dynamic body of knowledge rather than a static artefact.

Additionally, more equitable access to information for decision-making and action is crucial, and efforts must be made to correct existing inequities in access (e.g., in Indigenous communities). This could include providing assistance and building capacity to allow community members to access information and tools, adapt it to their context, and be in a position to lead research and monitoring efforts. In this respect, the options outlined in the “Building Capacity to Translate Knowledge into Action” section (Option 4, Option 5, Option 6) should be viewed as essential complements to the information-related options in this section.

## *OPTIONS*

### **Option 1: Establish a multi-stakeholder Canadian Centre for Climate Services**

In cooperation with existing information and service providers, Environment and Climate Change Canada could lead efforts to establish a Canadian Centre for Climate Services to bring together governments, academia, and other organizations to deliver the information and services needed by a wide range of adaptation decision-makers. The structure of the Centre would consider the roles, responsibilities, and competencies of participating jurisdictions and organizations.

The Centre could enhance open and equitable access to a variety of information, in areas such as:

- Climate (climate models and scenarios, seasonal forecasts, growing degree days, wind)
- Water (sea-level rise, water depth, tidal, storm surge predictions, inland and coastal flood risk maps, extreme rainfall data and analysis, sea ice maps and models, ocean acidification)
- Land and natural resources (soil salinity, topographic data, permafrost maps, drought risk maps, forest fire forecasts)
- Transportation and infrastructure (snow loads, vital assets)
- Socio-economic (vulnerable populations, migration patterns, economic capacity)

With a central physical location and a strong virtual network, the Centre could include: a mechanism for ongoing dialogue with and support for users; access to data and information through a single window and targeted complementary channels; and expertise to support the appropriate use of information.

The Centre could leverage existing capacities, bridge information and service gaps, and enhance the delivery of climate services by bringing cohesion and greater dialogue among climate information producers, providers, and users. The result would be a coordinated system that delivers locally and regionally relevant, accessible, authoritative, and actionable information and services.

## Option 2: Assess climate risk and the state of resiliency

The federal government could undertake, with provinces, territories, and other partners, a Canada-wide assessment of climate risk and the state of resiliency that builds on work completed to date. This could raise general awareness about resilience, support priority setting for future investments and action, and provide an overview of progress on adaptation. The Canada-wide assessment of climate risk should be a sustained effort that is reviewed regularly and communicated broadly. It would complement work on a national risk profile, which is part of current efforts to develop an emergency management plan for Canada.

The assessment could establish a consistent framework (including methodologies and key indicators), that could frame regional or sectoral assessments while also facilitating the tracking of progress. To support investment decisions and other action, governments, the private sector, and other partners (e.g., academia, non-governmental organizations, watershed authorities) could also undertake regional and sectoral assessments of climate risks related to, for example:

- Infrastructure that provides vital services (e.g., hospitals, water and power utilities)
- Strategic trade, transportation, and other economic assets (including transportation infrastructure that serves remote regions)
- Agricultural production
- Critical ecosystems
- Coastal assets

There are existing tools to support climate risk assessments. The Public Infrastructure Engineering Vulnerability Committee protocol is used to assess climate risks and vulnerabilities across a range of infrastructure systems, including: buildings, water and power utilities, roads and associated structures, and airport infrastructure. The *Health Care Facility Resiliency Toolkit* was developed to help health care facilities assess climate change resilience. The Canadian Council of Forest Ministers has produced a comprehensive framework for structured vulnerability assessments of sustainable forest management, which is applicable across Canada. Recognizing that several tools already exist, a concerted effort must be made to ensure decision-makers at all levels are aware of them and have the capacity to use them.

Climate risk assessments require authoritative data, climate scenarios and other information that could be provided by the proposed Canadian Centre for Climate Services (Option 1) and/or climate resilience centres (Option 4).

## Option 3: Improve observation, monitoring, and surveillance networks

Governments and key partners could work to better inform adaptation action by addressing some gaps in existing observation, monitoring, and surveillance activities. Indigenous Peoples are well positioned to play a leadership role in these efforts, given their deep knowledge and understanding of the land.

Governments could strengthen atmospheric, hydrometric, and oceanographic monitoring, such as rainfall extremes, snow, wind, sea ice, waves, tides, and sea levels, particularly in the North and coastal areas. Reducing gaps in geographic coverage and ensuring that comprehensive climate measurements are collected would facilitate the creation of tools and resources to help decision-makers improve planning.

Starting with a focus on Indigenous and northern communities, governments could facilitate a network of local observers of climate impacts. They could document and share observations on climate trends and impacts using local and Traditional Knowledge (including consulting Indigenous Elders), science, and technology. Promising models to draw on include the Local Environmental Observer Network and the Environmental Guardians / Watchmen model. Enabling citizen-based monitoring and local observation



programs raises awareness and contributes important information for community adaptation initiatives. Such a network would build collaborative partnerships between communities and researchers. Engaging youth in these efforts would have additional benefits, such as the maintenance of cultural values and the transmission of Traditional Knowledge.

Governments and the health sector could strengthen the coordinated monitoring and surveillance of climate change-related health impacts. This would allow for comparable, consistent data collection and analysis, and improve understanding of climate change risks and the impacts on human health and well-being, including for Indigenous Peoples. This could include information on changes in risks and impacts over time, rates of climate-related illness and disease, the impacts on and costs to the health system and society more broadly, and the effectiveness of interventions.

Governments and key partners could also establish robust and long-term wildlife and ecosystem health surveillance, monitoring, and analysis to improve understanding of their current state and future risks and vulnerabilities. This could track climate change impacts on biodiversity, including ecosystems and their services, as well as impacts on pests and pathogens. Monitoring sentinel species and ecosystems can provide early warnings about threats to human, animal, and environmental health, and potential climate change-related vulnerabilities in food safety and security, public health capacity, economic stability, and social capital.

Governments and agricultural stakeholders, including farming organizations, producers, and commodity groups, could also enhance collaboration to monitor the impacts of climate change on food production and supply and be an important source of information on how food production in Canada evolves in response to climate change.

### 3.1.2 BUILDING CAPACITY TO TRANSLATE KNOWLEDGE INTO ACTION

Successfully implementing adaptation actions depends on a willingness to act and the financial and human capacity to do so. This willingness to act can be bolstered by the support of constituents, memberships, stakeholders, and peers who are aware of climate change impacts and understand the need to adapt. Targeted campaigns grounded in concrete actions can build awareness, support action, and drive change.

The capacity to drive long-term change includes having knowledgeable and skilled practitioners and leaders with access to adequate funding. Capacity building activities include increasing knowledge and experience among adaptation practitioners and decision-makers, developing local adaptation leaders, increasing awareness in individuals working in related fields, engaging youth to build awareness from a young age, hiring staff to manage adaptation initiatives, and providing access to sustained resources (human and financial) to implement adaptation actions. Actors include the general public, Indigenous Peoples, professionals and practitioners across many disciplines, and government and private sector decision- and policy-makers.

#### *OPTIONS*

##### **Option 4: Establish a network of climate resilience centres**

In addition to the proposed Canadian Centre for Climate Services (Option 1), there is a need to ensure that Canadians in all jurisdictions have access to locally-relevant information, tools, expertise, and have the capacity to act. The federal, provincial, and territorial governments could work together with Indigenous Peoples to enhance existing capacity and create new capacity through a network of climate resilience centres.

These centres could bring together adaptation experts from various disciplines to help decision-makers and practitioners develop innovative responses to climate change impacts. Experts could include climate scientists, ecologists, economists, social scientists, agriculture, fisheries and aquaculture specialists, foresters, Traditional Knowledge holders, health professionals, adaptation practitioners, engineers, planners, artists, infrastructure vulnerability assessment experts, specialists in natural infrastructure solutions, and professionals specializing in home and building adaptation assessments.

Engaging Indigenous Peoples, using Traditional Knowledge, and tailoring information and tools to their particular needs could increase access to climate data, best practices, and tools. Furthermore, Indigenous Peoples can make valuable contributions by informing the development of tools and knowledge that are applicable more broadly.

Climate resilience centres could be involved in a number of activities, including:

1. Creating and delivering regionally- and locally-relevant information and services and providing support and guidance, with links to other climate resilience centres, the Canadian Centre for Climate Services (Option 1), and observation, monitoring, and surveillance networks (Option 3)
2. Developing and delivering local awareness-raising and capacity-building activities
3. Leading regional and local climate risk assessments based on common methodologies, indicators, and tools for evaluating vulnerability
4. Providing targeted research, knowledge, expertise, and services (e.g., disaster risk reduction and adaptation, climate resilient infrastructure, specific impacts, food security, emerging diseases, natural adaptation solutions, social / behavioural science)

#### **Option 5: Promote investments in training, skills, and capacity development**

Making progress on adaptation will require that professionals across all sectors have the knowledge and skills that they need. There are several ways to build this capacity throughout the workforce, all of which will need to be developed in a way that ensures equitable access and cultural sensitivity.

Peer-to-peer communication, inspiration, and sharing of successes and experiences are powerful motivational tools. Governments could enable the identification and promotion of adaptation champions and leaders. This could be achieved through climate resilience champion awards that raise the profile of individuals, communities, Indigenous spokespersons, businesses, schools, hospitals, and other organizations who are finding practical and innovative ways to adapt to climate change. Intensive climate resilience training programs for high potential individuals could also help develop adaptation leaders. Governments could also support partnering communities for peer-to-peer learning, which would benefit a wide range of communities (e.g., Indigenous communities, small / remote towns, large urban centres).

Governments, colleges, and universities could work together to enhance training opportunities, including:

- Training to teach government or community staff about climate change and its impacts on government programs, policies, and operations
- Scholarship programs to support university and college students, with a special emphasis on Indigenous students, studying adaptation-related issues
- Training, secondments, job swaps, communities of practice, and mentorship programs for professionals and practitioners already in the workforce

Governments and professional associations could work together to build adaptation capacity in the workforce. For example, foresters, agrologists, engineers, planners, landscape architects, natural resource managers,

accountants, health professionals, real estate professionals, local government staff and leaders, and others, should all be encouraged to continuously strengthen their ability to understand the impacts of climate change and apply solutions. Tools to support capacity-building activities include best practices, standardized guidance, model zoning by-laws and planning policies, accessible toolkits for considering future climate, assessment tools, cost-benefit tools, education, information, and training initiatives (e.g., secondments, job swaps, mentorship programs).

Governments could develop capacity within Indigenous and remote communities through a network of mobile adaptation experts, complemented by other efforts to build capacity, share knowledge, and raise awareness, such as community-led radio programs. These mobile adaptation experts could work within multiple communities in a region to help identify local adaptation issues, expertise, and solutions. They could also help communities access sustainable funding opportunities and assist with the development and implementation of adaptation initiatives.

#### **Option 6: Work with partners to mobilize Canadians**

Governments, the private sector, non-governmental organizations, and others could undertake topic specific education and awareness campaigns grounded in concrete actions to build support for adaptation and promote resilience. Topics could include health impacts and adaptation, natural infrastructure solutions, flood risk reduction, or wildland fire risk reduction. In addition, arts and culture granting councils could support the communication of climate change impacts and adaptation solutions through art and literature. Since local grassroots organizations are often at the leading edge of efforts to enable broad behavioural change, they could be supported to allow them to continue acting as social change leaders.

## **3.2 OPTIONS FOR ACTION IN PRIORITY AREAS**

### **3.2.1 BUILDING RESILIENCE THROUGH INFRASTRUCTURE**

Infrastructure plays a critical role in social, economic, and ecological well-being. It provides essential services to communities and businesses, including water, power, agriculture, hospitals and other health care facilities, transportation networks, telecommunications, and protection from the elements. Infrastructure is heavily interconnected, so a failure in one area can trigger failures in others. For example, damage to power transmission infrastructure can spur failures in telecommunications, health care systems, transportation networks, and other infrastructure.

In the context of this report, infrastructure refers to everything from traditional hard infrastructure (e.g., urban and rural buildings, water and waste water treatment facilities, public and private transportation networks, energy infrastructure, dikes, wharves, and seawalls, etc.) to natural infrastructure<sup>1</sup>

#### **INFRASTRUCTURE INTERCONNECTIVITY**

In 2005, extreme rainfall resulted in the collapse of a section of a major arterial street in Toronto, Ontario. This resulted in damage to two high-pressure gas mains, a potable water main, and telephone, hydro and cable service lines that were buried beneath the road. Costly repairs closed the road for months.



<sup>1</sup> In the context of this report, natural infrastructure refers to specific smaller-scale / local projects, as opposed to much larger ecosystem- or watershed-scale adaptation approaches (which are covered in Option 12).

(e.g., urban parks and tree canopies, naturalized stormwater basins and shorelines, and intact natural systems) to seasonal infrastructure (e.g., sea ice, winter roads).

Climate change impacts are already increasing the vulnerability of infrastructure, as well as the social and economic systems it supports, particularly in Indigenous communities where infrastructure is already a concern. Climate related infrastructure failures can result in threats to health and safety, interruptions in essential services, disruptions in economic activity, trade, and productivity, and high costs for recovery and replacement. As a result, there is a compelling case to be made for incorporating climate change considerations into all decisions regarding infrastructure. These decisions start with urban and land-use planning and water management, before a specific project is even contemplated. This ensures a comprehensive understanding of needs and risks prior to construction. This process includes consideration of different types of infrastructure (e.g., hard vs. natural), as well as the design, location, operation, maintenance, and decommissioning of infrastructure assets.

Billions of dollars are spent annually on new and existing infrastructure by all governments and the private sector; for example, the Government of Canada has committed to spend \$120 billion over 10 years. Making these substantial, long-lived investments resilient to climate change impacts saves costs in the long term and provides opportunities for the implementation of innovative approaches.

There are significant infrastructure needs in Indigenous and northern communities. While they vary between communities, they typically include housing, drinking water and wastewater treatment plants, basic internet connectivity, education, health and wellness facilities, and commercial/business facilities for economic development. In northern communities, thawing permafrost presents an additional and substantial challenge, as it impacts the landscape, infrastructure integrity, and the cost of many activities. Infrastructure solutions in Indigenous communities must be culturally sensitive and relevant, as well as energy efficient in their design. Efforts to ensure the climate-resilience of infrastructure—both existing and new—in these communities presents an opportunity to build overall resilience to other stressors in addition to climate change.

Natural infrastructure can play an increasingly important role in building resilience. While traditional infrastructure projects are more common, natural infrastructure has the potential to deliver the same results, but with multiple additional benefits (e.g., carbon storage, wildlife habitat, food security, recreational opportunities, health benefits). Natural infrastructure has a high return on investment, creates green jobs, and provides a cost-effective alternative (or complement) to traditional hard infrastructure. This is particularly relevant in circumstances where hard infrastructure may negatively affect local species and ecosystems (e.g., the impact of seawalls on coastal species and ecosystems).

Building climate resilience through infrastructure will require a shift in approaches to planning and funding. This is not limited to public and publicly funded infrastructure; the private sector also needs to consider climate risk and impacts in its projects (e.g., telecommunication, energy transmission, transportation). It will be important to ensure that an authoritative and accessible source for climate related data, information, and

### **PERMAFROST THAW AND TRANSPORTATION NETWORKS**

Segments of Yukon's highways affected by permafrost thaw require repairs and rehabilitation approximately three times more often than non-permafrost sections. Yukon's highway maintenance costs are over six times higher in permafrost areas than in non-permafrost areas.



knowledge is available to support efforts in this area (Option 1), as well as to ensure the relevant professional groups have the capacity and training they require to consider climate change in infrastructure decisions (Option 5).

## *OPTIONS*

### **Option 7: Develop Canada-wide guidelines, codes, standards, and best practices for climate-resilient traditional and natural infrastructure**

Governments could work together to develop a common toolbox that would support decision-makers and professionals in every jurisdiction in managing climate risks related to infrastructure. The toolbox could include best practices, guidelines, or standards for integrating climate change considerations. This initiative could provide guidance on where, when, and how climate change should be considered, including the types of infrastructure that are a higher priority for considering climate change and the stages when doing so is most important. It could also provide guidance and tools for systematically considering climate change impacts in all phases and aspects of infrastructure decision-making, including:

- Planning, design, location/siting, construction, and decommissioning, including procurement and regulatory approval processes (e.g., environmental assessments)
- Maintenance and retrofit of existing infrastructure (hard and natural), including vulnerability assessments and asset management approaches

It could also provide information on requirements, approaches, and tools for natural infrastructure, land-use planning and water management, the consideration of implications for Indigenous communities, and innovative and/or new applications of infrastructure technologies.

Individual jurisdictions would determine when and how to integrate climate change considerations into infrastructure decisions, whether through legislation, policies, directives, standards, and/or guidance.

Work is already underway to incorporate climate considerations into codes and standards. The federal government's 2016 Budget included funding for initiating and advancing these efforts over the next five years. This work will include the development of a revised national building code by 2020 (residential, institutional, commercial and industrial buildings). Guides that integrate climate resilience into the design and rehabilitation of public infrastructure (e.g., bridges, roads, potable water, and wastewater systems) are also being developed. Additional codes and standards related to climate resilience could be developed or updated to address areas, such as natural infrastructure, emerging technologies, renovations to existing building stock, specific complex building types like health care facilities, and environmental impact assessments. Work on codes and standards should also consider how they would be meaningfully implemented in Indigenous communities and other communities with limited enforcement capacity.

### **Option 8: Revise government procurement policies, where appropriate, to ensure consideration of climate change and co-benefits in infrastructure decisions**

Governments could review policies related to infrastructure financing and development with a view to ensuring that future climate is considered systematically and maximum co-benefits are achieved (including for health, biodiversity, and GHG reductions). Lowest-price procurement practices that do not consider climate change impacts or co-benefits can lead to higher costs over the lifespan of infrastructure by encouraging the replication of older, cheaper technologies and at-risk infrastructure. Procurement processes that consider climate change and co-benefits as evaluation criteria over the lifecycle of a project can encourage innovation, improve safety, result in long-term savings, and ultimately make the project more resilient.

Guidance could be established for considering climate vulnerability or risk assessments in infrastructure design (e.g., using a tool such as Engineers Canada’s Public Infrastructure Engineering Vulnerability Committee Protocol) or for implementing asset management planning for new and existing infrastructure projects. Any such considerations would take time to implement and would need to be tailored to reflect local circumstances. Regardless of the specific approach or mechanism, it would be necessary to ensure that the tools needed to apply these considerations are accessible. Consideration would also need to be given to how implement such mechanisms in Indigenous and northern communities, where budgets are limited and infrastructure needs are significant.

#### **Option 9: Make natural infrastructure a priority**

Living natural infrastructure offers a viable, sensible, and cost-effective approach to increasing resilience in the face of more intense weather events and dwindling water supplies. Governments could work to promote the increased use of natural infrastructure as an effective alternative and complement to traditional approaches, as the latter alone are unlikely to be able to protect against all climate change impacts. When planned and implemented alongside traditional infrastructure, natural solutions reduce traditional infrastructure requirements. For example, using natural infrastructure, like green roofs, to absorb stormwater where it falls can reduce the size—and therefore cost—of stormwater pipes needed. Natural infrastructure can also prolong the life of hard infrastructure (e.g., roads that are shaded from extreme heat by trees last longer than those that are exposed). Implementing “consider living natural infrastructure first” policies could promote natural infrastructure solutions by requiring project proponents to consider whether a natural approach will address the infrastructure need, where applicable.

#### **Option 10: Provide dedicated funding, top-up funding, or other financial incentives for advancing climate resilience through infrastructure**

Funding can build resilience in a number of ways. First, a top-up fund that covers or contributes to additional planning and construction costs could ensure that adaptation efforts are undertaken, where appropriate. This would help address the additional upfront costs of building resilience into infrastructure projects.

Second, while ideally all infrastructure projects would be built to be climate resilient, there is a subset of projects that are needed to directly address specific climate impacts (e.g., extreme precipitation, coastal erosion, storm surge, higher temperatures). These include both hard and natural infrastructure projects, as well as retrofits and upgrades to existing infrastructure. While adaptation infrastructure has been eligible for funding in the context of omnibus programs, these types of projects—which provide significant longer-term benefits and cost savings—typically compete for priority with infrastructure projects across a range of categories. A dedicated stream of funding for adaptation and disaster risk reduction projects could directly target adaptation-related infrastructure needs, and could be prioritized based on greatest vulnerability or need. For example, some municipalities have established stormwater fees or levies, with the goal of providing

#### **ADAPTATION INFRASTRUCTURE: THE RED RIVER FLOODWAY**

The Red River Floodway, which protects the City of Winnipeg, was originally constructed in 1968 at a total cost of \$63 million. It was recently expanded in 2014 at a cost of \$627 million. Since 1968, the Floodway has prevented approximately \$40 billion (in 2011 dollars) in flood-related damages for the City of Winnipeg.



dedicated funding to address community-level stormwater planning and upgrades, including retrofits (see Option 11).

Additionally, a dedicated stream of funding for natural infrastructure adaptation solutions could be established to increase investments in these types of projects. At a minimum, natural infrastructure projects could be considered eligible for existing infrastructure funding.

**Option 11: Include climate change adaptation in land-use planning, transportation, and demand-side management policies that affect infrastructure demand**

Governments could integrate climate change considerations and adaptation needs into the policies used to determine whether infrastructure is needed in the first place. This would build resilience, while offsetting infrastructure needs and costs. Relevant policies and tools include land-use planning, transportation planning, watershed planning, protection of natural areas and features, demand-side management (e.g., energy or water), and stormwater pricing. This approach could be mobilized through, for example, provincial, territorial, or local government directives, land-use planning frameworks, policies, and incentives.

Smart growth strategies can help communities mitigate GHG emissions and adapt to climate change, natural disasters, and other challenges, like energy price volatility. Strategies include directing development and growth in areas determined to be less vulnerable to climate impacts; discouraging development in vulnerable areas; preserving large, contiguous natural areas to better protect ecosystems under pressure from the changing climate and to protect natural infrastructure (e.g., absorb flood waters); and coordinating land-use planning and transportation infrastructure decisions, and incorporating climate change projections into these decisions.

Demand-side management that encourages water- and energy-efficiency in buildings and land-use patterns helps communities and their residents better cope with drought and extreme heat. It can also offset the need for bigger or more water and waste water and energy infrastructure.

**INFLUENCING INFRASTRUCTURE DEMAND: STORMWATER PRICING**

The City of Mississauga is one of the few municipalities in Canada that have a dedicated fee for stormwater management to address the intersecting pressures of a growing municipality, aging infrastructure, and climate change impacts. Properties are assessed based on their total hard surface area and charged accordingly (e.g., the greater the hard surface area, the higher the charge). In 2016, the stormwater charge will generate \$33 million in revenue, with \$12.3 million going to operations and maintenance and \$20.7 million going to infrastructure renewal. The advantage of a stormwater fee is that it lowers demand for new stormwater infrastructure, and flood mitigation and wet weather management priorities will not compete with other municipal priorities for general revenue.

### 3.2.2 PROMOTING HEALTHY ECOSYSTEMS AND HEALTHY PEOPLE

People are an integral part of the natural world, and human health and well-being depends on the health of species and ecosystems. In turn, healthy Canadians are more resilient and able to withstand the impacts of climate hazards, better able to contribute to efforts to address climate change, and participate in a vibrant economy.

Healthy, biologically diverse ecosystems are often more resilient to the adverse effects of climate change and they play a vital role in climate change mitigation. Wilderness areas, working landscapes and seascapes (e.g., agricultural lands, fisheries, sustainably managed forests), and urban ecosystems (e.g., urban forests, city parks, naturalized yards) provide communities with important ecosystem services, such as natural cooling, improved air quality, and flood protection. These ecosystem services would be very costly or



impossible to replace if damaged or lost. The natural environment is also an integral part of Indigenous culture, identity, and survival.

Resilient ecosystems also support the health and safety of communities across Canada by providing clean air and water, contributing to an active lifestyle, and having a positive influence on mental health. Ecosystems that are resilient to climate change impacts will also help to secure healthy living and livelihoods for people who depend on natural resources (e.g., forestry, fishing, trapping, tourist outfitters for hunting and fishing, and non-consumptive uses, such as wildlife viewing and ecotourism).

## ENHANCING ECOSYSTEM RESILIENCE

Steps taken to enhance the resilience of Canada's natural environment to the impacts of climate change will determine the diversity of species and ecosystems in the future. They will help maintain the ecosystem services that benefit human health, the economy, and society as a whole (e.g., food, raw materials, pollination, fresh water, recreation, natural carbon sequestration), including buffering communities from climate change impacts like more frequent and severe flooding. Resilient ecosystems are also integral to the long-term sustainability of resource sectors, like agriculture, fisheries, and forestry, in a changing climate.

Evaluating how legislation, regulations, policies, and programs support ecosystem resilience could be a first step. Better valuing the services provided by healthy, diverse, and resilient ecosystems can also contribute to more informed decision-making where natural capital is concerned (e.g., land-use planning, local government asset management).

Nature and biodiversity play an important role in reducing the social, economic, and environmental vulnerabilities related to climate change, as well as promoting healthy lifestyles. Sustainable management, conservation, and restoration of ecosystems, along with the implementation of targeted natural adaptation solutions (including natural infrastructure – see Option 9), can be an effective way to protect communities and help Canadians adapt to climate change. It is also an area where Indigenous Peoples can provide leadership in their capacity as stewards of the land. While natural solutions often result in significant additional benefits, they are currently underused for adaptation purposes.

## OPTIONS

### **Option 12: Promote ecosystem resilience as an adaptation solution**

Governments could favour the increasing use of resilient ecosystems as an effective adaptation measure. There are many ways to promote the use of natural adaptation solutions, including the approaches outlined below.

Natural assets could be better incorporated into existing frameworks and processes by improving consistency across jurisdictions. This could include developing guidelines, templates, and methodologies to support the identification, assessment, and consideration of natural assets (e.g., forests, wetlands) and ecosystem services in land-use planning and related decisions (e.g., natural heritage system planning, disaster risk reduction strategies, water management and watershed planning, and Crown land planning).

Incentives could be used to encourage actions that will build greater resilience (e.g., payments for ecosystem services or dedicated funding to target, for example, natural buffers like wetlands in flood-prone areas). While there is currently a variety of federal, provincial, and territorial funding programs that support conservation, none are dedicated solely to building ecosystem resilience to the impacts of climate change and advancing natural adaptation solutions. In addition to more targeted efforts, it is also important to support and enhance existing conservation funding to achieve win-win solutions for biodiversity and climate change.



Demonstration projects for natural adaptation solutions could be established, including those demonstrating ways to maintain overall ecosystem resilience, and information on their performance over time could also be shared. The experience gained and lessons learned from these projects are needed to inform future adaptation decisions for land and resource managers. Demonstration sites could also serve as an effective way to engage local communities and raise awareness.

Advancing work to value ecosystem services could help build a business case for ecosystem-based adaptation (e.g., protecting natural heritage systems as natural infrastructure, restoring groundwater recharge zones to secure water resources to aid in times of drought). This could also help produce a more complete picture of the costs and benefits of various adaptation decisions, in terms of how these decisions might enhance, diminish, or maintain the ecosystem services and diverse benefits they provide to Canadians. These efforts would ultimately improve the information base for decision-making and allow for evidence-based evaluation and prioritization of adaptation strategies.

### **Option 13: Integrate climate change considerations into all natural resource management decision-making, including biodiversity conservation efforts**

To help ensure ecological resilience and the effectiveness of conservation efforts in the future, planning and action related to biodiversity should incorporate climate change considerations (e.g., shifting habitat ranges) into all relevant areas of conservation work. While this work is already underway in some areas, there is a need for it to be more comprehensive and systematic. Areas where this work could be pursued include, for example, work to address invasive species, sustainable forest management policies and practices, stewardship efforts, protected areas and land-use planning and management (including legislative supports), and environmental assessments. Work on this front could be facilitated through the development of policies, guidelines, standards, tools, and best practices. It would complement efforts already underway by FPT Ministers to better assess and manage cumulative effects and to make progress on government conservation objectives, including the 2020 Biodiversity Goals and Targets for Canada.

### **Option 14: Advance integrated landscape- and watershed-level planning**

Climate change is just one of many stressors that affect ecosystem health and resilience. The most effective way to maintain productive, resilient ecosystems over the long term is by using a holistic, collaborative, landscape-level approach to planning (applicable to both terrestrial and aquatic environments). This sort of approach would consider projected changes in species ranges, ecosystems, and habitats due to climate change, the combined impacts of other pressures, opportunities for biodiversity conservation and restoration, and socio-cultural factors (e.g., Indigenous People's connection to the land). International cooperation with the United States and other countries would be an important part of such efforts.

Focus areas for landscape level planning going forward could include: the species, natural areas, landscapes, agricultural lands, or watersheds that are most vulnerable to climate change; areas that will provide connections that allow for species migration and habitat shift; key species of importance to Indigenous Peoples; and ecosystems that are important carbon sinks. Financial mechanisms to support this approach could be developed.

## **PROTECTING AND IMPROVING HUMAN HEALTH AND WELL-BEING**

Climate change is increasing the risks to the health and well-being of Canadians. Indeed, the World Health Organization has called climate change the defining issue of the 21<sup>st</sup> century and has asked member states to take urgent action to protect public health from its impacts.

The health and well-being of Canadians can best be protected from the impacts of climate change by focusing on both prevention (e.g., building capacity and awareness to promote good health and well being

and efforts to reduce risks), as well as effective response and recovery actions to address impacts (e.g., providing health care and related health services, actions, and interventions, such as heat and wildland fire smoke awareness and response plans). While there is already work underway, it will be important to build on and expand these efforts.

In doing so, it is important to take a broad and inclusive view of health and well-being. The social and cultural determinants of health must be accounted for, recognizing that factors like food, water, income, and energy security play an integral role in determining health and well-being. Community resources and traditions (e.g., Elders, traditional cultural practices, youth centres) also make significant contributions to health and well-being and they are as essential as conventional health resources. Furthermore, issues of health equity must be taken into account, especially since marginalized populations are often the most vulnerable and the least able to recover.

Efforts in this area must also extend to health promotion, including suicide prevention and mental health, which are often overlooked in the context of climate change impacts. More attention in this area is warranted, especially given that mental health is one of the prime factors in determining the resilience of an individual and a community. The prevalence of some mental health issues, like post-traumatic stress disorder and general anxiety, may rise in the medium to long term following a disaster or emergency. Additionally, anxiety related to changing climate and weather patterns, as well as the resultant impacts on livelihoods and traditional ways of living, is increasing in affected communities (e.g., Indigenous and farming communities). Psychosocial and mental health support is and will be increasingly needed to address the impacts of the loss of cultural identity in communities with a strong sense of place and deep ties to the land (e.g., coastal relocation, the inability to carry out traditional Indigenous cultural practices).

There is an opportunity for those involved in promoting health and well-being to take a greater leadership role in building capacity, increasing collaboration, strengthening partnerships, and mobilizing action to reduce the harmful health and psychosocial consequences of climate change. This will include raising awareness of climate change as a key risk to health and well-being while advocating for proactive and preventative measures to make individuals and communities healthier and better able to withstand climate change impacts, including advocating for healthy built environments that are resilient, protect from extreme weather, promote active transportation, and provide equitable access to safe, healthy foods. Taking collaborative action on this front will result in significant cost savings to the health system and the economy.

#### *OPTION*

#### **Option 15: Help Canadians adapt to the health impacts of climate change**

Capacity building will be necessary to enhance the ability of health practitioners, managers, program staff, and community-based health professionals to recognize and address the risks and impacts of climate change

#### **INFORMING PUBLIC HEALTH AND SAFETY DECISION-MAKING**

The Surveillance and Prevention of the impacts of Extreme Meteorological Events (SUPREME) tool, developed by Quebec's public health institute, provides a complete, real-time picture of the weather (actual conditions, forecasts, and alerts), historical data (e.g., temperature, floods), as well as factors that may influence the effect of weather on human health (e.g., heat islands, population density, housing conditions). This web portal is an innovative and low-cost tool to inform decision-making on public health and safety.



on public health. For example, this could be achieved by developing and applying guidelines and standards, technical guidance, and training courses, and by embedding climate change into all training related to the health and well-being of Canadians, including related disciplines (e.g., veterinary medicine, social work).

Increasing knowledge among Canadians about climate change–related health risks is important and will require collaborative efforts across the health community, including nurses, medical, and non-medical professionals, health emergency managers, public health professionals, academia, and non-governmental organizations. The intersection between public health and health care will become even more important as rising temperatures and changes in air quality exacerbate respiratory and cardiovascular illnesses, which may impact front-line health care. Strengthening channels for sharing knowledge and expertise related to the health impacts of climate change is integral to building the capacity necessary for managing and reducing adverse health outcomes. Additionally, a variety of initiatives could contribute to a robust knowledge base and improve strategic planning, such as vulnerability assessments, expanded monitoring (e.g., real-time health surveillance), incentives or scholarships for universities and colleges, innovative research and tools, and information sharing (e.g., experiences, success stories).

Efforts to increase knowledge and capacity must be complemented by work that puts that knowledge into practice. Specific actions to mitigate and respond to the health risks from climate change are needed. These could include:

- promoting green urban planning to reduce the consequences of extreme heat and precipitation;
- increasing food security;
- reducing the risks associated with emerging or re-emerging diseases influenced by a changing climate;
- supporting health-related adaptation planning (e.g., for health systems and health care facilities) with incentive-based approaches; and
- supporting the use of Indigenous approaches to promote health and wellness, including sweat lodges, Elder-youth based well-being programs, and harvesting programs.

In particular, it is essential that these efforts prioritize remote, isolated, and vulnerable communities, including Indigenous communities. This includes capacity building and support for the development of regionally specific and community-led adaptation plans and actions. These plans and actions should meaningfully engage Indigenous Peoples in their design and implementation, incorporate local and traditional knowledge, facilitate education and awareness, and promote holistic Indigenous health programs that exist both within and outside the primary health care system. They should also address unique challenges, such as increased transmission of disease in overcrowded houses or where there is no or limited access to clean water. To address the health impacts of climate change in the long term, support should be provided to adaptation and resilience efforts at the grassroots level, which can contribute to sustainable changes in behaviour and policy.

### 3.2.3 SUPPORTING VULNERABLE REGIONS

All regions in Canada are faced with unique risks and challenges; however, Canada's coastal and northern regions are particularly vulnerable and disproportionately affected by the impacts of climate change. The changes already being experienced are both dramatic and permanent. Unlike rebuilding after an extreme event like a flood or a fire, once permafrost has thawed, coastlines have eroded, or socio cultural sites and assets have disappeared, they are lost forever. These impacts have significant social, cultural, ecological, and economic implications.

Many of the options presented in the other sections of this report would contribute to increased resilience in these regions. However, this section presents options for near-term actions unique to Canada's coastal and

northern regions. For example, the information provided by the Canadian Centre for Climate Services (Option 1), targeted risk assessments (Option 2), and observation, monitoring, and surveillance networks (Option 3) would be invaluable in informing action in both of these regions. Capacity-building and skills development initiatives would also be essential in advancing work in vulnerable regions, including the climate resilience centres (Option 4) and mobile adaptation capacity to serve remote and Indigenous communities (Option 5). Additionally, infrastructure efforts, such as dedicated funding for adaptation infrastructure (Option 10) would play an important role in building resilience in these regions.

## COASTAL AREAS

Canada's Atlantic, Pacific, and Arctic coasts extend across 243,000 kilometres. Each region has unique vulnerabilities, sensitivities, and exposures to climate change. Changes in the natural environment have important socio-economic and cultural impacts, particularly given the high concentration of communities and economic activities along Canada's coasts. For instance, according to a 2016 study by Ouranos, the estimated cost of coastal erosion in Quebec's Gulf of St. Lawrence over the next 50 years is \$1.5 billion, with over 5,400 buildings and 320 kilometres of roads and railways affected. Additionally, ocean acidification and rising water temperatures affect marine fisheries, aquaculture, and ecosystems.

In the Arctic and northern areas, sea ice loss is creating safety hazards for people using the ice as transportation to food sources and other communities. It is also increasing the risk of oil spills and accidents from increased marine traffic, which is compounded by a fundamental lack of scientific knowledge to support these activities, the remoteness of the region, and a lack of capacity to respond to such events.

The consequences of the physical changes are exacerbated by other factors, such as socio-economic contexts, current infrastructure, and services, as well as a strong attachment to place that is particularly relevant in the context of retreat or relocation, especially in Indigenous communities.

## OPTION

### Option 16: Develop and implement a coastal adaptation initiative

The federal government could work with implicated provinces, territories, Indigenous communities, stakeholders, local governments, and international partners (e.g., the United States) to develop and implement a comprehensive, coordinated, and regionally specific coastal adaptation initiative. The initiative would cover the three marine coasts and ecosystems, as well as the Great Lakes and the St. Lawrence. Some initial areas of focus could be related to data, risk assessments, and collaborative planning.

Coastal and marine data and information is needed. This could include expanded coastal flood risk maps, oceanographic data, LiDAR mapping (including bathymetric), an expanded and sustained network of tide gauges, sea ice monitoring, coastal erosion monitoring, data on marine fisheries and aquaculture, and information related to the safe passage of ships, as well as broader dissemination and value added products to help decision-makers translate data to action.

### VULNERABLE REGIONS: LENNOX ISLAND, PEI

The Lennox Island First Nation is facing the combined pressures of rapid population growth and serious climate change threats from erosion and sea-level rise. Located on PEI's north shore, the island's territory is shrinking and could be entirely cut off from the mainland by increasingly severe storm surges. The Nation is now looking to build a 30-house subdivision on land it has acquired on mainland PEI. With two homes in immediate need of help, the choices are to relocate them (which will have significant cultural consequences) or reinforce the shoreline—either option will be expensive.

Risk assessments for coastal lands and assets could help in the identification of vulnerable areas and economic and socio-cultural assets (e.g., aquaculture, archaeological sites) and could help prioritize adaptive action. This work would be dependent on a variety of data being available (e.g., mapping of flood and erosion risks), and would be supported by Option 1 and Option 2.

Collaborative coastal planning and management of high-risk areas would be useful in enhancing long term outcomes with respect to environmental, economic, social, cultural, and recreational factors. This would include, among other elements, the design, location, and adaptation of existing and new coastal assets, and support tools for choosing, implementing, and managing adaptation solutions (including planned retreat and relocation), all considered within the broader coastal context.

## THE NORTH

Canada's North is undergoing a period of intense change. Northerners are balancing interest in resource development, rapidly evolving technological opportunities, and socio-economic challenges, all while experiencing the most intense climate change impacts of any region in Canada. With a landscape highly sensitive to small changes in temperature and precipitation, the rapid pace of change is having an unprecedented impact on social structures, economic development, ecosystems, and the built environment. Arctic systems will test the threshold for resilience far earlier than other regions within Canada, and there is an urgent need to identify and implement adaptation measures that will improve community and ecosystem sustainability.

The governance structure of Canada's North is unique in comparison to the rest of Canada. Self-government, land claims, and continuing devolution of land and resource management responsibilities mean that several governments are involved in decision-making: regional Indigenous, territorial, provincial, and federal. There is also strong international interest in the Canadian Arctic and it is the subject of international research and policy decisions.

Territorial and provincial governments, northern organizations, northern Indigenous communities, and academic and research organizations have been working together for many years to identify and address climate change impact and adaptation priorities. For example, the Pan-Territorial Adaptation Partnership is a collaboration between the Governments of Yukon, Northwest Territories, and Nunavut to identify and realize tangible adaptation outcomes in the North. This partnership convened the 2013 Pan-Territorial Permafrost

## CLIMATE CHANGE AFFECTS CULTURAL SURVIVAL

The Old Crow Flats is an ecologically significant network of lakes that is closely linked to the cultural identity of the Vuntut Gwitchin in northern Yukon. In June 2007, more than 80% per cent of Zelma Lake (equivalent of 2,300 Olympic-size swimming pools) drained away in a few days due to permafrost thaw.



"I was raised in Crow Flats [...]. For years my Mother monitored that area and noticed the permafrost thawing. In 2007 the lake broke through and [...]with it went our fish, the caribou changed their migratory route, and the ducks and birds disappeared. The whole of Old Crow Flats is changing very fast due to climate change. The traditional and cultural knowledge that is paramount for the survival of our future generations is under duress; people choose not to go to these traditional lands much anymore. It's affecting our whole way of life as Gwitchin—our cultural activities, our health and well-being."

*Norma Kassi, Director of Indigenous Collaboration with the Arctic Institute of Community-Based Research*

Workshop that brought together decision-makers and permafrost researchers to address adaptation related to impacts of permafrost degradation, particularly at the local scale. This has been complemented by growing field research aimed at better understanding permafrost and landscape change and how these changes may manifest themselves in the future.

Moving forward, the level of resources and effort dedicated to the North must match the scale of the current and future risk and the potential for irreversible impacts. There is an opportunity to assemble resources and information in support of northern leadership on climate change impacts and adaptation, thereby building capacity and tackling system-wide stressors. Lessons learned can be shared beyond the borders of Canada's North to inform responses to climate impacts throughout Canada.

#### *OPTION*

#### **Option 17: Develop and implement a Northern Adaptation Strategy to drive adaptation in Canada's North**

Work is underway with northern partners to develop a Northern Adaptation Strategy to identify priorities for action on climate change in the North. With coordinated efforts led by Indigenous and Northern Affairs Canada, the Strategy will set the stage for a new collaborative approach to addressing adaptation throughout the North. It will engage governments, Indigenous Peoples, and communities in mobilizing action and fostering innovation to support the development of strong and resilient communities and contribute to renewed Arctic leadership.

Although there are many pressing climate change issues facing Canada's North, all of which will need to be addressed either in the Strategy or elsewhere, some of the most significant ones include:

- Permafrost and infrastructure (including standards for mapping)
- Community, First Nations, and Inuit capacity
- Food, water, and energy security
- Risk analysis
- Emergency preparedness and response
- Cultural sites and traditional practices
- Health and well-being

While the Strategy will focus on the three territories, as well as Nunatsiavut and Nunavik, the expertise, lessons learned, technologies, and information gained through activities under the Strategy would benefit not only provinces with northern regions but all provinces, as well as Indigenous communities throughout Canada. A concerted effort should be made to share this knowledge and experience broadly.

### **3.2.4 REDUCING CLIMATE-RELATED HAZARDS AND DISASTER RISKS**

Climate change is impacting extreme and catastrophic weather events throughout much of Canada, including the likelihood of flooding, wildfire, drought, heat, and wind. Recent extreme events have resulted in loss of lives and livelihoods, considerable property damage, disruptions to the economy and the lives of thousands of people, and led to extraordinary costs for response and recovery. These include floods in Alberta, Manitoba, Saskatchewan, Quebec, and Ontario, and fires in Alberta, British Columbia, Saskatchewan, Yukon, and the Northwest Territories. Indigenous people, families, and communities, in particular, are at high risk of isolation or evacuation, infrastructure and property damage, loss of access to traditional lands and resources, and long-term social and health complications related to extreme events. While there can be capacity to recover from a single disaster, subsequent events can be devastating (e.g., the flooding that affected several

Indigenous communities shortly after the 2016 Fort McMurray fire).

These events highlight vulnerabilities and demonstrate that Canada, as a nation, can do more to prepare. While insured losses are rising, total economic losses are rising even faster, putting significant pressure on governments that are called on to fill the gap. Without urgent action to reduce these risks, losses will become unsustainable.

While hazards and disaster risks have always been a concern, climate change is driving the need to adapt to more intense and frequent events. Traditionally, responses to disasters have been reactive, but recent experiences have shown that investments in proactive and preventative measures are essential. Disaster risk reduction efforts and adaptation measures can work together to buffer society from negative climate-related impacts and better position society to reduce and manage disaster impacts more broadly. Additionally, land-use planning can be a powerful tool in helping to reduce the impacts of natural disasters, and can inform decisions about if and where to rebuild after a disaster.

There are currently a number of disaster risk reduction efforts being developed and implemented. For instance, FireSmart Canada helps communities located in wildland-urban interfaces better prepare for and manage wildland fires. In June 2016, the Canadian Council of Forest Ministers agreed to implement the Canadian Wildland Fire Strategy. Additionally, in May 2016, FPT Ministers responsible for emergency management endorsed the creation of the Emergency Management Plan (EMP) to allow Canada to better mitigate, predict, prepare for, respond to, and recover from weather-related emergencies and natural disasters. The EMP could include a number of initiatives to incorporate climate change considerations into an enhanced approach to emergency management. Among other initiatives, the EMP could include a national risk profile, which would account for climate-related impacts as key drivers of risk moving forward, and could also include an expansion of the National Disaster Mitigation Program to all hazards, as it currently only focuses on flooding.

#### *OPTIONS*

#### **Option 18: Integrate future climate considerations into disaster risk planning, management, response, and recovery policies and strategies**

To be effective, work to reduce disaster risk, such as the future Emergency Management Plan, must consider the impacts of a changing climate. Given that disaster risk reduction requires a significant effort even without the integration of adaptation planning, it would be prudent to begin by integrating climate change considerations into existing plans and processes, and then move towards enhanced planning for future catastrophic events (taking into account increasing scope, intensity, and frequency). Factoring climate change into non-weather-related disasters, like oil spills resulting from increased ship traffic in northern waters, will also be important.

#### **THE COST OF CLIMATE-RELATED DISASTERS**

The province of Alberta has been hit by 7 of the 10 most expensive disasters in Canadian history. Although no one event directly affects insurance rates, most Albertans are paying higher premiums. The recent Fort McMurray wildfire caused an estimated \$3.58 billion in damage. The Insurance Bureau of Canada has already labelled this disaster the costliest in terms of damage pay out and has made some direct attribution to climate change. While insurers are leading calls for greater efforts to keep people out of harm's way through proactive preventive measures, what is currently left out of insurance-disaster stories is how damage is calculated. Estimates of cost are based on damage to property, leaving out the actual cost of disasters to people, health systems' capacity, livelihoods, and mental health.

Climate change should also be considered when making decisions about how to “build back better” in the wake of these hazards and disasters, or not rebuild at all where the risks are too great, through the construction of climate-resilient infrastructure, both built and natural. This approach could also include potential modifications to the funding criteria for both disaster mitigation and post-disaster recovery to reduce duplication and support increased resilience in recovery / reconstruction.

Ensuring that climate considerations are integrated across the spectrum of disaster risk efforts will depend on the availability of authoritative climate information (Option 1). It will also depend on broad efforts to increase the climate resilience of infrastructure, including the continued development of codes and standards (Option 7).

#### **Option 19: Address specific hazards**

Targeted work is required to address the individual hazards to which Canadians are vulnerable, including flood, wildfire, heat, drought, landslides, and wind. For example, up-to-date flood maps could be created for both coastal and inland areas that incorporate future climate change projections. By providing broad coverage across the country, including for Indigenous communities, these maps would help jurisdictions better manage flood risks. In terms of wildfire, work on the Canadian Council of Forest Ministers' Wildland Fire Strategy should continue and be adequately resourced. To address the impacts of extreme heat, governments could work with partners to expand the coverage of heat alert and response systems and planning for heat-related emergencies. Other risks, such as drought and wind, represent future areas of work. Finally, more broadly, the federal government could expand the scope of and investment in the National Disaster Mitigation Program from flooding to all hazards in order to mitigate, prepare for, respond to, and recover from a range of disaster events. Efforts to address climate hazards should be comprehensive and include Indigenous communities.

#### **Option 20: Improve collaboration across practitioner communities, government institutions, and Indigenous organizations**

Integrating disaster risk reduction and climate change adaptation efforts requires well-coordinated, whole-of-government responses, alongside support of communities and the private sector. Collaborative efforts could include increased information sharing, given that the information needs of the adaptation and emergency management communities often overlap to a degree (e.g., floodplain and wildfire risk mapping). Along with increased collaboration, it will be important to be clear about roles and responsibilities around reducing risks in a changing climate.

## **4 CONCLUSION**

There is an immediate and growing need to adapt to the impacts of climate change in Canada. Failing to do so will have significant consequences for the continued well-being and prosperity of Canada's communities, economy, and environment. Governments can and should play an integral role in building Canada's climate resilience. However, the scope of this challenge requires that all parts of Canadian society be involved, from Indigenous communities to non-governmental organizations to the private sector to academia.

The Pan-Canadian Framework on Clean Growth and Climate Change is an opportunity to begin building widespread resilience across Canada. By supporting and mobilizing action broadly across all sectors and regions, while prioritizing specific vulnerabilities and opportunities, the options presented in this report will help move Canadian adaptation efforts toward a regionally responsive and holistic, system-wide approach that will allow Canadians to thrive in the face of climate impacts.



# **ANNEX 1: WORKING GROUP OVERVIEW AND ENGAGEMENT SUMMARY**

## **WORKING GROUP OVERVIEW**

On March 3, 2016, Canada's First Ministers released the Vancouver Declaration on Clean Growth and Climate Change. As a result, provincial, territorial, and federal governments came together to build on existing provincial and territorial actions and develop a Pan-Canadian Framework on Clean Growth and Climate Change to encourage clean economic growth, reduce greenhouse gas emissions, and prepare for the impacts of climate change. First Ministers agreed to identify measures that governments could take to reduce emissions and grow the economy in the longer term by establishing working groups in four areas: clean technology, innovation and jobs; carbon pricing mechanisms; specific mitigation opportunities; and adaptation and climate resilience.

The Working Group on Adaptation and Climate Resilience was mandated to provide a report with options on a comprehensive approach to adapt to climate change impacts, support affected communities—including Indigenous communities—and build greater resilience to these impacts. It identified specific priorities to support adaptation, including disaster risk reduction and conservation, and considered a range of policy tools to foster research, innovation, and investments in resilient infrastructure, integrate information, expertise, and best practices from Indigenous Peoples, and support the development of jurisdictional policies.

## **INDIGENOUS ENGAGEMENT**

The co-chairs of the Working Groups participated in some weekly teleconference calls with the Assembly of First Nations, Inuit Tapiriit Kanatami, and Métis National Council to provide updates on their work, as well as the opportunity for two- to three-hour discussions at face-to-face Working Group meetings. Federal co-chairs also offered to make themselves available for discussions.

The Assembly of First Nations, Inuit Tapiriit Kanatami, and Métis National Council expressed the hope and expectation that the Working Group process would be the beginning of a renewed, sustained dialogue. The Assembly of First Nations and the Métis National Council submitted substantive reports to the Working Group in August and, where possible, the issues, ideas, and recommendations have been integrated throughout this report. The Inuit Tapiriit Kanatami has committed to providing an Inuit-specific report outlining key Inuit priorities and policy recommendations for Canada's climate strategy to the Ministerial Tables developing policy recommendations for First Ministers.

The following messages were heard during early discussions with the Assembly of First Nations, Inuit Tapiriit Kanatami, and Métis National Council and helped shape the Working Group's report:

Adaptation and resilience are not just about the climate impacts felt by Indigenous communities; rather, Indigenous Peoples want to be presented as active agents of environmental, social, and cultural change. Building resilience in the face of climate change is fundamentally about food, water, and energy security and independence, where Indigenous communities are self-sufficient and are not dependent on importing what is needed for their survival and expression.

Priorities for Indigenous Peoples were also discussed and include infrastructure and the built environment, regional land management arrangements, and social and cultural resilience. Establishing a meaningful dialogue between Traditional Knowledge and science will likely also be a key issue. There is a need to ensure that the use of Traditional Knowledge in adaptation planning and action is done in an appropriate way that is

mindful of intellectual property issues, and that values Traditional Knowledge as equal to scientific knowledge.

## **STAKEHOLDER ENGAGEMENT**

In order to understand the breadth of adaptation challenges and identify innovative solutions, the Working Group engaged a range of partners and stakeholders. Engagement was carried out through a multi-day stakeholder engagement event held in Toronto on June 2-3, 2016. The Working Group invited approximately 50 organizations that represent the broad range of adaptation stakeholders and are national in scope (or have a significant presence across multiple jurisdictions).

Participating organizations:

- Canadian Association of Petroleum Producers
- Canadian Cattlemen's Association
- Canadian Chamber of Commerce
- Canadian Coalition for Green Health Care
- Canadian Electricity Association
- Canadian Federation of Agriculture
- Canadian Parks and Wilderness Society
- Canadian Society of Landscape Architects
- Canadian Wildlife Health Cooperative
- Chartered Professional Accountants Canada
- Ducks Unlimited Canada
- Engineers Canada
- Federation of Canadian Municipalities
- Fertilizer Canada
- Forest Products Association of Canada
- ICLEI – Local Governments for Sustainability
- Institute for Catastrophic Loss Reduction
- Insurance Bureau of Canada
- Intact Centre on Climate Adaptation
- International Institute for Sustainable Development
- Mining Association of Canada
- Nature Conservancy of Canada
- Northern Climate ExChange
- Ontario Centre for Climate Impacts and Adaptation Resources
- Ouranos
- Pacific Climate Impacts Consortium
- Railway Association of Canada
- University of Prince Edward Island Climate Research Lab
- World Wildlife Fund

At the event, participants provided brief presentations followed by moderated discussion with the Working Group members and other stakeholders. The following questions were provided in advance to help focus the presentations:

- What barriers do you face in adapting to climate change?
- What opportunities for innovation exist in your sector?
- What are your proposed solutions?

The general themes and ideas from the stakeholder engagement event are summarized below. Several participants later made submissions through the online portal.

## INFORMATION BROKERS

*Information brokers are organizations that facilitate the translation of foundational climate data into information, tools, and support for adaptation decision-making.*

The urgency for action on adaptation was broadly recognized by information brokers. It was noted that voluntary measures are insufficient; current policies and policy tools enable adaptation, but few are drivers of adaptation.

Recommended actions for governments included incorporating adaptation into all government decision-making and promoting collaboration at all levels. Increased investments in research and development to support innovation, leadership training, and national and regional climate services (that include tailored, science-based, regional information and knowledge) were highlighted as important elements for success.

Information brokers noted that a national climate change adaptation strategy should include a national strategy on climate services. Furthermore, a national risk assessment framework and monitoring and evaluation framework would support increased investments, and also more strategic investments through improved priority setting.

Several recommendations were presented to support the shift from providing climate information to creating knowledge products and tools for informing decisions and action. These included valuing the role of extension agencies and boundary organizations (organizations that specialize in translating science, information, and knowledge for use in decision-making) and reframing the issue by putting climate change in the context of other priorities for communities. Recommendations from information brokers also included developing methods and tools for integrating climate change considerations into decision-making that are scalable; developing projects in collaboration with end users; and focusing on simple tools underpinned by sound science. Stakeholders encouraged taking a broad view of resilience, as it was noted that there is not always a need to differentiate between climate resilience and resilience writ large in order to achieve desired outcomes.

## PEOPLE AND COMMUNITIES

From a local government perspective, barriers to adaptation include a lack of local capacity (human and financial) and a lack of accessible and locally relevant data and information on climate risks, particularly with respect to infrastructure.

Identified needs included capacity building, accessible information, resources (both human and financial) for undertaking risk and vulnerability assessments and adaptation planning, and investments in climate-resilient infrastructure. Stakeholders also expressed an interest in flexible and scalable approaches to meet the varied needs of communities (e.g., depending on region or size), and collaboration and partnerships with

other institutions, organizations, and local communities to help local governments understand and plan for current and expected impacts.

Representatives from the health sector expressed a need for healthcare facilities to better assess and prepare for climate change impacts to ensure essential services are maintained during extreme events. Stakeholders also identified a need for a wildlife health monitoring program to support public health objectives and the maintenance of traditional lifestyles.

Stakeholders also underscored the lack of capacity of small and remote communities to plan and prepare for climate change risks and access funds, as well as the need for support for them in doing so (in contrast to larger towns and cities, which tend to be better equipped, have greater capacity, and are already taking action). Where communities are too small or remote to support local capacity, stakeholders identified creating mobile regional capacity as an option.

## ENVIRONMENT AND CONSERVATION

Groups underscored the critical roles that natural systems play in responding to a changing climate, including as carbon sinks, refuges for species, buffers against impacts (e.g., floods, droughts), and support for built infrastructure. Barriers include a lack of incentives, gaps in regionally specific information, a lack of understanding about the role of natural systems, and inadequate valuing of ecosystem services.

Recommendations included promoting land-use planning that incorporates nature-based solutions; giving priority to adaptation solutions that work with nature and promote ecological resiliency; restoring, valuing, and employing wetlands as adaptation solutions; and properly valuing ecosystem services. The importance of undertaking systemic, large-scale conservation planning and incorporating climate change considerations into all conservation and species at risk activities were highlighted. The conservation of habitat corridors and increasing connectivity can allow for species and habitat shifts, and keeping working landscapes and seascapes closer to their natural conditions can increase resilience. The importance of demonstration projects was also noted.

## ECONOMIC SECTORS

Groups from a variety of sectors (e.g., forestry, mining, energy, agriculture) highlighted the importance of resilient trade and support infrastructure (e.g., bridges, roads, rail, water networks), and the need for a strong focus on innovation. There were calls for improved information, including: scientific research; national climate data; climate change information that is accessible, usable, and appropriate to local contexts; tools for integrating information into decision making; and information on the financial risks of climate change (e.g., the risk posed by inaction on both reducing emissions and adapting).

Perceived barriers to adaptation identified by stakeholders included: a lack of climate information (at the appropriate geographic and temporal scales); a lack of private sector awareness of risks, opportunities, and specific industry vulnerabilities; and inadequate understanding of the importance of investments in resilience. Groups highlighted the need to address the tension between short-term competitiveness and potential long-term investments required for resilience. Protecting economic competitiveness must therefore be a priority of adaptation policy.

Recommended policy responses put forward by stakeholders included land-use planning frameworks that incorporate adaptation, as well as flexible and responsive policy and legal frameworks. Other suggestions included the need for investments in northern infrastructure and the establishment of formal mechanisms for ongoing partnerships and collaboration across sectors and with government.

## PROFESSIONAL ASSOCIATIONS

The roles of professionals were highlighted in a number of areas, including mainstreaming adaptation into decision-making, bringing different disciplines together, valuing investments in resilience, and creating pathways to translate science into practice. The value of public-private partnerships was noted.

There are opportunities to better engage the private sector, particularly corporate leaders, and make the business case for adaptation investments. The investment community, institutional investors, and bankers are critical audiences to engage. Professionals need accessible and up-to-date information, policy direction on new design standards, innovation in tools, technologies, and systems, and high-level support for advocating for alternative approaches and methodologies.

Recommendations were provided on building climate-resilient infrastructure, such as vulnerability assessments, codes, standards, and related instruments, and underlying datasets and projections. A National Flood Strategy was proposed, and the potential of programs to reduce climate change risks at the homeowner level, such as the home adaptation assessment program, was noted.

## ONLINE ENGAGEMENT

The Working Group has also received input via the interactive website set up to allow the public to engage in the pan-Canadian framework process. The main themes that emerged included:

**Infrastructure:** Many submissions focused on adaptation activities in urban areas, particularly relating to traditional infrastructure (e.g., transportation and building codes) and natural infrastructure, such as green roofs, urban forests, and urban agriculture. Several mechanisms were proposed for building resilient traditional infrastructure, including procurement policies, more robust existing critical infrastructure, incentives, and support for communities. Natural infrastructure was identified as a way of reducing the urban heat island effect, aiding with stormwater management, and contributing to food security. Recommendations related to natural infrastructure included policies, programs, and financial mechanisms (e.g., a “consider living green infrastructure first” policy), funding eligibility, prioritization of natural infrastructure projects, and best management practices and standards for maintenance.

**Healthy ecosystems:** Submissions related to the conservation of healthy ecosystems included recommendations to assess lands and prioritize areas for protection, protect the water-food-energy-biodiversity nexus, include natural ecosystem assets and adaptation considerations in land-use planning, consider climate change impacts in species protection plans, and support assisted migration of plant and animal species.

**Awareness:** Portal submissions related to awareness raising included developing locally-relevant adaptation awareness brochures, incorporating climate change education into school curricula, supporting education workshops in schools, using peer-to-peer learning, social media, and how-to guides (e.g., for wildland fire, floods, conservation, and natural infrastructure systems), and developing educational technologies and mobile apps. It was also suggested that the arts (e.g. visual arts, literature, music) could also be used as an innovative way of building public awareness.

**Research:** There were calls for research funding and support for research networks (in order to develop regional data and expertise), community-university research initiatives, Northern-specific research efforts, and further research on the transportation sector, natural infrastructure, and climate forecasting. Submissions also emphasized the need for up-to-date and reliable climate data and services, as well as vulnerability and risk assessments (e.g. climate change, wildfire, flood), which were identified as essential tools to inform adaptation efforts.

**Indigenous Peoples:** Recommendations specific to Indigenous communities included acknowledging Indigenous rights and obtaining social license prior to engaging in projects, supporting capacity building in smaller and Indigenous communities to define climate risk and vulnerabilities to infrastructure, developing community-based adaptation plans, partnering with Indigenous communities to enhance local climate information and build resilience, providing sustained funding for on-reserve infrastructure, and supporting partnerships.

**International:** Recommendations regarding Canada's collaboration with international partners included supporting international climate change knowledge sharing, increasing scientific outreach and knowledge exchange, and engaging in cross-border collaboration with the United States to support ecosystem and species monitoring.

## ANNEX 2: JURISDICTIONAL ACTIVITIES

### YUKON

The Government of Yukon has clear direction and is taking action to improve its ability to adapt to climate change. This is outlined in its *Climate Change Action Plan Progress Report (2015)*. The territorial government has undertaken adaptation actions both directly and through partnerships with the federal government and non-government organizations. The Government of Yukon approach is guided by the following goals: enhancing knowledge and understanding of climate change, adapting to climate change, reducing greenhouse gas emissions, and leading Yukon action in response to climate change.

The Government of Yukon has heard from local communities and First Nations that climate change impacts on wildlife and wildlife habitat present significant risks for food security and the prosperity of communities. Numerous projects have been undertaken in the territory on the impacts of climate change on First Nations cultural activities, traditional food sources, and the use of Traditional Knowledge to understand and respond to climate change impacts.

Thawing and unstable permafrost creates immediate impacts on buildings and highway infrastructure, causing significant safety concerns and financial costs for the Government of Yukon and Yukon communities. The Government of Yukon has performed risk and/or vulnerability assessments, disaster resiliency planning, and is actively monitoring permafrost temperatures and identifying intervention opportunities to mitigate impacts with the help of the *Yukon Permafrost Knowledge Network*.

Increasing awareness about climate change impacts and adaptation options for Yukoners, as well as creating tools to help build adaptation into all levels of decision-making, is a priority for the Government of Yukon. The *Yukon Climate Change Indicators and Key Findings* report was developed in 2016 to provide an objective and accessible overview of the current state of Yukon's climate system that will be regularly updated. Other areas of interest include communicating the types of impacts and significance of climate change in Yukon, analyzing the financial costs of impacts and adaptation solutions, and enabling integration of climate change considerations (e.g., projections and modelling) into decision-making, particularly for planning and development. Risk and vulnerability assessments, along with reliable and updated data, have been identified as an important mechanism to further help the decision-making process.

Climate change is increasing the risk of catastrophic flood events. The *Yukon Flood Risk Mapping* project uses elevation modelling to identify where and how Yukon communities may be at risk for flooding. The *Emergency Measures Organization*, along with the Department of Environment, has engaged in a pilot project to evaluate the use of LiDAR and historic water-level data for community flood hazard mapping. It is envisioned that the methods and standards developed through this pilot will lead to publicly accessible flood hazard maps for Yukon communities at-risk of flooding.

### NORTHWEST TERRITORIES

The Government of the Northwest Territories (GNWT) is currently developing a NWT Climate Change Strategic Framework to describe and coordinate actions on climate change adaptation and resilience. This Strategic Framework will replace the NWT Greenhouse Gas Strategy that has been in place since 2001.

Responsibility for climate change adaptation activities within the GNWT is spread amongst departments with responsibilities for affected sectors and these departments work with many partners, including outside academics and experts, NWT Aboriginal governments and local community governments.

Through taking actions to respond to climate change, the NWT has developed considerable multi-disciplinary expertise in responding to impacts. Sector-specific responses continue to be refined and best practices are being developed, but these actions have placed additional costs on maintaining existing infrastructure and have made new projects more expensive.

As the NWT continues to adapt to the impacts from climate change, the GNWT is also focused on growing the territorial economy. Sustainable and innovative economic development of the NWT's many resources will be key in ensuring the people of the NWT are able to thrive in healthy and strong Indigenous and remote communities.

## NUNAVUT

Since the creation of Nunavut in 1999, the Government of Nunavut has been developing programs, policies, and partnerships that assist Nunavummiut (the people of Nunavut) with increasing adaptive capacity and address the impacts of climate change that we are readily experiencing in the north.

Climate change impacts and adaptation initiatives in Nunavut are supported through both standard scientific methods and Inuit Qaujimajatuqangit (IQ), the system of Inuit traditional knowledge and societal values. IQ is based upon a long and close relationship with the land that provides detailed insight into climate change in Canada's north.

The Government of Nunavut places great weight and importance on IQ in its planning, program, and policy development on climate change. Some of the most notable climate change impacts that are readily documented through IQ include: observations of inland as well as sea ice loss and thinning; seasonal freeze up occurring later in the year and melting sooner; the weather is unpredictable and changes faster than it used to with storms blowing up unexpectedly; water levels have gone down as temperatures have increased; permafrost is thawing and the land is drier and less stable.

Nunavut's efforts related to climate change adaptation have been guided by a series of policy initiatives, including the *Nunavut Climate Change Strategy (2003)*, *Upagiatavut: Impact & Adaptation (2011)*, and the *Pan-Territorial Adaptation Strategy (2011)*, which together identify strategic collaborative strategies and actions for addressing climate change impacts and adaptation across the territory and northern Canada.

The Government of Nunavut Climate Change Section has initiated a number of projects to support adaptation in Nunavut over the years. These include (but are in no way limited to): developing the *Nunavut Climate Change Centre (NC<sup>3</sup>)* website that provides Nunavummiut with current information on climate change; creating the *Nunavut Permafrost Databank* to improve access to open-source permafrost data from across the north; outreach initiatives like the *Tukisigiaqta* web-based risk tool that informs Nunavummiut about climate change risks in the home and on the land through a fun and interactive experience; and creating and delivering the *Climate Change Adaptation Training Course for Nunavut Decision-Makers* that instructs community and government staff on climate change impacts and adaptation and builds on both scientific and traditional knowledge.

The Government of Nunavut acknowledges that support for adaptation initiatives in the near-term will result in long-term benefits for all our communities, which include decreased costs to infrastructure, increased safety and security, successful economies, and more sustainable communities. The Government of Nunavut is therefore committed to working nationally to address climate change impacts and supports the undertaking of a coordinated, strategic, Canadian approach that will lead to improved resiliency of our communities.



## BRITISH COLUMBIA

In 2010, the Government of British Columbia released *Preparing for Climate Change: British Columbia's Climate Adaptation Strategy*, a plan to increase knowledge about climate change and its impacts on key economic sectors, and government programs and services; and produce tools to help governments, businesses, and communities find out how climate change will affect them, and what they can do now to prepare. Key elements of British Columbia's approach to adapting to climate change include:

- Climate change assessments for the agriculture, forestry, mining, hydroelectricity, and oil and gas sectors identify climate-related risks and actions that can help these sectors prepare for climate change.
- The Pacific Climate Impacts Consortium, a regional climate service centre, supports adaptation by providing projections of future climate conditions for British Columbia.
- A new Water Sustainability Act protects aquatic ecosystems during times of water scarcity, and allows water for essential household use during droughts.
- Provincial ministries and partners continue to operate and improve hydrological monitoring (climate, snow, surface water, and groundwater) in order to provide better data to support decision-making for drought, flood, infrastructure planning, Environmental Flow Needs, and ecological modelling.
- Guidance on sea dike design and coastal development enables local governments and qualified professionals to protect people, buildings, and infrastructure from sea-level rise.
- Guidance on tree species selection and reforestation ensures that future forests are resilient to future damage from fire, pests, and disease in a changing climate.
- Provincial ministries are taking climate change into account in designing and maintaining highways, managing parks and forest landscapes, and financing agricultural innovation.
- Local governments in British Columbia are planning ahead for climate change; some have integrated climate change adaptation into their plans, policies, priorities, and operations.
- Following completion of a series of climate risk and opportunity assessments, the agriculture sector has focused on developing and implementing multi-partner regional adaptation strategies in key agricultural areas of the province (Cowichan, Delta, the Peace, the Cariboo, the Fraser Valley, and the Okanagan), and is piloting and demonstrating adaptation practices on B.C. farms and ranches.

In 2015 British Columbia initiated a process to develop a new Climate Leadership Plan. The process included two rounds of public and stakeholder consultation, as well as convening an expert advisory panel to make recommendations to the provincial government. A new plan was announced in 2016.

For more information:

<http://www2.gov.bc.ca/gov/content/environment/climate-change>

## ALBERTA

Alberta views action on climate change adaptation as critical and complementary to all efforts to mitigate emissions. Alberta is also committed to developing a provincial adaptation strategy to help ensure the province is better prepared for and more resilient to a changing climate. The strategy will be developed with input from Albertans through a separate engagement process that recognizes the unique challenges and opportunities of adaptation.

Extreme weather events are increasing, and Alberta is focused on disaster mitigation, preparedness, and response. The recent Fort McMurray area fires of May 2016, the 2013 floods in southern areas of the

province, and other such incidents were devastating for many Albertans. Severe damage to public and private property occurred.

To reduce the damage from future flooding, the Provincial Recovery Framework outlines government functions to support local recovery efforts, mitigate future floods, and preparedness for future disasters. Province-wide, regional and community-based flood mitigation projects are complete and underway to reduce the impact of future events. A provincial assessment of flood vulnerability, for instance, investigates how changes in duration and intensity of rainfall affect the timing of flood events. Regional engineering studies assess options for Alberta's most flood-prone river basins, while detailed debris hazard and risk assessments are undertaken for mountain creek communities. Proactive preparedness for future events includes policy to restrict development in floodplains, mandatory standards for infrastructure, upstream infrastructure expansion, and enhancement and restoration of natural ecosystems to increase the ability of watersheds to reduce the intensity, magnitude, duration, and effects of flooding and drought. Hundreds of hectares of wetlands are being restored in high priority areas through the province, and riparian areas are being restored to improve resiliency.

Alberta has also been improving the knowledge on adaptation of forests to future climate. Since the mid-1990s, Alberta has been modelling different planting sites using different climate change scenarios, providing information on the extent to which climate change could affect forest productivity. This work has also facilitated the adjustment of seed use guidelines to allow seed transfers across zones.

Alberta invests in adaptation research and learning. The Climate Change and Emissions Management Corporation has supported three key projects to provide insight into climate change impacts throughout the province to enhance Alberta's ability to respond appropriately: the South Saskatchewan River Basin Adaptation to Climate Variability project helps communities explore possible impacts of climate variability and identifies opportunities for environmental and economic improvement in water storage, infrastructure, and alternative timing of withdrawals, releases, and flows; the Tree Species Adaptation Risk Management Project builds resilience to climate stressors; and the Biodiversity Management and Climate Change Adaptation Project estimates impacts on native species and ecosystems, including response of invasive plants to climate change, as well as tools to support sensitive species at risk.

Alberta has also been contributing to natural infrastructure measures to enhance resiliency to flood and drought through the Watershed Resiliency and Restoration Program. To date, 600 hectares of wetlands and riparian areas have been restored.

Alberta also recognizes the important roles played by municipalities in building resilience at the local community level, and has recently worked municipalities to complete a Resilience Tool Kit to facilitate community-level vulnerability assessments, as well as adaptation and resilience planning.

## **SASKATCHEWAN**

Saskatchewan's recently approved natural hazards risk assessment project under the *National Disaster Mitigation Program* is required to account for future climate change impacts. This will include estimating changing hazard risks under anticipated climate shifts and could be used as a basis for new adaptation strategies.

The Government of Saskatchewan has identified multiple areas for interventions. For instance, highways and infrastructure are a top priority due to freeze-thaw cycles. In order to sustain current infrastructure, Saskatchewan has increased the design flow for new culvert installations on the National Highway System highways from a 1:25 year return period to a 1:50 year return period, and modified culvert design to improve efficiency and safety. Moreover, Saskatchewan is using technology in winter maintenance to provide early

warning of weather events and gather better road information and data, thereby improving response times and ensuring the plows are properly equipped for the weather events. Increased severity and frequency of localized flooding from rainstorms and other extreme precipitation events are being addressed through flood mapping pilot projects and related infrastructure planning initiatives with municipal governments.

The Government of Saskatchewan is in the process of developing a drought strategy, conducting research on water quality at Lake Diefenbaker, and is developing a new water allocation policy and legislation that will provide flexibility to manage shortages. The province has developed an Irrigation Strategy, with a strong focus on long-term capacity building in the irrigation sector and continues to work with the industry to determine feasibility for large-scale irrigation development.

The Government continues to augment its provincial capacity to address wildfire. All aspects of the Wildfire Management program will need to be enhanced to mitigate rising risks including: improving wildfire response capacity; strengthening collaboration with international, national, and provincial jurisdictions; increasing government, community, and industry mitigation efforts; and adopting proactive wildfire legislation.

In partnership with the *Crop Development Centre* at the University of Saskatchewan, the province supports public sector plant breeding and several plant breeders who focus on developing crop varieties that can better withstand changing climatic conditions. In addition to the improvement of existing crop varieties, the province supports the development of new crops that will be suited to future climatic conditions in Saskatchewan. Saskatchewan also works with the federal government to support a strong suite of Business Risk Management programs for the agriculture sector, including Crops Insurance that assist growers in managing risks associated with crop yield declines that can be the result of extreme climatic events.

## MANITOBA

Manitoba has taken significant measures over the past twenty years to reduce the impacts of flooding within the Red and Assiniboine River basins, as well as developed strategies to conserve polar bear, caribou, and moose populations, and address invasive species in Manitoba. Actions include enhancing infrastructure resiliency, provincial strategies on surface water management and drought preparedness, further adaptive initiatives in land-use and watershed planning, and working with municipal and Indigenous communities in the south and in northern Manitoba.

Other initiatives include the release of *TomorrowNow – Manitoba's Green Plan* in 2012, which included a three-phase adaptation pathway approach towards enhanced climate resiliency. Manitoba partnered with the University of Winnipeg to develop a weather and climate data inventory leading to the development of the Climate Atlas, and with International Institute for Sustainable Development to establish the Prairies Climate Centre. Following the Task Force Report on Agricultural Risk Management, early stages of a high-level provincial agricultural adaptation strategy are now underway, climate change adaptation considerations have been integrated into the Provincial Land-Use Policies, and a planning resource guide has been developed to help municipal officials incorporate adaptation into land-use planning. Manitoba has also partnered with Health Canada on a Heat Alert and Response System initiative with Regional Health Authorities in Southern Manitoba.

To improve understanding of the impacts and adaptation associated with climate change to support adaptive decision-making, Manitoba conducted vulnerability assessments covering terrestrial (grassland/agriculture, forestry) ecosystems, wetlands, coastal region, mining, and northern transportation as well as hydrological and water demand studies. As well, policy enablers and barriers to mainstreaming climate change adaptation into natural resource sectors were assessed.

In April 2016, a new government was elected and has made a commitment to develop a new made-in-Manitoba climate action plan, which will include measures to adapt to a changing climate across key sectors. Further stakeholder engagement will be undertaken. The new climate plan will include land-use and conservation measures that sequester carbon and foster adaptation to climate change, and incorporate climate change into watershed-based planning. Manitoba will also work with partners to implement a province-wide program based on the Alternative Land-Use Services model to help reduce flooding and improve water quality and nutrient management, and develop a framework to reconcile the needs of industry and rural and northern communities while continuing to enhance the network of protected areas in Manitoba. Collectively these measures support enhanced landscape resiliency to flood, drought, and other risks posed by a changing climate, thereby helping to ensure communities and economic sectors are better prepared and less vulnerable to these changes.

Manitoba was a key partner in both of the Prairies Regional Adaptation Collaboratives (PRAC) from 2010-12 and 2014-2016 with several initiatives accomplished within and across the three Prairie Provinces. Manitoba is a member of the Natural Resources Canada-led Plenary and Platform Working Groups and has participated in several sector-based projects funded under the Platform over the past three years.

## ONTARIO

Building on recommendations from *The Report of the Expert Panel on Climate Change Adaptation (2009)*, the province released *Climate Ready: Ontario's Adaptation Strategy and Action Plan (2011-2014)*. The Plan served as a first step in taking action across government on adaptation. It contains 37 actions to be taken by ten ministries including two overarching actions to ensure the ongoing mainstreaming of impacts and adaptation across government. Significant progress has been made on many of the commitments and actions outlined in Climate Ready and will continue to have ongoing relevance as the province moves forward to build resiliency in areas such as infrastructure.

Based on commitments made in Climate Ready, ministries have continued to integrate climate change considerations in decision-making processes, both internal and external to government. To guide internal government decisions, climate change adaptation considerations have been built into the province's ten-year infrastructure plan, *Building Together*, including requiring the province and transfer payment partners (e.g., universities and municipalities) to prepare asset management plans that consider climate change adaptation in project design. Additionally, future projected rainfall intensity-duration-frequency curves to understand the capacity and thresholds for key infrastructure in the province are being developed.

In order to guide decision-making by external parties, the province has also supported the development and demonstration of a range of tools to identify and assess vulnerabilities to infrastructure. Projects to date have included vulnerability assessments using the Public Infrastructure Engineering Vulnerability Committee's (PIEVC) risk analysis approach, and included assessments of three public buildings and a municipal water treatment facility.

Ontario has integrated climate change into Great Lakes agreements including the Canada-Ontario Agreement on Great Lakes Water Quality and Ecosystem Health. This agreement contains a new Climate Change Annex that aims to continue to build understanding of climate change impacts and integrate this knowledge into Great Lakes adaptation strategies and management actions.

The province is working with its partners in the agricultural sector to protect animal health through continuous improvement in early detection, prevention and response to emerging animal diseases. This includes implementation of the Reporting of Hazards and Findings Regulation (2013) under the Animal Health Act (2009), implementation of biosecurity standards for all farm species, and annual reporting of notifiable diseases by third-party animal health laboratories (2014).

With respect to human health, the province has developed the Ontario Climate Change and Health Toolkit to meet the public health challenges of a changing climate in Ontario and to support adaptive and resilient communities. This toolkit has been designed to support an adaptive and resilient public health system that anticipates, addresses and mitigates the emerging risks and impacts of climate change. This Toolkit will assist public health units in raising awareness of climate change as it relates to potential health hazards; and in identifying vulnerabilities and implementing local adaptation strategies. The *Ontario Climate Change and Health Toolkit* was released in July 2016.

With the expansion of black-legged tick populations in Ontario due to climate change, the province has been working with its partners in public health and with other stakeholders to provide Ontarians and health care providers with information and resources they need to know about Lyme disease. The Lyme disease education and awareness plan *Combatting Lyme Disease Through Collaborative Action* was released in July 2016. The Plan identifies opportunities to improve awareness, education, prevention, control and timely diagnosis and treatment of Lyme disease in Ontario.

Land-use planning policies and guidance for municipalities in support of climate change mitigation and adaptation have been integrated as part of the recent update to the *Provincial Policy Statement*, as well as proposed policies in Ontario's provincial land-use plans as part of the ongoing Co-ordinated Plans Review (i.e. Growth Plan for the Greater Golden Horseshoe, Greenbelt Plan, Oak Ridges Moraine Conservation Plan, and Niagara Escarpment Plan). In particular, revised policies in these plans highlight the need for communities to plan for resilient infrastructure, stormwater management, and other adaptation measures (e.g., green infrastructure and low impact development).

Ontario has recently committed to release an update to *Climate Ready*. A key part of the new plan will include the establishment of a Climate Change Modelling Collaborative, which will establish a one-window source for climate data and services. The Modelling Collaborative will work with municipalities, Indigenous communities, and leaders and help both public and private sectors make informed and evidence-based decisions regarding adapting to climate change and increasing resilience. By offering a range of climate services the Modelling Collaborative would provide access to expertise to understand how climate change may affect different activities or lines of business, and help plan for and manage risks in areas such as agriculture, infrastructure, and public health.

## QUEBEC

In 2012, Quebec adopted its 2013-2020 government strategy for Climate Change Adaptation. Through commitment and action, the Strategy aims to reduce the impacts of climate change, to strengthen the resilience of Quebec society and to seize new opportunities provided by climate change. The Strategy is structured around eight priorities and seventeen underlying objectives that focus on specific challenges for Quebec: (1) maintain the health of individuals and communities, (2) preserve economic prosperity (3) improve the safety and longevity of buildings and infrastructures, (4) conserve biodiversity and the benefits of ecosystems, (5) integrate climate change adaptation into the public administration, (6) develop knowledge and know-how, (7) build awareness and provide training, and (8) modify land use and manage risks to reduce vulnerabilities.

The vast majority of the Strategy's objectives are realized through the implementation of the 2013-2020 Climate Change Action Plan that puts forward a complementary approach to reducing greenhouse gas emissions and adapting to climate to change. The Action Plan is financed through the revenues of Quebec's carbon market, which are entirely dedicated to fight against climate change. As such, in addition to investments in greenhouse gas reduction initiatives, more than \$200M is dedicated to a wide range of concrete actions that will strengthen Quebec's collective capacity to adapt.

To better inform decision-making at all levels, the Government of Quebec has a strong partnership with the Ouranos consortium, which it helped create in 2001 to provide specialized information on regional climate science and adaptation. Ouranos has realized over 100 projects in collaboration with government, academia and industry. In addition to developing knowledge and decision-making tools, the Strategy and the Action Plan support specific initiatives in all sectors of adaptation, including ecosystem conservation, urban and municipal planning, disaster mitigation, and vulnerability assessment in coastal communities. The Strategy and the Action Plan also aim to strengthen collaboration at the international level. Following the Paris Agreement, the Quebec government announced a set of cooperative measures totalling \$25.5M to fight climate change in Francophone countries that are the most vulnerable to the consequences of climate change.

Meant to be a collaborative effort, the Strategy and the Action Plan bring together stakeholders and key players in implementing actions from the Quebec government, municipalities, civil society, and research organizations. Finally, to ensure consistency and more efficient government action, adaptation and climate resilience are also reflected in many different government documents, such as the government's *Sustainable Development Strategy 2015-2020* and the Quebec Policy 2014-2024 on civil security. This demonstrates that there are strong links between adaptation, climate resilience, and sustainable development, as well as natural hazards policies.

**For more information:**

[http://www.mddelcc.gouv.qc.ca/changements/plan\\_action/strategie-adaptation2013-2020-en.pdf](http://www.mddelcc.gouv.qc.ca/changements/plan_action/strategie-adaptation2013-2020-en.pdf)

[http://www.mddelcc.gouv.qc.ca/changements/plan\\_action/pacc2020-en.pdf](http://www.mddelcc.gouv.qc.ca/changements/plan_action/pacc2020-en.pdf)

## **NEW BRUNSWICK**

New Brunswick's Climate Change Action Plan 2014-2020 has a solid strategy and a range of actions identified to address climate change adaptation and enhance our collective resilience to the impacts of climate change. These actions are centred on a premise of providing information to help influence decision-makers to consider future climate in all aspects of decision-making. Goal 1 of the Action Plan speaks to Enhancing Resilience to the Impacts of Climate Change, identifying key actions in the focus areas of data collection and research into climate change impacts, risk and opportunity assessments, and mainstreaming adaptation.

Efforts in these areas include the dissemination of climate change knowledge (updated sea-level rise projections, climate-adjusted intensity-duration-frequency curves, coastal erosion monitoring, and updated climate indicators from Ouranos) used to inform decision-makers and the public as to future climate conditions and projected impacts to sectors such as health, infrastructure, and natural resources. Targeted workshops and conferences have been very effective in rolling out the latest climate change knowledge and adaptation measures.

The Province's efforts on climate change adaptation have focused on three main areas: engaging communities, infrastructure owners, and the natural resource sector to identify vulnerabilities and offer solutions and options to address climate impacts. These efforts have resulted in the undertaking of vulnerability assessments and the development of adaptation plans in numerous municipalities, the creation of an Adaptation Planning Guide for municipalities, the completion a cost-benefit analysis of adaptation measures in the major trade corridor for New Brunswick and Nova Scotia, and providing Environmental Impact Reviews that guide project proponents to consider climate change in their project design, construction, and operation.

Key to success on climate adaptation is the ability to collaborate and leverage funding opportunities. The Climate Change Secretariat leverages a range of funding sources, including the Environmental Trust Fund,

Natural Resources Canada, and the Gulf of Maine Council. The Secretariat has made significant efforts to collaborate with our neighbouring jurisdictions in the Atlantic region and leverage our individual contributions to achieve greater results as a collective than any individual province could achieve on its own.

The province is currently undertaking an initiative to explore options to enhance our current climate change action plan. A Select Committee of the New Brunswick Legislature was established to engage with New Brunswickers on the issue of climate change and report back to the Legislature with its recommendations.

## **NOVA SCOTIA**

Nova Scotia's 2009 *Climate Change Action Plan* outlined the province's first steps towards adaptation. In those early years, a community climate adaptation fund was launched to support local adaptation projects; a dedicated climate change website was created to house local climate data and impacts information; a guidebook was developed to help environmental assessment proponents account for and develop plans to respond to anticipated climate risks; municipalities created climate change adaptation and mitigation plans and the province worked with a consortium of Atlantic provinces, municipalities, universities and professional associations on a wide range of risk assessments in a number of vulnerable coastal and inland communities across the region. Since 2010, over 20 local, community-scale projects led by community groups and researchers on the frontlines of climate change have been supported through the adaptation fund and have helped communities prepare for climate change.

Currently, Nova Scotia is focusing its efforts on building the provincial government's capacity to mainstream climate adaptation into all department planning policies and operations, so that it becomes a normal, automatic part of how government does business. We do this by delivering an integrated program of work that was designed in 2014 based on well-established social and behaviour change theory and research. The program works to enhance the socio-cultural competencies of the public service to effectively communicate climate concerns, lead complex adaptation initiatives, work across department silos and build the strong public-private partnerships that are required to advance smart and meaningful action.

Participating departments formally commit to undertaking the program and the associated learning modules, knowledge exchanges and interdepartmental networking that goes with it. They appoint champions to lead the development and implementation of department mainstreaming strategies and project leaders to create teams that will co-design interdepartmental adaptation projects that effectively move research into action. Qualitative and quantitative metrics are used to measure progress not only regarding the implementation and impact of the projects and mainstreaming strategies, but also the ability of the program itself to enhance government's capacity to anticipate, prepare for and respond to projected and unforeseen climate risks. Symposiums are hosted to showcase results and provide a forum for learning exchange and conversation on what is working and not working with advancing adaptation practice.

Participating departments currently include: Nova Scotia Environment, the Nova Scotia Department of Fisheries and Aquaculture, the Nova Scotia Department of Agriculture, Transportation and Infrastructure Renewal, Municipal Affairs, and the Executive Council Office. These departments are advancing adaptation efforts in everything from marine development and land-use planning to infrastructure maintenance and agricultural crop selection. Additional partner departments and sector topics will be added over time. Nova Scotia also continues to support and work with a wide range of industry, academic, and NGO partners to advance adaptation.

## PRINCE EDWARD ISLAND

Prince Edward Island (PEI) is vulnerable to the impacts of climate change. Increased storm intensity and frequency, along with sea-level rise, are leading to increased coastal erosion and coastal flooding. PEI's coastal communities are particularly vulnerable, with publicly- and privately-owned properties, buildings, and infrastructure at risk to storm surges and receding shorelines.

Adaptation efforts on PEI in recent years have focused primarily on risk assessment, community engagement, capacity building, and supporting provincial and municipal decision makers. Since 2008, with funding from Natural Resources Canada's (NRCan) Regional Adaptation Collaborative (RAC) program, PEI has partnered with the Atlantic provinces and the University of Prince Edward Island Climate Lab to form the Atlantic Climate Adaptation Solutions Association (ACASA). Through RAC I (2009-2012), PEI's adaptation efforts included the enhancement and update of its coastal data (e.g., erosion rates, coastal flooding vulnerability, shoreline classification), vulnerability assessments of select coastal communities, and outreach to increase adaptive capacity amongst local decision-makers on PEI. Through RAC II (2012-2016), PEI continued its efforts in building capacity through local conferences and workshops (e.g., for engineers, planners, scientists, municipalities), and also continued its work assessing coastal risk (i.e., coastal erosion and coastal flooding) for municipalities and coastal property owners. PEI also increased its efforts to better integrate climate considerations across provincial government, particularly in the area of infrastructure design, placement, and maintenance.

Through its partnership in ACASA, PEI also co-led two regional projects (funded by NRCan): the development of a decision support tool for small coastal communities and an economic analysis of adaptation option for coastal infrastructure and property. Both projects included extensive stakeholder involvement across federal, provincial, and municipal governments.

Future adaptation efforts on PEI will focus on the dissemination of existing products that will assist provincial and local decision-makers as they seek to minimize climate change impacts. PEI is also currently developing both a climate change mitigation strategy (to be released October 2016) and a climate change adaptation strategy (to be released July 2017) that will seek to minimize the impacts of climate change on PEI. These strategies will replace PEI's previous climate change strategy, *Prince Edward Island and Climate Change: A Strategy for Reducing the Impacts of Global Warming* (2008).

## NEWFOUNDLAND AND LABRADOR

In 2011, the Government of Newfoundland and Labrador released *Charting Our Course: Climate Change Action Plan*, a five-year strategy that contained 18 commitments aimed at improving the province's resilience to the impacts of climate change. Progress has been made on all 18 of these commitments and implementation is ongoing. The commitments focus broadly on improving the understanding of climate change impacts in Newfoundland and Labrador and mechanisms to integrate that understanding into decision-making by individuals, businesses, communities, and governments. This action plan expires at the end of 2016 and the Government has committed to developing a new climate change strategy, which will include adaptation.

With the collaboration of various stakeholders, provincial efforts related to adaptation have put forth programs and actions. To increase collaboration on this issue, the Government of Newfoundland and Labrador established an *Adaptation Network* that includes representatives from government departments, industry, and Memorial University. The network identifies research needs and shares best practices for integrating climate change adaptation into decision-making. As a result of this network, the impacts of climate change are being more thoroughly considered in the government's decision-making processes for environmental assessments and the granting of crown land.



Additionally, climate data and science, facilitated through a *Climate Information Portal*, such as climate projections and updated intensity-duration-frequency (IDF) curves for Newfoundland and Labrador inform planning and decision-making to improve resilience to climate change. IDF curves are critical tools for ensuring that infrastructure designs are able to withstand increases in precipitation, including vital transportation, municipal, marine, and mining infrastructure. Moreover, the establishment of 112 coastal erosion monitoring sites inform planning and development decisions given the risk of more rapid coastal erosion in a province where 90% of the population lives along the coast.

Capacity building and education is facilitated and maintained through workshops in partnership with Engineers Canada to raise awareness of climate change impacts on infrastructure and available datasets among local decision-makers, engineers, and planners at the provincial and municipal levels. In addition, public awareness is encouraged through the development and roll out of an award-winning public campaign including a comprehensive and authoritative website ([www.turnbackthetide.ca](http://www.turnbackthetide.ca)) to provide tips, information, and resources to individuals, business, and communities about how to enhance resilience to climate impacts and reduce greenhouse gas emissions.

## FEDERAL GOVERNMENT

Domestic action on adaptation by the Government of Canada is guided by the *Federal Adaptation Policy Framework*, approved in 2011. The objectives of the Framework include ensuring that Canadians understand the impacts of climate change and have the information and tools they need to adapt effectively. The Framework established a federal role that includes generating and sharing knowledge, building capacity, and supporting the integration of adaptation into decision-making processes. This role recognizes unique federal expertise (e.g., climate research and related information) and the federal government's ability to generate knowledge and information that can be applied across regions and sectors, thereby minimizing duplication of efforts. The Government also has direct responsibilities for areas and populations particularly vulnerable to climate change, including oceans, the North, and Indigenous peoples.

### Programs

Currently, seven departments and agencies deliver targeted programs which provide information and tools to support risk assessment, planning, and decision making in the most vulnerable sectors and communities. The federal government has committed to working with provinces and territories, Indigenous Peoples, and municipalities to bring together partners to share and leverage knowledge, capacity and resources.

Natural Resources Canada's Adaptation Platform is an example of such an initiative. It brings together key groups from government, industry and professional organizations, to collaborate on adaptation priorities. The Adaptation Platform was built to promote collaboration among those who have a collective stake and role to play in making Canada more climate-resilient. The overarching goal of the Adaptation Platform is to create an enabling environment for adaptation, where decision-makers in regions and key industries are equipped with the tools and information they need to adapt to a changing climate.

The 2016 federal budget provided funding for a range of activities that will build resilience across Canada. More specifically, \$129.5M is dedicated to seven departments and agencies for a suite of federal adaptation programs related to science, health, northern and Indigenous communities, and key economic sectors. Moreover, \$40.0M is given to the National Research Council to develop climate-resilient building and infrastructures codes and guides, building resilience in our communities and making economic sectors more competitive. Additionally, \$75.0M is committed to the Federation of Canadian Municipalities, part of which will help local governments conduct climate risk assessments and planning.

## Assessments

Assessments have been performed by departments and agencies as a tool to further highlight the importance of understanding and addressing climate change impacts. These assessments are scientific reports that assess, critically analyze, and synthesize the growing knowledge base on the issue. Working with subject matter experts in government, universities, and non-government organizations, departments produce science assessments that are current, relevant, and accessible sources of information, to help inform planning of policies, program, and actions. Assessments have been completed at the national scale, namely, through *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation (2014)*, *Canada's Marine Coasts in a Changing Climate (2016)*, and *Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity (2008)*.

## Climate Science and Information

The federal government undertakes science and monitoring activities related to past, present and future states of the climate system and how it functions, as well as on the changing composition of the atmosphere and related impacts. These activities include foundational climate and climate change science and climate information and services provided by federal departments to inform effective adaptation planning and implementation.

## ANNEX 3: KEY DEFINITIONS

**Adaptation:** Adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. (<http://unfccc.int/focus/adaptation/items/6999.php>)

**Climate resilience:** The capacity of a community, business, or natural environment to anticipate, prevent, withstand, respond to, and recover from a climate change related disruption or impact. (Adapted from: <https://toolkit.climate.gov/get-started/overview>)

**Conservation:** The protection, care, management and maintenance of ecosystems, habitats, wildlife species and populations, within or outside of their natural environments, in order to safeguard the natural conditions for their long-term permanence. ([https://www.iucn.org/downloads/en\\_iucn\\_glossary\\_definitions.pdf](https://www.iucn.org/downloads/en_iucn_glossary_definitions.pdf))

In the context of climate change adaptation, conservation has a role in ecosystem-based adaptation (EbA), along with sustainable management and restoration of natural ecosystems, to help people and ecosystems adapt to climate change. (Adapted from: <http://www.conservation.org/projects/Pages/adapting-to-climate-change-ecosystem-based-adaptation.aspx>)

**Disaster risk reduction:** The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. (<https://www.unisdr.org/we/inform/terminology>)

**Ecosystem services (ES):** The direct and indirect contributions of ecosystems to human well-being. ES typically fall into four categories: provisioning (e.g., food, raw materials, fresh water), regulating (e.g., air quality, carbon sequestration), cultural (e.g., recreation, tourism, spiritual experience), and habitat or supporting (e.g., species habitat, maintenance of genetic diversity). (Adapted from: <http://www.teebweb.org/resources/ecosystem-services/>)

**Food security:** Defined as a condition that exists when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life. Food security is based on:

- *Food availability* – sufficient quantities of food available on a consistent and affordable basis
- *Food access* – having sufficient resources to obtain appropriate foods for a nutritious diet
- *Food use* – appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation

(Adapted from: <https://www.wfp.org/node/359289>)

**Natural (green) infrastructure:** A strategically planned network of natural and semi-natural areas with other environmental features (e.g., urban forests and parks, natural areas, green roofs, streams, riparian zones, wetlands, bioswales, rain gardens, etc.) designed and managed to deliver a wide range of ecosystem services. Compared to single-purpose, grey infrastructure, natural infrastructure has many ecological, economic, and social benefits. It can help avoid relying on infrastructure that is expensive to build when nature can often provide cheaper, more durable solutions, many of which create local job opportunities, and can serve as an alternative, or be complementary, to standard grey solutions. (Adapted from: “[Green Infrastructure \(GI\): Enhancing Europe’s Natural Capital](#)”)

**Risk:** The potential for consequences where something of value is at stake and where the outcome is uncertain. Risk is often represented as the product of two components: the probability of occurrence of hazardous events or trends multiplied by the magnitude of impacts (or consequences) if these trends or events occur. Risk results from the interaction of vulnerability, exposure, and hazard (or extreme event).

*Agard, J., E.L.F. Schipper, et al, Eds. 2014. Glossary. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability, Intergovernmental Panel on Climate Change, Fifth Assessment Report, Working Group II.*

**Scenario.** A scenario is a coherent, internally consistent, and plausible description of a possible future state of the world (IPCC, 1994). It is not a forecast; each scenario is one alternative image of how the future can unfold. A projection may serve as the raw material for a scenario, but scenarios often require additional information (e.g., about baseline conditions). A set of scenarios often is adopted to reflect, as well as possible, the range of uncertainty in projections.

(Adapted from: <http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=125>)

**Standardization / standards:** Standardization is the development and application of standards publications that establish accepted practices, technical requirements, and terminologies for products, services, and systems. Standards help to ensure better, safer, more resilient methods and products, and are an essential element of technology, innovation, and trade.

**Vulnerability:** In the context of climate change, vulnerability is the predisposition to be adversely affected by a change in climate, depending on sensitivity or susceptibility to harm, and capacity to cope and adapt.

*Agard, J., E.L.F. Schipper, et al, Eds. 2014. Glossary. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability, Intergovernmental Panel on Climate Change, Fifth Assessment Report, Working Group II.*

## ANNEX 4: KEY REFERENCES

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