

# UPAGIAQTAVUT

## SETTING THE COURSE

*Climate Change Impacts  
and Adaptation in Nunavut*





## MESSAGE FROM THE GOVERNMENT OF NUNAVUT

### Statement from the Minister

"Inuit have always been able to adapt to change and change is happening very quickly. We are adapting, but at some cost to our health, families, and culture. We are making a commitment – taking a firm stand against the things that are causing harm to people – and making positive, manageable change that will better prepare us for our future."

*CLC Tamapta: Building Our Future Together*

Climate change presents one of the more significant challenges facing Nunavummiut. Elders, scientists and many others are increasingly observing unusual weather events that are impacting many facets of life in Nunavut.

For generations, the people of Nunavut have demonstrated an ability to adapt to rapidly and drastically changing circumstances. It is this adaptability that has allowed Nunavummiut to survive in what most people in the world consider to be a cold and hostile environment. The Government of Nunavut is committed to supporting Nunavummiut in continuing to rise to the challenges and opportunities that climate change may present.

As part of this commitment, my Department, in partnership with many other stakeholders, has developed the *Upagiaqtavut – Setting the Course: Climate Change Impacts and Adaptation in Nunavut* strategic document. *Upagiaqtavut* sets the strategic direction for climate change adaptation in Nunavut. The objectives set out in this document aim to increase our adaptive capacity to ensure all

Nunavummiut are equipped with the tools, skills and knowledge needed to adapt to the projected impacts of climate change.

Since the release of the 2003 Climate Change Strategy, extensive dialogue has taken place between governments, scientists, and communities. This document is based on valuable input received from elders and youth, community members, scientists, professional planners, other levels of government and organizations through informal and formal meetings, workshops, and written submissions.

*Upagiaqtavut* establishes clear direction for the future. It will help us set the course in working together toward our common vision of a positive and sustainable future for "our land," Nunavut.

The Honourable Daniel Shewchuk  
Minister of Environment



## EXECUTIVE SUMMARY

Addressing the causes of climate change and adapting to its impacts are high priorities for Nunavut. The Government of Nunavut recognizes that climate change is highly complex and dynamic. Nunavut's communities are facing multiple changes that are impacting daily life and the continuation of traditional activities. The climate change impacts we are observing today are projected to continue into the future and will likely intensify some of



the other pressures we face as a territory. As such, proactive steps must be taken to ensure the vitality and sustainability of Nunavummiut. As people in our territory have done for hundreds of years, we will have to adapt to changing conditions.

Some of the more significant impacts we are already experiencing in Nunavut as a result of climate change include:

- Decreasing sea ice thickness and distribution, which is changing wildlife habitat and affecting impacting hunters' ability to harvest wildlife.
- Permafrost degradation, changes in ice conditions, rainfall and snow quantity, drainage patterns, temperatures, and extreme weather events can all have implications for existing infrastructure (such as roads and

buildings); all of which was designed around a permanently frozen soil regime.

- Increased length of the ice free season may allow for increased shipping through our waterways, including the Northwest Passage. While this may result in economic benefits, it will also increase the risk of waterway contamination through oil spills and other pollution events.
- Arrival of new insects, birds, fish and mammals previously unknown or rare in Nunavut, and change in the abundance and distribution of familiar animals.

Inuit Qaujimajatuqangit is reinforcing and supporting scientific observations of these changes. It is also providing valuable insight on adaptation, and information on how these changes may affect Nunavummiut and the ecosystems on which we rely.

A warming Arctic climate could have both positive and negative consequences for the environment, economic development, and the social well-being of people in the North. Climate change stands to impact cultural practices and traditional activities, food security, health of people and wildlife, community infrastructure, transportation, heritage resources, resource development, and energy, among other aspects of daily life in Nunavut.

The Government of Nunavut is currently engaged in a number of climate change initiatives with an emphasis on adaptation at the community level. The Government of Nunavut has already achieved success in working in partnership with a variety of stakeholders on climate change research, monitoring and community adaptation initiatives.

The *Upagiatavut* strategic document establishes a framework for climate change impacts and adaptation initiatives in Nunavut. Overall, the



purpose of *Upagiaqtavut* is to provide strategic direction, enabling Nunavummiut to better adapt to current and future changes brought on by climate change. Well-planned actions are the foundation for successful adaptation.

The adaptation approach outlined in *Upagiaqtavut* is organized around four main components, or *napuit*, each with a set of corresponding objectives. A summary of the *napuit* is as follows:

### ***Napuk 1 – Partnership Building***

**Objective 1.1:** Identify new and innovative partnership opportunities with the federal government, provincial and territorial governments, communities, other organizations, universities, the private sector, and individuals, in order to facilitate a coordinated approach to climate change.

**Objective 1.2:** Establish an interdepartmental climate change working group.

### ***Napuk 2 – Research and Monitoring***

**Objective 2.1:** Strengthen research and monitoring of impacts in Nunavut through partnerships with communities, the scientific community, organizations and the federal government.

### ***Napuk 3 – Education and Outreach***

**Objective 3.1:** Develop and distribute climate change awareness material and tools.

**Objective 3.2:** Encourage and support continued transfer of knowledge and skills from elders to youth.

**Objective 3.3:** Ensure climate change is incorporated into school curricula.

**Objective 3.4:** Increase national and global awareness of the climate change impacts on Nunavut and Inuit culture.

### ***Napuk 4 – Government Policy and Planning***

**Objective 4.1:** Integrate climate change considerations into all government decision making.

**Objective 4.2:** Ensure climate change considerations are integrated into land use planning and environmental assessments.

**Objective 4.3:** Identify new economic opportunities associated with climate change.

**Objective 4.4:** Work with our partners to ensure climate change impacts are considered in emergency planning.

Ongoing reporting and monitoring of climate change adaptation initiatives and opportunities will be coordinated through an interdepartmental working group on climate change impacts and adaptation. *Upagiaqtavut* will guide the activities of this working group and all subsequent climate change adaptation initiatives and projects in Nunavut.



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## I. INTRODUCTION: TOWARDS A RESILIENT NUNAVUT

Nunavut's communities are facing multiple environmental changes that are impacting daily life as well as traditional activities. Environmental changes including altered weather and temperature patterns can affect everything from the stability of the buildings in our communities to the timing and methods we use to harvest food from the land and sea.

The environmental changes and impacts we see today are projected to continue into the future. A collaborative and comprehensive approach is needed to ensure resilience among our people and in our communities. *Upagiatavut* is a strategic document that describes such an approach, and outlines the Government of Nunavut's plans for creating a sustainable future for Nunavut in an ever-changing climate.

### Addressing Climate Change in Nunavut

There are two main ways of managing climate change. One method, *mitigation*, involves finding and implementing methods to reduce **greenhouse gas emissions**\*. The other method, *adaptation*, means taking action to minimize the negative impacts and maximize potential benefits from a changing climate.

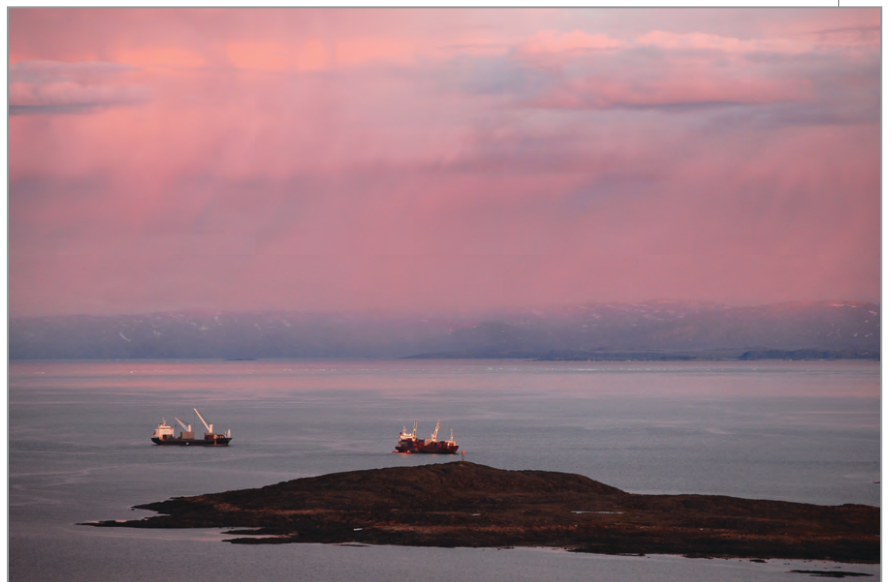
Although Nunavut's share of global greenhouse gas emissions is extremely small, the Government of Nunavut remains engaged and involved in mitigation efforts. The current and projected impacts of climate change are likely to be significant to the environment, economy and daily lives of Nunavummiut. Therefore, we have an important role to play in educating the world about the significant impacts climate change is having and will continue to have, on Nunavummiut and our communities. Nunavut is committed to remaining

engaged in the global discourse surrounding the reduction of greenhouse gas emissions, with the hopes that effective and timely action will be taken before impacts on our environment and way of life become too severe.

Meanwhile, Nunavummiut must increase their understanding of climate change and proactively plan for the changes being brought on by a warming climate. As Inuit have done for centuries, we will have to adapt to these new and ever-changing conditions. As such, building adaptive capacity among Nunavummiut is the focus of the Government of Nunavut's climate change mandate.

The Government of Nunavut committed to climate change adaptation action in its *2003 Climate Change Strategy*. Specifically, the Strategy calls for identifying and monitoring climate change impacts and developing strategies that would help Nunavummiut adapt to climate change.

*\*All text that appears in bold throughout this document has a corresponding glossary definition in Appendix A, at the back of the document.*





Since 2003, the Government of Nunavut has collected valuable information and knowledge from a diversity of sources through interviews, workshops, and formal and informal meetings. Particular emphasis was placed on gathering input and expertise of well-respected elders throughout Nunavut. Through this initiative and the amassed efforts of many researchers, our understanding of climate change and its potential impacts has increased.

The Government of Nunavut has also been involved in climate change adaptation through its work with various intergovernmental forums. At the Council of the Federation in July 2008, Canadian premiers agreed that regional research institutions will collaborate to expand the inventory of climate change-related research and to establish a community of practice for knowledge transfer to assist jurisdictions on climate change adaptation.

In their 2008 Conference Statement, the Arctic Council asked governments in the Arctic region to increase research on adaptation to climate change. The focus of this research would be to address the social and economic needs of the people living in the Arctic. In November 2009 the Inuit Circumpolar Council (ICC) called on global leaders to recognize the **vulnerability** of Inuit and other indigenous peoples by adopting a mechanism for adaptation assistance.

### **The *Upagiatavut* Strategic Document**

Through the examples listed above, and through many other new and ongoing projects and initiatives, the Government of Nunavut aims to increase adaptive capacity to ensure a resilient Nunavut. We will lead and support Nunavummiut toward this common vision by supporting pro-active planning against the negative impacts of climate change, and facilitating the uptake of emerging new opportunities provided by it.

As further described in Section VII of this document, the Government of Nunavut's approach to climate change adaptation is comprised of four main areas of focus: Partnership Building, Research and Monitoring, Education and Outreach, and Government Policy and Planning.

The strategic objectives detailed within each of the four focus areas sets the direction for adaptation in Nunavut.

Just as a hunter plans his course and packs his qamutik with the necessary tools for the journey, *Upagiatavut* sets the course and identifies what is needed for Nunavut's future. It is built on a solid foundation that marries science and Inuit wisdom gained through a close relationship to an ever-changing landscape. This strategic document supports Nunavummiut moving forward into the future, prepared and equipped for what lies ahead.

## **II. GUIDING PRINCIPLES**

*Upagiatavut* is guided by the following principles from the Government of Nunavut's *Tamapta: Building our Future* mandate document. These guiding principles, founded on Inuit societal values, will help facilitate increased resilience and adaptive capacity in Nunavut.

### **Inuuqatigiitsiarniq – Respecting others, relationships and caring for people.**

The Government of Nunavut recognizes climate change as an issue that stands to impact the lives of Nunavummiut. Strategic planning is being done out of care for Nunavummiut and their needs. *Upagiatavut* respects Inuit knowledge and takes into consideration the important contributions that all Nunavummiut can make toward planning for the future.

### **Tunnganarniq – Fostering good spirit by being open, welcoming and inclusive.**

The government will take an inclusive and collaborative approach to climate change adaptation planning and research.



**Pijitsirniq – Serving and providing for family and/or community.**

*Upagiatavut* demonstrates the government's commitment to providing Nunavut families and communities with the tools and resources needed to successfully adapt to a changing climate.

**Aajiqatigiinniq – Decision making through discussion and consensus.**

Individuals, community governments and other organizations will be given meaningful opportunities to share ideas and participate in decision making that will directly affect them and their communities.

**Pillimmaksaniq/Pijariuqsarniq – Development of skills through observation, mentoring, practice and effort.**

Participation in the development and implementation of adaptive measures will enhance individual and community self-reliance, empowerment and capacity. Training, capacity building and skills acquisition are key factors to increasing local adaptive capacity.

**Piliriqatigiinniq/Ikajuqtigiinniq – Working Together for a common cause.**

Collaborative relationships that are based on the integrated application of *Inuit Qaujimajatuqangit*, local knowledge and scientific research will help us work together in innovative partnerships towards increased resilience.

**Qanuqtuurniq – Being innovative and resourceful.**

*Upagiatavut* ensures the wise use of human, natural and financial resources through innovative partnerships and collaboration. This innovation and resourcefulness will maximize our climate change knowledge and our potential to successfully adapt.



**Avatittinnik Kamatsiarniq – Respect and care for the land, animals and the environment.**

The Government of Nunavut will demonstrate leadership by continuing to diligently and responsibly take actions to control its own emissions of greenhouse gases and adapt to climate change impacts. Through collaboration by all stakeholders, decisions will be made that help ensure the long-term sustainability of Nunavut's people and the land and wildlife on which we all depend.

# PART ONE: CHANGES AND IMPACTS

## III. CLIMATE CHANGE IN NUNAVUT

**Climate change** is a natural and continuous process; however, studies have identified that global temperatures are rising at a much faster rate than previously experienced. It is now widely accepted in the scientific community that human-caused (anthropogenic) warming is accelerating and amplifying climate change, particularly in

Arctic regions. Greenhouse gases produced by humans through the burning of fossil fuels and changes in land use have intensified global warming trends.

Documented changes to the Arctic include: glacier retreat, sea-ice and lake-ice thinning, thawing of permafrost, coastal erosion

from wave action, changes in ocean currents, and shifting ranges of plant and animal species<sup>1,2,3,4,5</sup>. The timing, nature and severity of the impacts on Nunavut communities are difficult to predict and will vary locally and regionally.

Nunavut, like many nations across the globe, is striving to reduce greenhouse gas emissions in response to climate change. However, a main focus for Nunavut is to promote adaptation to the new conditions

that have arisen due to climate change. This involves adjusting planning, decisions, and activities in response to the projected impacts of climate change. Our current knowledge of climate change impacts is based upon information gathered from many different sources. This section presents an overview of the main scientific findings and local observations with respect to climate change impacts in Nunavut. In the short term, neither mitigation nor adaptation actions alone can prevent significant negative climate change impacts. However, taking adaptive measures will minimize harm to people and communities and will allow Nunavummiut to take advantage of any positive impacts associated with these phenomena.

### Changes in Temperature

Over the last 100 years, the Arctic has experienced an average warming of 1.5°C; however, regional increases of 1°–3°C have also occurred<sup>6,7</sup>. Recent reports by scientists, hunters, and elders suggest significant local warming trends across Nunavut in the last half century<sup>5,8</sup>. These changes in temperature influence the length and onset of different seasons, particularly the traditional Inuit seasons, which are closely tied to traditional land use activities. Temperature changes may have also caused changes in Nunavut's weather, such as an

increased frequency of storms and more variable and unpredictable winds.

Current projections indicate that the warming trend is likely to continue into the next century even if efforts to mitigate and stabilize global greenhouse gas emissions are successful. Climate models suggest that future warming will not be

### What is the difference between climate and weather?

Climate refers to the long-term average weather patterns in a given geographic area. Climate conditions ("normals") are typically calculated for 30 year time intervals. Weather is what you see outside your window today, or the pattern you see over shorter time spans (for example a 'rainy week').

Scientists predict that the frequency of extreme weather events will continue to increase in frequency and intensity due to changes in the climate.



uniform across Nunavut; some areas (e.g. western Nunavut and the High Arctic) could warm much faster than other areas (e.g. south Baffin/Davis Strait). However, as with any forecast, there is uncertainty in these predictions.

## Changes in Weather and Precipitation

The amount, type, and patterns of precipitation in Nunavut are expected to change and influence existing cultural, social, and environmental factors. Arctic precipitation has increased by approximately eight percent in the last 100 years<sup>9</sup> and further

increases in precipitation are predicted. Similarly, the number and frequency of extreme weather events such as ice storms, wind storms, and **storm surges**, are expected to increase. Precipitation is highly variable from place to place and more difficult than temperature to

predict. Projections of future precipitation conditions at a local or regional scale in Nunavut are thus subject to large degree of uncertainty.

## Changes in Sea Level<sup>10</sup>

The range of sea-level rise projections varies greatly. The Intergovernmental Panel on Climate Change<sup>11</sup> recently projected global sea-level rise ranging from less than 20 cm to nearly 60 cm of sea-level rise during the 21st century.

Across much of Nunavut, the land is rising in response to the disappearance of the large ice sheets that covered most of Canada during the last

Ice Age 11,500 years ago<sup>12</sup>. This is called **Isostatic Rebound**. Some parts of Nunavut's landmass are rising so quickly that sea level may appear to continue to drop, even while taking into account potentially increased global sea-levels. At any one place, the amount of sea-level change that occurs depends on how quickly the land is rising or sinking. Therefore, the effect on Nunavut's communities will differ. Further monitoring of land motion is required to better understand the current and future implications of sea level rise in Nunavut.

## Changes in Permafrost<sup>13</sup>

**Permafrost** depth and coverage throughout Nunavut are expected to decrease as average Arctic temperatures continue to increase. Permafrost is the subsurface ground material that remains frozen for more than two years in a row<sup>2</sup>. As permafrost thaws, it weakens the structure of the ground, which in turn accelerates erosion<sup>1, 4, 14</sup>. Shorelines that have ice-rich permafrost are highly susceptible to higher rates of erosion from wave action<sup>2</sup>. Thawing permafrost also increases the depth of the **active layer**, which can lead to changes in the flow, retention and absorption of water in a given area.<sup>2</sup>

### ISOSTATIC REBOUND

During the last ice age, Nunavut was covered in glaciers that were kilometres high. This enormous weight pushed the land down. With the retreat of the glaciers, the land is now "springing" (rebounding) back; rising to its former height. This is much the same as what would happen if you were to place a heavy rock on a sheet of rubber. The rubber deforms and depresses but when you remove the rock, the rubber sheet springs back to its original shape. This process is called isostasy. This is happening in certain areas of Nunavut such as in Arviat.

### ACTIVE LAYER

The active layer is the top layer of the soil (or surface material) that thaws in the summer and freezes up again in the fall. The depth of the active layer varies across Nunavut, and even within communities depending on factors such as soil type and location (e.g. proximity to a river).



Thawing permafrost will have lingering and continuous impacts on Northern infrastructure such as buildings, roads and other community structures. This will be further explained in Section V, Potential Impacts of a Changing Climate.

## Changes in Ice Conditions<sup>15</sup>

One of the more striking changes in the Arctic has been the decrease in summer sea ice. Satellite data shows that the extent of Arctic sea ice has decreased each decade since 1978; the first year that satellite data was available. The lowest extent of summer sea ice to date was in September 2007. The primary

cause of decreased ice thickness and late summer ice coverage is attributed to the loss of multi-year ice that is being replaced by younger, less stable ice. One of the consequences of a decrease in multi-year sea ice is that formerly inaccessible waters will become navigable, thereby expanding the opportunities for shipping, resource exploration and

subsequent development<sup>15</sup>. Increased access and development may translate into increased risk of environmental incidents requiring collaborative response efforts.

A number of other changes in ice conditions have been observed. For example, the number of ice-free days on lakes, rivers and the ocean is increasing throughout the Arctic as ice cover is developing later and melting earlier. There is also increasing evidence that Nunavut's glaciers are retreating and

### ICEBERG CALVING

Iceberg calving is the sudden release and breaking off of ice from glaciers, ice shelves or icebergs themselves.



shrinking in part due to **iceberg calving**. This could result in changes in run-off, impacting areas that rely on glacier-fed rivers and streams. The impacts of increased glacial run-off may include fluctuations in water levels, changes in salinity in salt and fresh water, water quality changes, and availability and quality of drinking water.

## Changes in Wildlife and Vegetation<sup>9,12</sup>

Climate change is affecting Arctic vegetation and wildlife through a variety of impacts. There have already been observations of changes in range distribution, habitats, abundance, genetic diversity, and behavior of migratory and non-migratory species.

Overall the number of species in Nunavut is projected to increase as southern species move northward with a changing climate. Current Arctic species will see changes in their habitat including new plants, reduced ice cover, changing snow patterns, changing ocean salinity and increased acidity. This could potentially affect species numbers and distribution.

For example, polar bears are highly intelligent and adapt quickly to changing conditions. They have persisted through numerous climate change cycles in the past, so they are likely adapted for any changes that might be expected to occur. However it is quite possible that there will be changes in their range distribution and composition. Some areas may experience reduced polar bear numbers or even extirpation (with polar bears ceasing to

### Did You Know?

Historical sea ice data can be collected from some rather unique sources. This includes bowhead whale bones from ancient sites used by Thule<sup>16</sup>. The age and distribution of bones potentially demonstrate changing sea ice and occupancy patterns in the Northwest Passage.

exist in a specific area) during the warmest period. Other areas may experience increased numbers of polar bears as a changing climate leads to improved polar bear habitat by reducing multi-year ice. In other areas, polar bear numbers and polar bear productivity may remain relatively constant.

Wildlife has and continues to play a vital role in the traditions, culture, economy and diet of Nunavummiut. It will be critically important for Nunavut to continuously monitor our wildlife populations and adjust our wildlife management systems accordingly.

#### IV. INUIT QAUJIMAJATUQANGIT OF CLIMATE CHANGE<sup>17-20</sup>

**Inuit Qaujimagatuqangit**, the system of Inuit traditional knowledge and societal values, is based upon a long and close relationship with the land and environment. It provides rich and detailed insight into climate change and adaptation, and provides context to help understand how climate change will impact Inuit culture, communities, and individuals.

Interviews with elders, hunters and community members have supplemented and enhanced scientific research on climate change. Inuit observations have provided useful information at different time scales and levels of detail that have significantly contributed to our understanding of climate change in Nunavut.

Recurring themes with respect to Inuit knowledge of climate change include:

- Sea ice conditions have changed; the ice is thinner, freezes up later and melts earlier. Similar observations have been made for lake ice.
- *Aniuvat* (permanent snow patches) are decreasing in size. There is more rain, and the snow and ice form later in the year and melt earlier.
- The weather is unpredictable. It changes faster than it used to with storms blowing up unexpectedly.

- Water levels have gone down, making it hard or impossible to travel by boat in certain areas.
- Temperatures are warmer throughout the year.
- New species have been observed.
- The land has been observed to be drier and the stability of the permafrost is changing.
- The length and timing of the traditional Inuit seasons have changed.

*"I am now more fearful of the sea ice because we don't know if what used to be safe to travel on may not be safe. There are more unsafe areas on the sea ice and this also goes for the lake ice."*

– Johnny Karetak in Inuit Qaujimagatuqangit of Climate Change in Nunavut – Kivalliq Region, Nunavut

*"It is getting more unpredictable as to what will happen; because the signs are misleading the Inuit who are used to weather that follows these signs."*

– Sytukie Joamie in Inuit Qaujimagatuqangit of Climate Change in Nunavut – South Baffin Region, Nunavut

*"Never know how [the] weather is going to be. So unpredictable nowadays."*

– Bobby Algona in Inuit Qaujimagatuqangit of Climate Change in Nunavut – Kitikmeot Region, Nunavut

*"We were able to predict the weather based on the direction of the wind and the look of the clouds. We were able to predict where the wind was going to come from or if the weather was going to be nice the next day. Now you don't know where the wind is going to come from and how strong it will be."*

– The Arctic Climate Changing Perspective – Kivalliq

#### V. POTENTIAL IMPACTS OF A CHANGING CLIMATE

A warming Arctic climate may have both positive and negative consequences for the environment, economic development, and the social well-being of people in the north. For example, decreases in annual and multi-year ice may allow for increased shipping through Arctic waterways, including the Northwest Passage. While this may result in economic benefits, it may also increase the risk of

waterway contamination through oil and chemical spills. Increased land use activities and interest in natural resources, alongside population growth and an expanding economy mean that careful planning is needed in order to ensure environmental sustainability in the future.

### Culture, Health and Well-being<sup>17-24</sup>

For centuries, Inuit have maintained a close relationship with ice (*siku*), land (*nuna*), sky (*qilak*), and wildlife (*uumajut*). Inuit rely on innovative survival skills adapted to the unique climate and weather of the Arctic. Rapid environmental changes will continue to impact Inuit culture, and the well-being and health of all Nunavummiut.

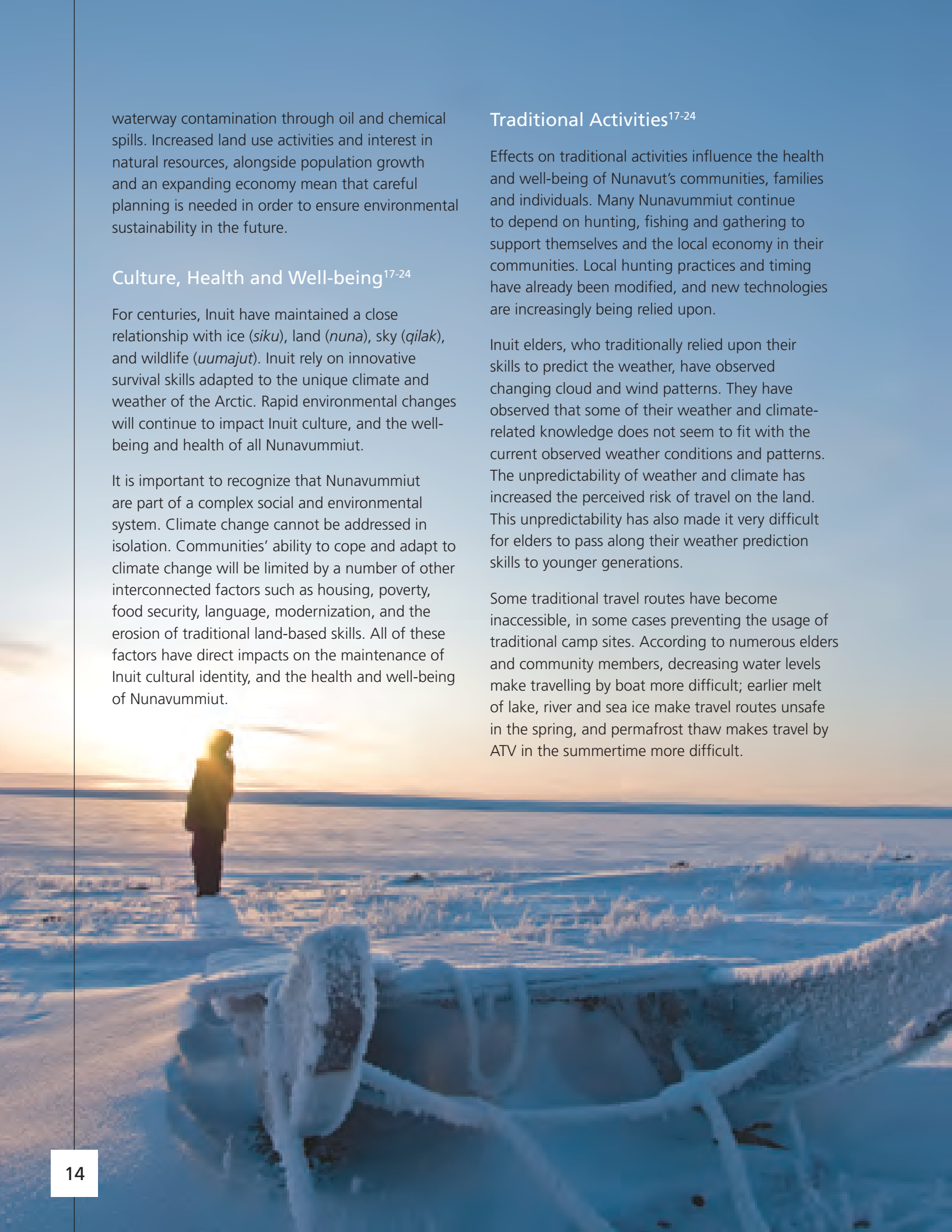
It is important to recognize that Nunavummiut are part of a complex social and environmental system. Climate change cannot be addressed in isolation. Communities' ability to cope and adapt to climate change will be limited by a number of other interconnected factors such as housing, poverty, food security, language, modernization, and the erosion of traditional land-based skills. All of these factors have direct impacts on the maintenance of Inuit cultural identity, and the health and well-being of Nunavummiut.

### Traditional Activities<sup>17-24</sup>

Effects on traditional activities influence the health and well-being of Nunavut's communities, families and individuals. Many Nunavummiut continue to depend on hunting, fishing and gathering to support themselves and the local economy in their communities. Local hunting practices and timing have already been modified, and new technologies are increasingly being relied upon.

Inuit elders, who traditionally relied upon their skills to predict the weather, have observed changing cloud and wind patterns. They have observed that some of their weather and climate-related knowledge does not seem to fit with the current observed weather conditions and patterns. The unpredictability of weather and climate has increased the perceived risk of travel on the land. This unpredictability has also made it very difficult for elders to pass along their weather prediction skills to younger generations.

Some traditional travel routes have become inaccessible, in some cases preventing the usage of traditional camp sites. According to numerous elders and community members, decreasing water levels make travelling by boat more difficult; earlier melt of lake, river and sea ice make travel routes unsafe in the spring, and permafrost thaw makes travel by ATV in the summertime more difficult.





## Food Security<sup>21</sup>

The projected impacts of climate change include decreased access to wildlife, and increasing safety risk stemming from changes in sea ice thickness and distribution, permafrost conditions and extreme weather events. Under such a scenario, traditional **food security** may be significantly impacted. It has been documented that the overall shift away from country food towards expensive store bought, and often unhealthy food items, has resulted in negative effects on Inuit health and cultural identity. The negative impacts of climate change as described above could worsen this problem.



Storage of food is also affected by warmer temperatures and thawing permafrost. Interviews with elders suggest that outdoor meat caches now spoil, where formerly they remained fresh and preserved in the cold environment.

Country food continues to be the healthiest food choice for Nunavummiut; however, climate change may increase human exposure

to contaminants as the environment continues to warm. A changing climate may alter air and water currents that bring these contaminants into the Arctic<sup>25</sup>. Additionally, changes in ice cover and thawing permafrost appear to have contributed to increased mercury levels in some northern lakes. This results in more contaminants being deposited into our environment and consequently increased uptake by plants, animals and ultimately, humans.

## Health and Diseases

Diseases that can be transmitted from animals to humans (in scientific terms referred to as “zoonotic diseases”) are projected to increase as temperatures warm. This includes trichinella found in walrus and polar bear meat and brucellosis in caribou. The transmission of these and other diseases may increase when previously isolated wildlife populations come in contact with one another as natural barriers decrease.

Direct impacts on human health from a changing climate are related to natural hazards and increases in extreme weather events that may lead to an increased number of accidents and emergency situations. It has been reported that search and rescue missions are also impacted by a rapidly changing climate as searches are hampered by unpredictable weather patterns.

## Heritage and Special Places<sup>26</sup>

Permafrost degradation and coastal erosion increased by later freeze-up of sea ice, also impacts heritage and special places. The cold Arctic climate is well-known for its preservation of organic material frozen in permafrost. Changes in permafrost will continue to result in the destruction of cultural remains and archaeological artifacts that were previously very well preserved. Ongoing freeze-thaw cycles promote decay of artifacts such as sod



houses (many of which hold their form because of permafrost), and other historical resources such as sites relating to European exploration of the Arctic. Naturally occurring coastal erosion is expected to be worsened by sea level rise, and increase threats to a number of historic sites on southern Baffin Island, northern Victoria Island and the western high Arctic islands on which little archaeological surveying has been done.

Nunavut has seen a marked increase in the number of tourists who come north to experience the unique Arctic environment and to visit our heritage sites, parks and special places. Nunavut's historic and archaeological resources are key attractions for cruise ships and other visitors. As such, their deterioration could negatively impact tourism.

## Infrastructure

Permafrost is an important component of the landscape and influences ecosystems and northern development. Frozen ground, and ice contained in the soil, presents challenges to construction, operation and maintenance of buildings, airports,

roads and other infrastructure. Over the past several decades, we have been able to use the unique properties of frozen ground to our advantage and in fact have tailored the engineering of our buildings and facilities around the characteristics of frozen ground. Changes in permafrost, ice conditions, precipitation, drainage patterns, temperatures, and extreme weather events can have negative implications for existing infrastructure, which was designed for permafrost conditions. Permafrost thaw has been observed to cause building foundations to shift and destabilize<sup>13</sup>. While frozen ground provides a secure foundation, if it does not stay frozen, its strength and integrity – or ability to support a building, pipeline, road or airstrip – may be significantly compromised. Given the time period over which much of the present infrastructure is expected to last, older facilities may be more vulnerable because climate change was not considered when these structures were built.

The impacts of climate change are expected to become a major burden on government resources. Municipal infrastructure impacted by degrading permafrost (e.g. sinking/cracking buildings) may divert resources from building new, basic infrastructure. Engineering and construction practices for building on changing permafrost are being adapted and developed. These changing practices will impact the cost of both construction and ongoing lifecycle maintenance of current and future infrastructure.

Infrastructure such as pipelines, roads and airstrips, which also rely on permafrost for structural integrity, are experiencing stresses from shifting and thawing grounds. This will translate into increased need for maintenance and repair due to changing freeze and thaw conditions.

Although new infrastructure is being designed to suit a changing environment, existing water and waste containment facilities may not have been designed to withstand the challenges of current and projected warming trends. As a result, these facilities and other naturally-occurring containment structures may fail, with potential impacts on the environment and human health.



Land-use activities have contributed to changes in the structure of the ground and permafrost by altering the amount of sunlight absorption, and changing the flow of water<sup>2</sup>. This feedback poses a threat to infrastructure in northern communities, and could result in collapsed roadways, and shifting building foundations<sup>2,27</sup>. Avoiding this will involve extensive planning to ensure that the integrity of infrastructure is maintained throughout its intended life. Considerations for environmental changes and effects on permafrost are presently considered in community land use planning and climate change adaptation plans. Current data and tools being developed will continue to provide the information necessary to design appropriate and sustainable infrastructure that is suitable in a changing climate<sup>13</sup>.

## Transportation

The transportation sector is expected to experience significant impacts as a result of climate change. The reduction of sea ice thickness and cover, coupled with an increase in the length of the summer shipping season will open up previously inaccessible areas of both land and water. This will lead to increased shipping and industrial activities. While this will translate to increased economic opportunities for Nunavut, it will also increase risks to the environment, most notably through spills and other pollution incidents.

Other transportation-related challenges have also been identified. For example, sea ice changes present challenges to traditional snowmobile or dog team transportation routes over the sea ice and will require, at the very least, identification of alternate routes for the safe continuation of traditional hunting and recreational activities.

Another significant transportation challenge includes impacts of degrading permafrost and changing freeze-thaw cycles that have visibly shifted and cracked the surface of airport runways throughout Nunavut<sup>21</sup>.



In response to these challenges, Nunavut will require improved research, monitoring and response capabilities, including new and better infrastructure, mapping, and navigational systems. This improved infrastructure will likely include roads, asphalt paved runways, and fixed marine structures in coastal areas.

## Resource Development

Current climate change projections, which include reduced sea ice cover and warmer temperatures, are likely to lead to an increase in exploration and industrial activities. The Canadian Arctic Archipelago has the potential for vast hydrocarbon deposits and other mineral deposits. Oil and mineral resource development are expected to increase.

Renewable resource development such as fisheries will also be impacted by climate change. Fishing in Nunavut is an important part of the economy and subsistence living. It is likely that the number of fish species present in the waters off Nunavut will increase as sub-arctic species move northward with the warming climate. Although this could result in new opportunities for fisheries it could also add to stressors such as parasites and the appearance of new predators. Current and planned fisheries activities and management will need to be continuously monitored and adjusted as needed to address the impacts of climate change.



## Tourism

Climate change may impact the tourism industry in Nunavut. Longer summers will potentially result in a longer 'high' tourism season and increased tourism activity. Projected decreases in ice cover are likely to result in increased shipping traffic, particularly cruise ship activity into areas that were formerly inaccessible and/or had limited access. While beneficial, increased marine tourism brings challenges in the form of impacts on communities, historic resources, and the environment in general. Addressing these challenges will require additional resources.

## Arts and Crafts

An increase in tourism activity should lead to an increase in sales of arts and crafts, while an increase in milder weather will make access to carving stone possible for longer periods during the year. However, sudden and unexpected weather patterns, as have been increasingly prevalent in the changing

climate, coupled with thawing permafrost, could pose a risk to the safety of artists and businesses accessing quarry sites at great distances from the communities.

## Energy

The changing climate will potentially have considerable impacts on our energy sector. Warmer temperatures will have a direct impact on our heating requirements making it less expensive to heat our buildings.

Existing power plants will be affected by changes in permafrost conditions influencing the stability of the infrastructure. Settling of foundations in existing power plants has already been observed. Degrading permafrost is also expected to impact fuel tank farms and transmission lines. For example, it has been reported that permafrost degradation has created conditions where hydro poles are easier to install, but the same degradation which results in a structurally weaker soil regime, is also responsible for destabilizing poles causing them lean precariously.

Changes in water and precipitation patterns along with permafrost degradation may impact prospective hydroelectricity development. Previous studies that estimated hydroelectric potential will no longer be reliable as the flow patterns in our lakes and rivers may change as a consequence of climate change. Some studies have suggested that precipitation will increase, which can have a positive effect on the amount of water available for hydroelectric power production. Possible changes in wind patterns may affect the feasibility of wind generation.



## PART TWO: ADAPTATION AND PLANNING

### VI. FROM IMPACTS TO ADAPTIVE CAPACITY<sup>30</sup>

**Adaptation** refers to changes in social, economic, cultural, engineering and environmental practices in response to current or expected impacts caused by climate change. Unlike natural systems, which are purely reactive in their response to change, humans have the ability to predict and respond proactively to anticipated changes. We are able to adjust community planning, hunting and fishing practices, and travel in order to lessen potential negative impacts and to benefit from opportunities associated with climate change.

Human adaptability to diverse and changing conditions is one of the reasons why humans have been such a successful species.

Mitigation efforts strive to lessen humanity's impact on the environment through means such as waste reduction and energy conservation. Adaptation planning acknowledges that changes are inevitable and that we must adjust our processes and practices accordingly. While mitigation remains an important aspect of dealing with climate change, current scientific predictions suggest that even if we stopped all greenhouse gas emissions today, global average temperatures could rise by as much as 2°C during this century<sup>15</sup>. Therefore, it is important that Nunavut is well prepared to meet the current and predicted impacts associated with a changing climate.

A region or community's adaptive capacity is influenced by many factors including, but not limited to location, socioeconomic conditions,

available technology, and knowledge about climate change and its current and projected impacts. For example, if a community affected by increasing coastal erosion is able to secure the necessary expertise, funding and technology to build a levee or breakwater to prevent further erosion, it is considered to have adaptive capacity. On the other hand, a community that is unable to plan for and respond to similar impacts is said to have limited or no adaptive capacity. Without the required

knowledge, tools and resources, communities are very vulnerable to the impacts of climate change.

Each community within Nunavut is, and will continue to be, affected by climate change in different ways. Some communities are more vulnerable to the effects of reduced sea ice coverage, while others are more vulnerable to the effects of thawing permafrost or changes in water levels. Regardless of *how* a community or region is affected, it is important to ensure that each one has the necessary

tools, resources and knowledge to effectively manage its unique circumstances.

The Government of Nunavut aspires to increase adaptive capacity amongst Nunavummiut and within the Government to ensure a *resilient Nunavut* – a territory taking action to respond to the negative impacts of climate change and taking advantage of any emerging new opportunities that may be provided by it.

**Vulnerability** refers to the degree to which a natural or anthropogenic (human-made) system is susceptible to, or unable to deal with, the impacts of change.

**Adaptation** refers to any action that combats the negative impacts of climate change or takes advantage of potential new opportunities.

**Adaptive Capacity** is a region or community's ability to manage the impacts and risks of climate change.

## ADAPTATION PROJECTS

The Government of Nunavut has completed a number of adaptation projects aimed at increasing adaptive capacity within Nunavut communities. These projects have been undertaken in partnership with communities, local and national organizations, universities and governments. Future projects and initiatives will build on the successes and lessons learned from these pilot projects.

### The Nunavut Climate Change Partnership

Since 2006, the Government of Nunavut has been working with the Canadian Institute of Planners (CIP), Natural Resources Canada (NRCan), and Indian and Northern Affairs Canada (INAC) on adaptation planning and climate change research in Nunavut.

The initial collaboration between the project partners saw four workshops organized, one in each of the three regions; Baffin (2006), Kivalliq (2007) and Kitikmeot (2007), and one for elders and youth in Iqaluit (2008). These workshops brought people together for the purpose of discussing climate change, establishing priorities and adaptation planning. An initial pilot project bringing professional community planners, community members, and scientists together to develop community-level climate change adaptation action plans for Clyde River and Hall Beach was also undertaken in 2007 and 2008.

Building on the lessons learned from the initial pilot work and the outcomes of the workshops, the Nunavut Climate Change Partnership (NCCP) was formed in 2008 between the four organizations to work on the *Atuligtuq* project.

### Atuligtuq: Action and Adaptation

*Atuligtuq* meaning “coming into force” and was chosen as the title for the umbrella project under the NCCP. The objective of *Atuligtuq* is to build community capacity for adaptive action through awareness building, planning and research. This objective is clearly visible in the three main themes and the key deliverables under each theme:

***Atuligtuq Theme 1: To build capacity for climate change adaptation planning within the GN and communities.***

**The Nunavut permafrost monitoring network<sup>13</sup>** has been monitoring permafrost condition at stations in: Resolute Bay, Arctic Bay, Pond Inlet, Clyde River, Pangnirtung, Iqaluit, Igloolik, Repulse Bay, Kugaaruk, Taloyoak and Gjoa Haven. The first six stations were established in 2008 collecting baseline data.

These monitoring stations will provide valuable data on permafrost temperatures and change in our communities. Information on permafrost conditions will aid in community land use planning.

The sites were established as a collaborative effort between the GN, the hamlets, and the Geological Survey of Canada. The Nunavut network will also contribute towards an enhanced understanding of current permafrost conditions across northern Canada.

- Climate change adaptation action plans have been developed for five pilot communities: Iqaluit, Arviat, Cambridge Bay, Whale Cove and Kugluktuk;
- A climate change adaptation planning tool kit is being created to assist adaptation planning in the remaining Nunavut communities;
- A two hour classroom or web based climate change educational module has been developed;
- Nunavut youth and community members have been provided training and employment opportunities in climate change projects.



**Atuliqtuq Theme 2:** *To develop tools to collect, publish, share and communicate climate change adaptation knowledge across the communities of Nunavut and beyond.*

- Watershed and drinking water supply vulnerability analyses have been undertaken for Iqaluit, Clyde River, Arviat, Whale Cove and Rankin Inlet;
- A Nunavut Permafrost Monitoring Network has been established, encompassing 11 communities,
- Nunavut wide sea level rise assessment is underway;
- A landscape hazard mapping methodology has been developed in support of climate change adaptation planning based on in-depth work conducted in Clyde River, Pangnirtung, and Iqaluit in addition to preliminary work completed in Kugluktuk, Cambridge Bay, Whale Cove and Arviat. Landscape hazard mapping studies are integral in community planning and will be an essential component for climate change adaptation;

- The NCCP has worked with elders and local knowledge holders to prioritize climate change issues at the community level.

**Atuliqtuq Theme 3:** *To create scientific information that is regionally and locally targeted to help communities adapt to climate change and transfer this capability into Nunavut.*

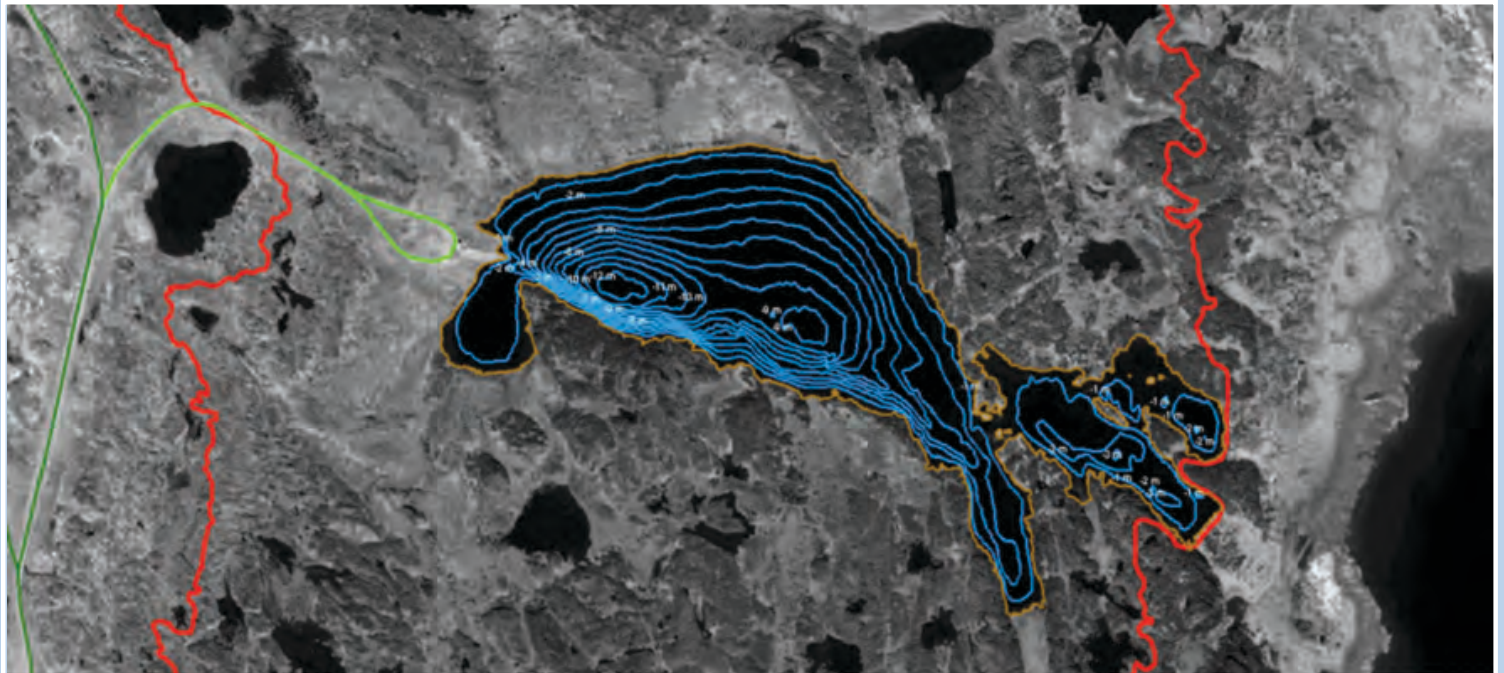
### Community collection of water supply data<sup>33</sup>

Cost-effective tools have been developed that enable community members to collect detailed information about local water supplies that can be used in decision-making. An example of results is shown on a satellite image in Figure 1.

By using these methods and tools, data can be compared between communities.

Models showing water losses and gains will show communities the vulnerability of their water sources.

This information is invaluable to the water management decision process.



**Figure 1:** Lake depth contours (in blue) and limits of the watershed boundary on the left and right (in red) are illustrated on an image of the water reservoir for Whale Cove, Nunavut. Access roads are shown in green and reveal parts within and outside the watershed<sup>33</sup> Worldview-1 image © Digital Globe, 2009, All rights reserved.



government and provinces and territories, led by Natural Resources Canada (NRCan).

There are six Regional Adaptation Collaboratives (RACs) in Canada. The goal of these RACs is to facilitate adaptation planning, decision-making and action through a regional approach to adaptation building on local adaptation knowledge and expertise.

Northern governments, communities, and industry all have diverse but linked roles to play in the development of adaptation measures and strategies that reduce vulnerabilities and increase resilience to climate change. A Northern Regional Adaptation Collaborative (RAC) is currently being established to facilitate adaptation decision-making through collaborative activities in Yukon (YK), the Northwest Territories (NT) and Nunavut (NU).

In Northern Canada, the work will focus on large-scale infrastructure planning, with reference to mine development, and will document best practices in dealing with climate change.

## Challenging Times

Nunavut encompasses one fifth of Canada's landmass and spans a range of ecozones from polar desert in the High Arctic to areas of boreal forest in the southern Kivalliq. Climate change impacts and adaptation challenges across such a huge and diverse territory are highly variable and complex, and are very difficult to monitor and project. Nunavut's population size and economy, however, are small compared to other parts of Canada and our limited resources and a small and widely-dispersed population present major challenges to adapting to climate change. Despite these challenges, the Government will seek to support communities in the design and implementation of adaptive measures.

Effective planning for the current and future impacts of climate change on Nunavut requires collaboration and a multi-faceted and innovative approach. Despite these challenges, *Upagiatavut* lays out a path to help Nunavummiut move forward and adapt in the face of change and uncertainty.

- The Government of Nunavut is creating a Nunavut resource website housing information on climate change research, impacts and adaptation;
- Communication and outreach materials informing Nunavummiut on locally relevant climate change science and planning have been developed.

The aim of *Atuliqtuq* has been to apply local knowledge, Inuit Qaujimajatuqangit and science to inform the development of community climate change adaptation plans and to increase awareness and knowledge of climate change and adaptation alternatives. Regional Adaptation Collaboratives (RAC)

### Regional Adaptation Collaboratives (RAC)

The Regional Adaptation Collaboratives ("RAC") program is a partnership between the federal

The Government of Nunavut's primary goal with respect to climate change is to increase adaptive capacity to ensure Nunavummiut have the skills and awareness needed for adaptation. The *Upagiatavut* framework is modeled after an Inuit sled, or *qamutik*. This signifies the importance of both planning and application of appropriate tools and resources to reach one's destination. In the *Upagiatavut* framework, the "crossbars" or "*napuit*", each represent one of the four main focus areas for Nunavut's approach to climate change adaptation planning. The objectives associated with each *napuk* are intended to facilitate enhanced adaptive capacity by promoting and facilitating research and monitoring, education and outreach, planning and partnership building. All of these are considered essential to guiding Nunavummiut toward a sustainable future.

### Napuk 1: Partnership Building

The Government of Nunavut cannot address climate change impacts and adaptation by itself. Existing partnerships will need to be nurtured and innovative new ones established to take a multi-disciplinary and holistic approach to increasing adaptive capacity.

**Objective 1.1 Identify new and innovative partnership opportunities with the Government of Canada, provincial and territorial governments, communities, other organizations, universities, private sector, and individuals in order to facilitate a fully coordinated approach to climate change.**

Climate change is a global issue that affects and is affected by the actions of many. Developing innovative and unilateral partnerships will facilitate cooperation and information exchanges by pooling resources, capacity, and skills. The Government of Nunavut is already working with the Northwest Territories and the Yukon with the aim to improve information sharing and knowledge exchange, and to ensure coordination of adaptation initiatives.

**Objective 1.2 Establish an interdepartmental climate change working group.**

An interdepartmental climate change working group within the Government of Nunavut will be established. This group will work together to facilitate community-based approaches to adaptation. This group will be responsible for

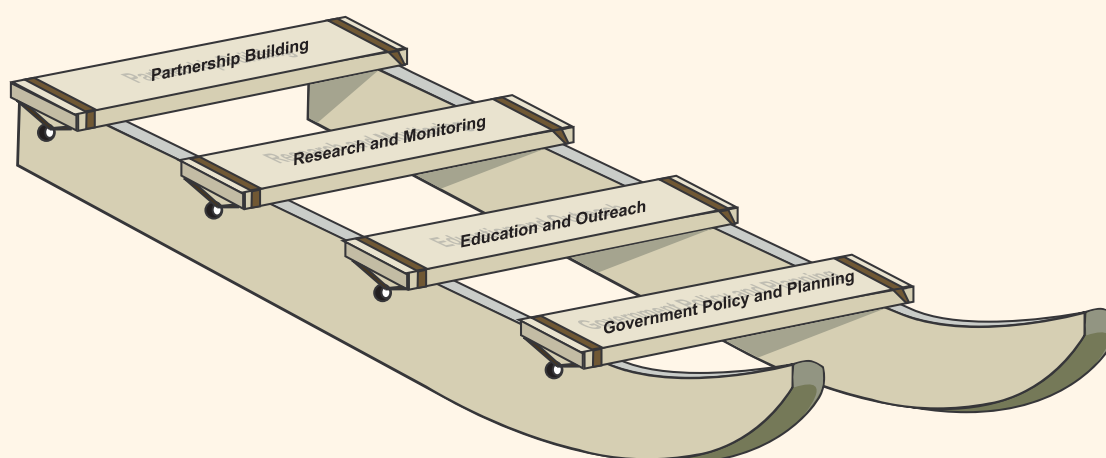


Figure 2: Illustration of adaptive capacity framework.



identifying priorities, improving communications between departments, and providing technical and policy support to communities on climate change impacts and adaptation.

## Napak 2: Research and Monitoring of Impacts

Research and monitoring of impacts in Nunavut is required to develop awareness and tools for adaptation. Through continuous research and monitoring, we will obtain a more complete understanding of the timing, nature and severity of the impacts on our communities, culture, health, environment and economy. By bringing together the best available scientific, community, and Inuit knowledge, Nunavummiut will be better prepared in the face of uncertainty and change.

### **Objective 2.1 Strengthen research and monitoring of impacts in Nunavut through partnerships with communities, organizations and the Federal Government.**

Government, scientists and communities have already expressed a need for more data on permafrost and sea ice conditions, temperature, wind speed and direction, precipitation and landscape hazards. Research and monitoring partnerships will be formed to address these knowledge gaps and to meet specific community research and monitoring needs.

We will build on past successes in community involvement in research and monitoring initiatives, and ensure the application of both scientific data and Inuit/local knowledge. Research and monitoring of wildlife will continue to be a high priority.

The Government of Nunavut will also look for other avenues to expand monitoring programs by working with existing partners and initiatives such as the Nunavut General Monitoring Plan.

## Napak 3: Education and Outreach

The Government of Nunavut will support climate change outreach and learning opportunities for Nunavummiut. This includes supporting initiatives such as community-based committees and other local forums to transfer information on climate change, facilitate training opportunities and document Inuit Qaujimajatuqangit and local knowledge.

### **Objective 3.1 Develop and disseminate climate change awareness material and tools.**

Nunavummiut must have access to current and accurate climate change information. This has been identified as a priority by both communities and government departments. A Nunavut climate change resource website is one of several ways to communicate with the public. Materials such as fact sheets and newsletters will be created. Developed tools and best practices will be gathered and disseminated through the resource website.

### **Objective 3.2 Encourage and support continued transfer of knowledge and skills from elders to youth.**

Learning tools on climate change will be integrated in to Nunavut's education curriculum. This will ensure that students are provided with the opportunities, skills, and knowledge necessary to make informed decisions about climate change and contribute to climate change adaptation.

### **Objective 3.3 Ensure all aspects of climate change are incorporated into school curricula.**

By facilitating intergenerational learning, we ensure the continued knowledge transfer from elders to youth. Land skill knowledge transfer will equip younger generations with the traditional skills needed to adapt to a changing environment.



**Objective 3.4 Increase national and global awareness of the climate change impacts on Nunavut and Inuit culture.**

Global awareness must be raised about the impacts of climate change on Nunavummiut. The Government of Nunavut will advocate for Nunavummiut through various mechanisms, calling for action that curbs greenhouse gas emissions in order to minimize impacts in our territory.

**Napak 4: Government Policy and Planning**

The Government of Nunavut makes a large number of decisions every day that affect a wide range of people and activities. These include the development of government legislation, regulations and policies, programs and related financial measures. It is vital that current and future planning fosters the continued development of adaptive capacity throughout Nunavut.

**Objective 4.1 Integrate climate change considerations into all government decision-making.**

The Government of Nunavut will ensure that all departments and agencies integrate climate change projections, impacts and best practices in all levels of their decision-making in order to implement a comprehensive response to climate change.

**Objective 4.2 Ensure climate change considerations are integrated into land use planning and environmental assessments.**

Incorporating climate change projections in land use planning and environmental assessments can help ensure climate change impacts are fully considered when planning future development. The Government of Nunavut will work with various partners in the regulatory review and implementation process to ensure climate change considerations are incorporated into all



land use planning < including community land use planning, and environmental assessments. By continuing to provide technical advice and expertise, the Government of Nunavut will support the integration of climate change adaptation measures into community services and infrastructure planning.

**Objective 4.3 Identify new economic opportunities associated with climate change.**

In addition to risks and challenges, climate change is also expected to lead to new economic opportunities. The Government of Nunavut will continue to work with stakeholders to maximize any climate change-related economic and employment opportunities for Nunavummiut.

**Objective 4.4 Work with our partners to ensure climate change impacts are considered in emergency planning.**

Emergency and contingency plans help to ensure the safety, health and welfare of the population and the protection of property. Climate change is expected to increase the frequency and intensity of extreme weather events and affect human safety when travelling on land or by water. The Government of Nunavut will work with all stakeholders to ensure climate change considerations are incorporated into emergency planning.



*Upiagiatavut* confirms the Government of Nunavut's commitment to increasing adaptive capacity in Nunavut's communities and within the Government itself. It sets the course for future projects and actions. Only by working together towards a resilient Nunavut will we be able to efficiently and effectively meet the challenges presented by climate change.

The Government of Nunavut is committed to annual reporting on its climate change impacts and adaptation activities. This will be coordinated through the interdepartmental working group on climate change impacts and adaptation. The annual reports will be made available to the public.

We have started a process to identify current gaps in knowledge, understanding and actions towards adaptation. A first task for the interdepartmental working group will be to identify and elaborate on these knowledge gaps. Then, we will assess where our limited resources can best be put to use in order to address these gaps.

Climate change has presented Nunavut with many technical, engineering, social and cultural challenges. Historically, Nunavummiut have traditionally overcome many difficult challenges by working together and by maximizing the use of our limited resources. *Upiagiatavut* sets the course for how we will work together to adapt to a changing climate.

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## REFERENCES

1. Serreze, M.C., Walsh, J.E., Chapin III, F.S., Osterkamp, T., Dyurgerov, M., Romanovsky, V., Oechel, W.C., Morison, J., Zhang, T., and Barry, R.G. 2000. Observational evidence of recent change in the northern high-altitude environment. *Climate Change*, 46: 159-207
2. Nelson, F.E., Anisimov, O.A., Shiklomanov, N.I. 2002. Climate Change and Hazard Zonation in the Circum-Arctic Permafrost Regions. *Natural Hazards*, 26: 203-225
3. Smol, J.P., Wolfe, A.P., Birks, H.J.B., Douglas, M.S.V., Jones, V.J. Korhola, A., Pienitz, R., Rühland, K., Sorvari, S., Antoniades, D., Brooks, S.J., Fallu, M., Hughes, M., Keatley, B.E., Laing, T.E., Michelutti, N., Nazarova, L., Nyman, M., Paterson, A. M., Perren, B., Quinlan, R., Rautio, M., Saulnier-Talbot, É., Siitonen, S., Solovieva, N., and Weckström, J. 2005. Climate-driven regime shifts in the biological communities of arctic lakes. *Proceedings of the National Academy of Sciences of the United States of America*. 102(12): 4397-4402
4. Hinzman L.D, Bettez N.D, Bolton W.R, Chapin F.S, Dyurgerov M.B, Fastie C.L, Griffith, B., Hollister R.D, Hope A, Huntington H.P, Jensen A.M, Jia G.J, Jorgenson T, Kane D.L, Klein D.R, Kofinas G, Lynch A.H, Lloyd A.H, McGuire A.D, Nelson F.E, Oechel W.C, Osterkamp T.E, Racine C.H, Romanovsky V.E., Stone R.S., Stow D.A., Sturm M., Tweedie C.E., Vourlitis GL, Walker MD, Walker DA, Webber PJ, Welker JM, Winker KS, and Yoshikawa K . 2005 Evidence and implications of recent climate change in northern Alaska and other arctic regions. *Climate Change* 72:251–298
5. Huntington, H.P., Boyle, M., Flowers, G.E., Weatherly, J.W., Hamilton, L.C., Hinzman, L., Gerlach, C., Zulueta, R., Nicolson, C., and Overpeck, J. 2007. The influence of human activity in the Arctic on climate and climate impacts. *Climate Change*, 82:77-92
6. Overpeck, J.T., Hughen, K., Hardy, D., Bradley, R., Case, R., Douglas, M., Gajewski, K., Jacoby, G., Jennings, A., Lamoureux, S., Lasca, A., MacDonald, G., Moore, J., Retelle, M., Smith, S., Wolfe, A, and Zielinski. G. 1997 Arctic Environmental Change of the Last Four Centuries. *Science*, 278(1251): 1251-1256
7. Overpeck, J.T., Strum, M., Francis, J.A. Perovich, D.K., Serreze, M.c., Benner, R., Carmack, E.C., Chapin, E.S., Ill., Gerlach, S.C., Hamilton, L.C., Hinzman, L.D., Holland, M., Huntington, H.P., Key, J.R., Lin, J., Lloyd, A.H., MacDonald, G.M., McFadden, J., Noone, D., Prowse, T.D., Schlosser, P., and Vorosmarty, C. 2005. Arctic system on trajectory to new state. *EOS*, 86(34):309-311.
8. Zhang, X., Vincent, L.A., Hogg, W.D., and Niitsoo, A. 2000. Temperature and precipitation trends in Canada during the 20th century. *Atmospheric – Ocean*, 38(2): 395-429.
9. Arctic Climate Impact Assessment. 2004. Arctic climate impact assessment. Cambridge University Press, Cambridge, UK
10. James, T., and Forbes, D. 2010. Sea-level Change. Personal Communications.
11. Intergovernmental Panel on Climate Change, 2007. Polar regions (Arctic and Antarctic). In: *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 655-677.
12. Pielou, E. C. (1992) *After the ice age: the return of life to glaciated North America*. University of Chicago Press, Chicago, IL. 376pp.
13. Smith, S., and Leblanc, A. 2010. Permafrost. Personal Communications.
14. Michaelson, G. J., Ping, C. L., and Kimble, J. M. 1996. Carbon storage and distribution in tundra soils of Arctic Alaska, U.S.A, *Arctic and Alpine Research* 28: 414–424.
15. Arctic Climate Impact Assessment. 2007. Arctic climate impact assessment. Cambridge University Press, Cambridge, UK
16. Rencz, A., 2010. Northwest Passage. Personal Communications.
17. Department of Environment. 2005. Inuit Qaujimajatuqangit of Climate Change in Nunavut, Kivalliq Region, Nunavut. Government of Nunavut. 8-52.

18. Department of Environment. 2005. Inuit Qaujimajatuqangit of Climate Change in Nunavut, Kitikmeot Region, Nunavut. Government of Nunavut. 5-32.
19. Department of Environment. 2005. Inuit Qaujimajatuqangit of Climate Change in Nunavut, North Baffin Region, Nunavut. Government of Nunavut. 7-38.
20. Department of Environment. 2005. Inuit Qaujimajatuqangit of Climate Change in Nunavut, South Baffin Region, Nunavut. Government of Nunavut. 7-33.
21. Furgal, C., and Prowse, T.D. 2008. Northern Canada; IN: From Impacts to Adaptation: Canada in a Changing Climate 2007. Eds. D.S., Lemmon, F.J., Warren, J., Lacroix, and E.Bush. Government of Canada, Ottawa, Ontario.
22. Ford, J., Smit, B., Wandel, J. 2005. Living with Change in Nunavut: Vulnerability of Two Inuit communities to Risks Associated with Climate Change. University of Guelph.
23. Nickels, S., Furgal, C., Buell., and Moquin, H. 2005. Unikkaaqatigiit – Putting the Human Face on climate Change: Perspectives from Inuit in Canada. Ottawa: Joint publication of Inuit Tapiriit Kanatami, Nasivvik Centre for Inuit Health and Changing Environment at Université Laval and the Ajunnginiq Centre at the National Aboriginal Health Organization.
24. Gearheard, S., Pocernich, M., Stewart, R., Sanguya, J., and Huntington, H.P. 2010. Linking Inuit knowledge and meteorological station observations to understand changing wind patterns at Clyde River, Nunavut. *Climatic Change*, 100:267-294.
25. Muir, D.C.G., and de Wit, C.A. 2010. Trends of legacy and new persistent organic pollutants in the circumpolar arctic: Overview, conclusions, and recommendations. *Science in the Total Environment*. 408: 3044-3051
26. Ross, J. 2009. CLEY. Personal Communications.
27. Williams, P. J.: 1986, *Pipelines & Permafrost: Science in a Cold Climate*, Carleton University Press, Don Mills, Ontario.
28. Dale, V.H. 1997. The relationship between land-use change and climate change. *Ecological Applications*, 7(3): 753-769.
29. Foley, J.A., DeFries, R., Asner, G.P., Barford, C., Bonan, G., Capreuter, S.R., Chapin, S.F., Coe, M.T., Daily, G.C., Gibbs, H.K., Helkowski, J.H., Holloway, T., Howard, E.A., Kucharik, C.J., Modfreda, C., Patz, J.A., Prentice, I.C., Ramankutty, N., and Snyder, P.K. 2005. Global Consequences of Land Use. *Science*, 309(5734): 570-774.
30. Smit, B., and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. *Global Environmental Change*. 16:282-292.
31. Murray C., and Marmorek, D.R. 2004. Adaptive management: A Spoonful of Rigour Helps the Uncertainty Go Down. 16th International Annual Meeting of the Society for Ecological Restoration, Victoria, British Columbia, Canada.
32. Sharpe A., and Conrad, C. 2006. Community based ecological monitoring in Nova Scotia: Challengers and Opportunities. *Environmental Monitoring and Assessment*. 113(1-3): 395-409
33. Budkewitsch, P., Prévost, C., Pavlic, G., Pregitzer, M., and Zhang. Y. Water Availability. Personal Communications.

## APPENDIX A – GLOSSARY OF KEY TERMINOLOGY

**Active Layer** The active layer is the top layer of the soil (or surface materials) that thaws in the summer and freezes up again in the fall. The depth of the active layer varies across Nunavut, and even within communities depending on factors such as soil type and location (e.g. proximity to a river).

**Adaptation** refers to any action that combats the negative impacts of climate change or takes advantage of potential new opportunities. Adaptation can be proactive, spontaneous, or planned.

**Adaptive Capacity** is a region or community's ability to manage the impacts and risks of climate change.

**Climate Change** refers to a change in the long-term average weather patterns.

**Food Security** is a way to describe how steady people's access is to safe, acceptable and culturally appropriate food in a quantity and quality that allows them to lead active and healthy lives all year round (from "Terminology on Climate Change").

**Inuit Qaujimajatuqangit** means traditional Inuit values, knowledge, behaviour, perceptions and expectations pertaining to language, culture, survival skills, use of resources, harvesting and understanding of society, ecology and environment.

**Isostatic Rebound** occurs as land that was weighed down (depressed) by the enormous weight of the glaciers of the last ice age rises as a result of disappearing ice. The depressed land is 'bouncing back' (rebounding) – a process called isostasy. This is happening in certain areas of Nunavut.

**Permafrost** is frozen soil or rock that has been frozen for at least 2 years in a row. Permafrost degradation refers to thawing permafrost; frozen soils that are thawing or getting warmer. Certain areas of permafrost contain more water than others. When the water in the soil (for example ice wedges) melts, the soil becomes wet and unstable and may slump down. Frozen soil is hard – when it thaws it turns soft. Infrastructure in Nunavut relies on the permafrost for stability. When the permafrost degrades, the load bearing capacity (the integrity) of the permafrost decreases and the soil can become unstable (buckling, sinking etc) and cause damage to houses, roads, airports or other facilities.

**Storm Surge** refers to a temporary rise in the height of the sea along a coastline. This kind of large wave moves with, and is caused by, strong storms with spiralling winds (from "Terminology on Climate Change").

**Vulnerability** refers to the degree to which a natural or anthropogenic (human-made) system is susceptible to, or unable to deal with, the impacts of change.

**Weather** is what you see outside your window today, or the pattern you see over shorter time spans (for example a 'rainy week'). In other words, weather refers to the short-term conditions of the air and sky over an area. It is described by air temperature, cloud and wind patterns, rainfall or snowfall (adapted from "Terminology on Climate Change").



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