

Discussion Paper: Climate Change Initiatives in NWT

Overview, Gaps and Opportunities

A report for the Climate Change and Communities in the NWT Forum

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Acknowledgements

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Contents

1. Climate Change in NWT	1
Climate change in NWT	1
This report	1
2. Overview of Climate Change Initiatives and Projects in the NWT	3
2.1 Reports and Research	3
2.1.1 General Adaptation Resources	3
Northwest Territories	3
Northern Canada.....	5
2.1.2 Infrastructure and Transportation	7
2.1.3 Community adaptation planning.....	13
NWT community plans	13
Community Planning tools.....	16
2.1.4 Water and wastewater management.....	19
2.1.5 Economic and social impacts	21
2.1.6 Human health and food security.....	23
2.1.7 Emergency preparedness	26
2.1.8 Energy efficiency and renewable energy options	27
2.2 Funding Opportunities	31
2.3 Outreach and Communications	34
Organizations	34

Conferences and Workshops	38
2.4 Academic Research Programs	39
3. Gaps and opportunities in climate change adaptation in NWT	42
3.1 Analysis of gaps in climate change and adaptation initiatives.....	42
3.2 Opportunities for moving forward	43

1. Climate Change in NWT

Climate change in NWT

Climate change is rapidly occurring in the north, and impacts are being felt in almost every aspect of life in Northwest Territories (NWT) communities. Observations and impacts of climate change include:

- Melting of permafrost, causing damage to infrastructure.
- Increased frequency of severe storms, leading to erosion and property damage in low-lying coastal areas.
- Unpredictable ice formation and breakup are decreasing the use of ice roads for transportation and creating dangerous conditions for hunting.
- Wildlife and plant distribution is changing.

Communities in NWT are on the front lines these changes. Mitigating and adapting to climate change impacts will be critical for the well-being of communities in the future. It will be necessary to consider climate change in almost every decision made by municipal governments. In order to do this, community leaders need to have the knowledge and resources to make decisions to address climate change.

While some communities have engaged in research and planning processes to adapt to climate change impacts, others have not yet done so. Those communities who have completed the research and planning may have valuable lessons to share with those who have not. There is a need to share knowledge across communities, which can reduce the overall costs of adaptation and to allow community leaders to learn best methods and practices from each other.

Similarly, there is much to be learned from other resources. There are many examples of government programs and sources of funding, academic research and communication tools that can be useful to community leaders. Community leaders may not be aware of all the resources and expertise available to them at the community, territorial and national levels. In addition, research needed to inform the decisions of community leaders may not yet be complete, or may not be readily available.

This report

The report provides an overview of the initiatives and projects up to completed to date and can help participants reflect on the gaps in our knowledge and opportunities to continue to address climate change within communities.

This report is intended as a discussion paper for the “Climate Change and Communities in the NWT Forum” held March 29th and 30th, 2011 in Yellowknife, NWT.

This project aims to increase the decision-making capacity of community leaders to address climate change effects in their community. The objectives of this project are:

- Build the capacity of municipal governments to address climate change in everyday decision making.
- Create a dialogue between community leaders, and climate change researchers and agencies on best practices and lessons learned on climate change adaptation and mitigation.
- Develop an action plan for regional approaches and research on climate change in the NWT.

This working document can be updated after the forum as a result of discussion and participants’ input.

Scope of this report

This report is mainly focused on NWT, with the exception of a number of databases and tools that are aimed at municipal leaders which have applications for NWT but may not be specifically developed in NWT.

This report focuses on the initiatives or projects that address impacts felt by communities. It is not a full summary of the existing literature on all climate change related issues. Ecosystem impacts such as changes to wildlife populations (except in terms of a food source, e.g. caribou); shifts in habitat or invasive species are not included within the review.

This report summarizes information that is publicly available, and thus the full body of academic research that has taken place in the NWT has not been included here. Please see section 2.4 for a summary of major research programs.

Important Definitions¹

Climate change mitigation is defined as reducing greenhouse gas emissions that cause climate change. This can include reducing the burning of fossil fuels, and altering land-use practices to enhance storage of carbon in the environment.

Climate Change adaptation can be defined as technical, structural, operational, and behavioural adjustments that minimize the risks from the effects of climate change we are experiencing now and expect to later, and position us to take advantage of opportunities.

¹ National Roundtable on the Environment and Economy “True North: Adapting Infrastructure to Climate Change in Northern Canada” <http://www.nrtee-trnee.com/eng/publications/true-north/true-north-eng.pdf> (2009).

2. Overview of Climate Change Initiatives and Projects in the NWT

2.1 Reports and Research

2.1.1 General Adaptation Resources

There is a very large body of academic literature that discusses the impacts of climate change and adaptation actions. However, as stated above, this report lists publicly available resources that are specific or applicable to NWT.

The most comprehensive summary of climate change impacts can be found in the Intergovernmental Panel on Climate Change reports² which discuss global trends and impacts, The Arctic Climate Impact Assessment³ provides a comprehensive assessment of pan-Arctic effects. The chapters of these reports that are applicable to the NWT and this report are discussed below.

Northwest Territories

Project Title	NWT Adaptation Roadmap (upcoming)
Project Description	The document, expected in spring of 2011, outlines what adaptation actions have been undertaken by NWT government departments and will outline future actions.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more	Brian Sieben, brian_sieben@gov.nt.ca

² Intergovernmental Panel on Climate Change Assessment Reports can be found at http://www.ipcc.ch/publications_and_data/publications_and_data.shtml. The 4th report was released in 2007, and the 5th is expected in 2012.

³ Arctic Climate Impact Assessment (2005) <http://www.acia.uaf.edu/>

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Project Title	Pan-Territorial Adaptation Strategy (upcoming)
Project Description	NWT is working with Yukon and Nunavut the Northwest Territories to develop a joint adaptation strategy for the three northern territories outlining common impacts of climate change and opportunities for collaboration for adaptation.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	Brian Sieben, brian_sieben@gov.nt.ca

Project Title	Northern Regional Adaptation Collaborative (2010- in development)
Project Description	This collaborative effort attempts to bring together climate change adaptation planning and decision-making within similar regions. The northern RAC focuses on climate change impacts on infrastructure (particularly the impacts of permafrost on mining and transportation).
Organizations/ Agencies	Natural Resources Canada
For more information	http://adaptation.nrcan.gc.ca/collab/colcol_e.php or Greg Cousineau, greg_cousineau@gov.nt.ca

Project Title	Climate Change Adaptation Project (2010)
Project Description	This projects aims to increase knowledge of community leaders about climate change adaptation by collecting information on previous work, identify gaps in knowledge and developing a best practices summary for climate change impact and adaptation assessments.
Organizations/ Agencies	NWT Association of Communities

For more information	http://www.nwtac.com/climate.html
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Project Title	Report: NWT Climate Change Impacts and Adaptation (2008)
Project Description	This report provides a summary of impacts on transportation, the environment, and infrastructure in the NWT and identifies some possible adaptation actions,
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	http://www.enr.gov.nt.ca/live/documents/content/NWT_Climate_Change_Impacts_and_Adaptation_Report.pdf

Project Title	Report: <i>Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change</i> (2007)
Project Description	Chapter 15 (Polar Regions) gives a summary of climate change impacts in polar regions, and identifies a few adaptation efforts. Chapter 17 focuses on general adaptation principles, tools and strategies. A fifth assessment report will be published in 2014.
Organizations/ Agencies	Intergovernmental Panel on Climate Change, Working Group II
For more information	http://www.ipcc-wg2.gov/publications/AR4/index.html

Northern Canada

Project Title	Climate Prosperity (upcoming)
Project Description	This is a series of reports that discuss responses to climate in various sectors across Canada, expected to be released in 2011. Report topics relevant to NWT communities include adaptation, an assessment of

	costs of climate impacts, an assessment of policy pathways for climate impacts and a discussion of citizen engagement.
Organizations/ Agencies	National Roundtable on Environment and Economy
For more information	http://www.nrtee-trnee.com/eng/issues/programs/climate-prosperity/overview/timeline-climate-prosperity-eng.php

Project Title	Report on Adaptation to Climate Change Activities in Arctic Canada (2007)
Project Description	This report summaries climate change adaptation action from federal territorial government and other in the Canadian North.
Organizations/ Agencies	Indian and Northern Affairs Canada
For more information	http://www.ainc-inac.gc.ca/enr/clc/adp/pubs/adap/adap-eng.asp#Exe

Project Title	Report: Climate Change Impacts and Adaptation: A Canadian Perspective (2004)
Project Description	This report focuses on climate change and adaptation options research up until 2002. Chapters of interest to northerners include water, coastal zones, transportation, and human health.
Organizations/ Agencies	Natural Resources Canada
For more information	http://adaptation.nrcan.gc.ca/perspective/index_e.php

Project Title	Poster: Climate Change in the Yukon and Northwest Territories (2001)
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Project Description	This poster is a visual presentation of climate change science and adaptation efforts in Northern Canada.
Organizations/ Agencies	Natural Resources Canada
For more information	http://adaptation.nrcan.gc.ca/posters/wa/index_e.php

Project Title	National Climate Data and Information Archive
Project Description	This online resource allows users to access climate data by community. It also provides some compilations of historical data trends.
Organizations/ Agencies	Environment Canada
For more information	http://climate.weatheroffice.gc.ca/climateData/canada_e.html

2.1.2 Infrastructure and Transportation

Impacts on infrastructure and transportation are expected to be some of the most costly effects associated with climate change in the North. Buildings, roads, bridges, and airports are all expected to be impacted, and adaptation actions will likely include changes to the timing, method, intensity and location of building and transportation activities.

Project Title	Airport and highway evaluation, rehabilitation, permafrost monitoring and routing (Highway 3) (ongoing)
Project Description	The GNWT Department of Transportation has undertaken a program of research, monitoring, repair and replacement of a number of highways and airports in NWT. In particular, Highway 3 between Yellowknife and Behchoko, is being evaluated to complete a vulnerability assessment using PIEVC (see below).

Organizations/ Agencies	Department of Transportation, GNWT
For more information	http://www.dot.gov.nt.ca/ live/pages/wpPages/home.aspx

Project Title	Deh Cho Bridge Project (ongoing)
Project Description	<p>The Deh Cho will span the Mackenzie River near Fort Providence on NWT Highway 3. The bridge will replace the operations of the Merv Hardie Ferry and the Mackenzie River Ice Crossing currently at that location.</p> <p>The bridge will provide year round access and overcome climate change threats to the present ferry and ice crossing due to warm temperatures and low water levels. A fixed bridge will eliminate lengthy and uncertain disruptions during winter freeze-up and in the spring during break-up.</p>
Organizations/ Agencies	Department of Transportation, GNWT
For more information	http://www.dehchobridge.info/

Project Title	Report: Geotechnical Site Investigation Guidelines for Building Foundations in Permafrost (2010)
Project Description	The guide explains best practices for collecting information and evaluating site conditions for permafrost conditions.
Organizations/ Agencies	Public Works and Services, GNWT
For more information	www.pws.gov.nt.ca/pdf/publications/GeotechnicalGuidelines.pdf

Project Title	Guidelines: Infrastructure foundations in permafrost: A practice guide for climate change adaptation(2009)
Project Description	These guidelines were designed to support the proper consideration of permafrost during planning, design and development of community infrastructure. It provides an assessment of trends in climate and permafrost melt in Northern Canada and characterizes the types of foundations used for community infrastructure and their general strengths and weaknesses. A process to ensure the potential effects of climate change are incorporated into the design of foundation systems will also be outlined.
Organizations/ Agencies	Canadian Standards Association
For more information	http://www.csa.ca/cm/ca/en/home

Project Title	Report: Good Building Practices for Northern Facilities (2009)
Project Description	This set of guidelines is updated from the <i>Design Standards and Guidelines for Northern Facilities</i> . This is an advisory paper that provides updated northern codes and includes recommendations for energy efficiency and reduced life-cycle cost.
Organizations/ Agencies	Public Works and Services, GNWT
For more information	http://www.pws.gov.nt.ca/pdf/GBP/GBP%202009.pdf

Project Title	Report: Flat Loop Thermosyphon Foundations in Warm Permafrost (2009)
Project Description	This report evaluates existing thermosyphon installations and makes recommendations for technical and site considerations for effective future use of further thermosyphons.
Organizations/	Public Infrastructure Engineering Vulnerability Committee, Public

Agencies	Works and Services, GNWT
For more information	http://www.pws.gov.nt.ca/pdf/publications/Thermosyphon%20Foundations%20in%20warm%20permafrost%20.pdf

Project Title	Report: True North: Adapting Infrastructure to Climate Change in Northern Canada (2009)
Project Description	This report summarizes the predicted costs of climate change impacts on infrastructure in Canada's territories and barriers and opportunities for adaptation action. NWT-specific components of this report include a discussion the shortening of the ice-road season and impacts on diamond mines, coastal erosion and permafrost melt.
Organizations/ Agencies	National Round Table on the Environment and the Economy
For more information	http://www.nrtee-trnee.com/eng/publications/true-north/true-north-eng.php

Project Title	Report: Potential climate change-induced permafrost degradation and building foundations: An assessment of impacts and costs for five case communities in the Northwest Territories (2007)
Project Description	This assessment of the potential impacts and costs of thawing permafrost on building foundations in five NWT communities. This report found that in Inuvik total costs of foundation repair be up to \$120 million, but that this cost could be partly mitigated with proactive maintenance.
Organizations/ Agencies	Natural Resources Canada
For more information	http://adaptation.nrcan.gc.ca/projdb/index_e.php?class=116

Project Title	Report: The Role of Codes, Standards, and Related Instruments in Fostering Adaptation to Climate Change in Relation to Physical Infrastructure in Canada's North (2008)
Project Description	This study, commissioned by the National Roundtable on the Environment and the Economy, discusses the role of standards in preparing for climate change impacts on community infrastructure.
Organizations/ Agencies	Canadian Standards Association, National Roundtable on the Environment and the Economy
For more information	http://adaptation.nrcan.gc.ca/projdb/index_e.php?class=116

Project Title	Report: Climate Change and Transportation in the NWT (2007)
Project Description	This report determined the vulnerability of road and runway to climate change. It examined whether the current transportation system is capable of handling projected changes in climate. Adaptation strategies to adjust the type, timing and intensity of transportation are discussed.
Organizations/ Agencies	Department of Transportation, GNWT, Natural Resources Canada, Dillon Consulting
For more information	http://www.dot.gov.nt.ca/live/documents/content/Climate%20Change%20Report%20for%20posting%20to%20web.pdf

Project Title	Report: Adapting Infrastructure to Climate Change in Canada's Cities and Communities (2006)
Project Description	This literature review of community infrastructure impacts is national but includes northern implications of climate change to infrastructure and suggests adaptation actions.
Organizations/ Agencies	Infrastructure Canada

For more information	http://www.infc.gc.ca/research-recherche/results-resultats/rs-rr/rs-rr-2006-12_02-eng.html
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Project Title	Climate change, permafrost degradation and infrastructure adaptation: community case studies in the Mackenzie Valley (2007)
Project Description	This report assesses the effects of predicted permafrost conditions in Norman Wells and Tuktoyaktuk on infrastructure, with a literature review and thermal modelling. Part of the outcome of this report was to provide these communities with engineers for use in their decision-making. The researchers also provided each town with ideas and tools for developing adaptation strategies to deal with the projected changes in permafrost.
Organizations/ Agencies	Natural Resources Canada —Geological Survey of Canada Municipal and Community Affairs, GNWT , Environment Canada, National Research Council
For more information	Stephen Robinson, srobinson@stlawu.edu

Project Title	Mackenzie Valley Winter Road Bridge Construction Program (2000)
Project Description	The project installed permanent water crossings at 10 locations along the Mackenzie Valley Winter Road between Wrigley and Norman Wells to extend the winter road season.
Organizations/ Agencies	Department of Transportation, GNWT
For more information	http://wiki.nwtresearch.com/2000085.ashx

Project Title	Tool: Engineering Protocol for Climate Change Vulnerability Assessment
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Project Description	This tool for engineers is designed to assess the climate change impacts on the design, operation, maintenance and management of buildings, roads, storm water and wastewater systems, and water resources. This tool is being used in the vulnerability assessment of Highway 3 (Yellowknife-Behchoko).
Organizations/ Agencies	Public Infrastructure Engineering Vulnerability Committee (PIEVC)
For more information	http://www.pievc.ca/files/PIEVC-Climate_06-07_EN.PDF

2.1.3 Community adaptation planning

One of the tools to address climate change adaptation is a community adaptation plan. A plan can help communities increase their effectiveness in responding to the impacts of climate change. A community adaptation plan should be used to evaluate the vulnerability of people, the environment (both built and natural), and the economy to climate change impacts. The planning process should identify, assess and prioritize adaptation actions, and lay out the framework for implementation. A thorough adaptation planning process addresses infrastructure and transportation, community planning, water and wastewater management, economic and social impacts, human health, emergency management, food security and energy efficiency options.

Many of these considerations may overlap with existing planning efforts. However, pulling together all of these components into one plan allows communities to make sure there are no gaps, to avoid duplicating efforts, to assess the full costs of adaptation, and to respond to impacts in an organized way.

Beyond the planning process, communities must consider how to implement the plan. A successful planning process must incorporate community priorities. The outcomes of the plan must address the highest-priority issues for the community, and provide methods to achieve the outcomes. A successful plan will provide a framework for council and municipal staff to move forward with action.

NWT community plans

Project Title	Climate Change Adaptation Action Plan for Ulukhaktok (2011)
Project Description	This ongoing planning process is attempting to identify climate change impacts, vulnerabilities and adaptation actions for the community of

	Ulukhaktok.
Organizations/ Agencies	Hamlet of Ulukhaktok, ArcticNorth Consulting, Indian and Northern Affairs Canada
For more information	http://www.arctic-north.com/ulukhaktok/

Project Title	Climate Change Adaptation Action Plan for Tsiigehtchic (2011)
Project Description	The Tsiigehtchic Adaptation plan reviews expected climate change impacts for the community, and creates recommendations for adaptation actions based on community priorities. Key recommendations include increasing community resilience, sharing of information and traditional knowledge and incorporating climate change considerations into existing decision-making processes.
Organizations/ Agencies	Community of Tsiigehtchic, Ecology North, Indian and Northern Affairs Canada
For more information	http://ecologynorth.ca/Climate_Change.html

Project Title	Tetlit Gwich'in Adaptation Plan (2011)
Project Description	The draft Tetlit Gwich'in Adaptation Plan outlines 45 suggested climate change adaptation actions for the Community of Fort McPherson. These responses include monitoring what is happening on the land, incorporating climate change into ongoing planning processes, working to make travel on the land safer, reducing the impacts of permafrost melt on community infrastructure and promoting the opportunities that will accompany change.
Organizations/ Agencies	Community of Fort Macpherson, Ecology North
For more information	http://ecologynorth.ca/Climate_Change.html

Project Title	Climate Change Adaptation Action Plan for Tlicho Communities (2010)
Project Description	Adaptation planning for the communities of Wekweeti, Gameti, Wha'ti and Behchoko took place in 2009-2010. These plans involved the development of community profiles and interviews and public meetings to identify concerns and document observations for impacts. Some key priorities for the communities were hazardous waste disposal, forest fires, permafrost melting and effects on infrastructure, water quality and invasive species.
Organizations/ Agencies	Communities of Wekweeti, Gameti, Wha'ti and Behchoko, Ecology North, Indian and Northern Affairs Canada
For more information	admin@ecologynorth.ca , www.tlicho.ca

Project Title	Climate Change Adaptation Action Plan for Paulatuk (2010)
Project Description	This report identifies climate change vulnerabilities, adaptation actions and resources with respect to business and economy, culture and learning, health and wellbeing, subsistence harvesting, transportation and infrastructure. This report highlights the importance of traditional knowledge, capacity building, consideration of community needs in the planning process, and involvement of elders in guiding the process.
Organizations/ Agencies	Community of Paulatuk, ArcticNorth Consulting, Indian and Northern Affairs Canada
For more information	http://www.arctic-north.com/paulatuk/

Project Title	Creating a More Resilient Yellowknife: Climate Change Adaptation and Municipal Decision Making (2007)
Project Description	This document assesses climate change vulnerabilities and priorities for adaptation in the City of Yellowknife in order to develop a

	community adaptation plan. Recommendations included establishment of an Adaptation Coordinator and reviewing infrastructure investment plans and existing by-laws for climate change considerations.
Organizations/ Agencies	City of Yellowknife, Pembina Institute
For more information	http://communities.pembina.org/partners/yellowknife

Community Planning tools

Project Title	Integrated Community Sustainability Planning (2010)
Project Description	<p>As part of an initiative to support long-term community sustainability planning, communities in NWT completed integrated plans that included energy planning, along with capital investment, human resources and strategic planning.</p> <p>As part of the ICSP process, communities in NWT have undergone the Community Energy Plans, where energy use and supply is evaluated, potential for renewable energy and energy efficiency is assessed, and cost-savings and environmental benefits of energy conservation are identified.</p>
Organizations/ Agencies	Department of Municipal and Community Affairs, the NWT Association of Communities, and the Arctic Energy Alliance
For more information	http://www.maca.gov.nt.ca/toolkit/sustainability_planning/index.html http://www.aea.nt.ca/programs/community_energy_planning/

Project Title	Changing Climate, Changing Communities: Guide for Municipal Climate Adaptation (2010)
Project Description	This guide is intended to assist local governments in creating an adaptation plan to address climate change. It provides a toolkit to guide the planning process.

Organizations/ Agencies	ICLEI-Canada
For more information	http://www.iclei.org/index.php?id=11710

Project Title	Adapting to Climate Change: An Introduction for Canadian Municipalities (2010)
Project Description	Summary of essential elements of climate change adaptation in municipalities and case studies from Canadian cities. While none of the case studies are from NWT, valuable lessons may be gained from other jurisdictions
Organizations/ Agencies	Natural Resources Canada
For more information	http://adaptation.nrcan.gc.ca/mun/index_e.php#toc

Project Title	Managing the Risk of Climate Change (2010)
Project Description	This interactive climate change risk management guide is based on a Canadian Standard for Risk Management for Aboriginal and northern communities. It provides a series of guidebooks to the planning process, including assessing risks and vulnerabilities, gaining stakeholder input and designing adaptation actions.
Organizations/ Agencies	The Centre for Indigenous Environmental Resources
For more information	http://ccrm.cier.ca/

Project Title	Report: Promising Practices in Adaptation and Resilience: A resource guide for local leaders (2010)
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Project Description	This study is focused on large, southern (mostly American) cities, but does provide interesting case studies of cities that have integrated adaptation into existing planning processes, and examples of partnerships between municipal governments.
Organizations/ Agencies	Institute for Sustainable Communities, Centre for Clean Air Policy
For more information	http://www.ccadaptation.ca/download/documents/adaptationtoolsplans/instituteforsustainablecommunities_adaptationresou?attachment=1

Project Title	Canadian Communities' Guidebook for Adaptation to Climate Change (2008)
Project Description	This guide for municipal governments contains a proactive decision-process that combines sustainable development, climate change adaptation and mitigation. It contains Canadian case studies and examples of potential adaptation actions.
Organizations/ Agencies	Environment Canada and University of British Columbia
For more information	http://www.forestry.ubc.ca/LinkClick.aspx?fileticket=xsexCSatHjo%3d&tabid=2455&mid=5415&language=en-US

Project Title	Climate Change Planning Tools for First Nations Guidebooks (2006)
Project Description	This series of six guidebooks have been designed for First Nations communities. They outline the planning process for climate change adaptation and contain suggestions for assessment of impacts and vulnerabilities, how to involve the community members and how to set community priorities.
Organizations/ Agencies	Centre for Indigenous Resources
For more	http://www.cier.ca/information-and-resources/publications-and-

information	products.aspx?id=412
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2.1.4 Water and wastewater management

Climate change is expected to impact both quantity and quality of water in the NWT. Permafrost melt, changes in precipitation patterns and changes in the timing and duration of melt season and open water season will all greatly impact surface and groundwater flows. Together, these changes could lead to increases in sediments in water, changes to the movements of contaminants, and increased pressure on infrastructure components such as sewage lagoon berms, roads and building foundations. The potential for significant changes to flows has implications for planning and engineering of community water treatment, wastewater and solid waste infrastructure.

Project Title	Tool: Vulnerability assessment protocol to of community water and wastewater systems (2011)
Project Description	Ecology North is developing a protocol to conduct site-specific assessments of the vulnerability of community water and wastewater systems to climate change in the NWT. Assessment and planning documents have been developed in collaboration with the communities of Deline, Wekweeti, Tsiigehtchic, Trout Lake and Ulukhaktok.
Organizations/ Agencies	Ecology North
For more information	http://ecologynorth.ca/Climate_Change.html

Project Title	Northern Voices, Northern Waters: NWT Water Stewardship Strategy (2010)
Project Description	The NWT Water Stewardship Strategy provides a vision, guiding principles, goals and approaches to water management and stewardship in the NWT. The document briefly discusses climate change impacts on water.
Organizations/ Agencies	Environment and Natural Resources, GNWT and Indian and Northern Affairs Canada.

For more information	http://www.enr.gov.nt.ca/ live/documents/content/NWT Water Stewardship Strategy.pdf
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Project Title	Report: <i>Navigating the Waters of Change</i> (2009)
Project Description	This report outlines potential climate change impacts to community water and wastewater systems in NWT. The report recommends ten action items to community, regional and federal governments and non-governmental Organizations/agencies to help strengthen the capacity of NWT communities to respond to the impacts of climate change on municipal water and wastewater system including site-specific assessments of water systems, increased water monitoring, controlled release of contaminants and exploration of options for wastewater treatment.
Organizations/ Agencies	Ecology North
For more information	http://ecologynorth.ca/Climate_Change.html

Project Title	NWT Government Support for Wilfrid Laurier Environmental Science Research (2010)
Project Description	The Government of the NWT has partnered with the Canadian Aquatic Laboratory for Interdisciplinary Boreal Ecosystem Research at Wilfrid Laurier. A portion of research from this program will focus on climate variability and the sustainability of boreal ecosystems in NWT.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	Erin_kelly@gov.nt.ca

Project Title	Protecting Drinking Water in Indigenous Communities in Canada's North Program (2010)
Project Description	This project is focused on protection of that the natural sources of drinking water from potential threats such as hazardous chemicals and wastewater. It also includes a capacity-building component that works to increase community awareness, and enhance technical expertise of community water stewards.
Organizations/ Agencies	Trent University, RBC Blue Water program, Aurora College
For more information	http://watercanada.net/2010/a-nice-cold-drink/

Project Title	The Implications of Climate Change for Canada's Boundary and Transboundary Water Management (2003)
Project Description	This project discusses the potential impacts of climate change on boundary and transboundary water basins between Canada and the United States and between provinces and territories. Section 5.2.2. discusses the Mackenzie river and the bilateral agreement between NWT and Yukon.
Organizations/ Agencies	Natural Resources Canada
For more information	http://adaptation.nrcan.gc.ca/projdb/pdf/48_e.pdf

2.1.5 Economic and social impacts

Climate change is expected to have both positive and negative impacts on the economy of the NWT. Some sectors, such as tourism and offshore shipping, may see increased activity, while others such as onshore transportation may show negative impacts.

Project Title	Modeling the Impact of Melting Permafrost on Forest Landscapes
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	(upcoming)
Project Description	Building on the permafrost melt work of from Wilfred Laurier University, a timber supply model was used to provide preliminary predictions of future successional changes in vegetation cover near Fort Simpson, NWT. This work may inform future forestry activities in that region.
Organizations/ Agencies	NWT Environment and Natural Resources
For more information	Tom Lakusta, tom_lakusta@gov.nt.ca

Project Title	Climate Change Impacts and Adaptations on Sea Ice Transportation in Canada's Northwest Passage(2007)
Project Description	This report examines the impacts of the loss of seasonal ice on transportation and discusses policy options for increasing communication and interaction between northern communities, shippers and researchers.
Organizations/ Agencies	Natural Resources Canada, Fisheries and Oceans Canada
For more information	http://adaptation.nrcan.gc.ca/projdb/pdf/128.pdf

Project Title	Report: Greening the NWT Economy: Local Pathways to Territorial Prosperity (2009)
Project Description	This report summarizes the impacts of climate change on the NWT economy, outlines the principles for a green economy and provides case studies of successful economic adaptation.
Organizations/ Agencies	Ecology North

For more information	http://ecologynorth.ca/Climate_Change.html
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Project Title	Report: Canadian Inuit Perspectives on Climate Change and Unikkaaqatigiit – Putting the Human Face on Climate Change: Perspectives from the Inuvialuit Settlement Region (2005)
Project Description	These reports were the result of a series of workshops focused on local adaptation actions and observations of climate change in Arctic communities. These reports are focused on social and economic implications of climate change and impacts on traditional lifestyle.
Organizations/ Agencies	Inuvialuit Regional Corporation, Inuit Tapiriit Katanami, Nunavut Tunngavik Incorporated, Makivik Corporation, Labrador Inuit Association, the Nasivvik Centre for Inuit Health, the Changing Environments program at Laval University and the Ajunnginiq Centre at the National Aboriginal Health Organization.
For more information	http://www.itk.ca/publications/canadian-inuit-perspectives-climate-change-unikkaaqatigiit

2.1.6 Human health and food security

Climate change is linked to human health and food through impacts such as changes to the availability and quality of traditional foods like caribou and fish. Other impacts on human health could include personal safety that are changing hunting and traveling practices, increased warm weather days.

Project Title	Climate Change as a Health Determinant in Aklavik, Northwest Territories (2010)
Project Description	This study investigated the connection between health and climate change in regards to food and diet of residents of Aklavik.
Organizations/ Agencies	Arctic Health Research Network, Health Canada and Institute For Circumpolar Health Research
For more	http://ichr.ca/past-projects/climate-change-and-health/

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Project Title	Arctic Peoples, Culture, Resilience and Caribou (2008-2011)
Project Description	This project attempts to assess the evolving relationship between human and caribou across Northern Canada, and discusses how caribou are related to community resilience and climate change adaptation. This initiative Involves a number of aboriginal groups and academic researchers.
Organizations/ Agencies	Arctic Athabaskan Council
For more information	http://www.ipycaribou.ca/

Project Title	Barren-Ground Caribou Management Strategy for the NWT 2006 – 2010
Project Description	This report briefly discusses the impacts of climate change on barren-ground caribou and identifies strategies to support the herd. The Management Strategy will be updated in 2011.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	http://www.enr.gov.nt.ca/ live/documents/content/Caribou forever our heritage our responsibility.pdf

Project Title	Public Health Advisory -Mercury Levels in Fish (2010)
Project Description	Due to increasing levels of mercury in fish, the GNWT issued an advisory to reduce the amount and type of fish consumption from certain lakes in NWT. Mercury concentrations are increasing , likely due to climate change
Organizations/ Agencies	Health and Social Services, GNWT

For more information	http://www.hlthss.gov.nt.ca/pdf/public_health_advisories/2010/english/elevated_mercury_levels_in_four_nwt_lakes.pdf
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Project Title	Report: Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity (2008)
Project Description	This report summarizes health effects and adaptive actions of climate change in Canada. Chapter 7 of this report focuses on the northern territories. For NWT, health issues associated with food security, water contamination, and accidents due to unpredictability of weather conditions were identified as the most pressing threats.
Organizations/ Agencies	Health Canada
For more information	Request a copy from Health Canada at http://www.hc-sc.gc.ca/For more information_/pubs-eng.php , also posted at http://www.sindark.com/2008/08/03/human-health-in-a-changing-climate/

Project Title	The Impact of Climate Change on Food Security on Three Northern Aboriginal Communities – Plans for Adaptation (2007)
Project Description	This study discusses specific nutrient and contaminant related impacts resulting from climate change related impacts on country food availability and the associated potential health impacts on three northern aboriginal communities including Fort Providence, NWT.
Organizations/ Agencies	Natural Resources Canada, CHUL Research Centre-Public Health Research Unit, Dene Nation
For more information	Laurie Chan, Laurie.chan@mcgill.ca

Project Title	Hunting, fishing, and gathering: Indigenous peoples and renewable resource use in the Arctic: Chapter 12 of the Arctic Climate Impact Assessment report (2005)
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Project Description	This chapter discusses the present economic, social, and cultural importance of harvesting renewable resources for arctic peoples. One of the case studies focuses on Sachs Harbour, NWT It assesses the past, present and future impacts of climate change on harvesting activities and considers adaptive actions including modifications to the limit, location and method of harvest.
Organizations/ Agencies	Arctic Climate Impact Assessment
For more information	http://www.acia.uaf.edu/pages/overview.html

2.1.7 Emergency preparedness

Climate change is expected to lead to increased frequency and severity of weather events and thus emergency preparedness will become increasingly especially. In coastal communities, preparation for storms and flooding will be more necessary, while in southern regions of the NWT, it is expected that forest fire frequency will increase.

Project Title	Emergency Planning Tool for Communities and Community Emergency Plan Template and Instruction Manual (2008)
Project Description	This tool aims to help communities achieve a state of preparedness for emergencies. Increased frequency and severity of weather events are expected with climate change. A template is provided so that communities can create an emergency plan. The plan will define the roles and responsibilities of agencies during an emergency and in order to facilitate an effective and coordinated response.
Organizations/ Agencies	Municipal and Community Affairs, GNWT
For more information	http://www.maca.gov.nt.ca/emergency_management/emergmanage/documents/emergency_plan_comm.htm

Project Title	Floe Edge Service
Project Description	This online service provides images of ice floes in regions around

	Arctic communities to encourage safe travel on sea ice.
Organizations/ Agencies	Noetix Research Inc., Canadian Ice Service of Canada
For more information	http://www.noetix.ca/floeedge/

2.1.8 Energy efficiency and renewable energy options

Energy efficiency and renewable energy options will be essential for NWT communities not only in reducing the greenhouse gas emissions that contribute to climate change, but to reduce their cost of living and dependency on rising fuel costs. In addition, transportation of fuel on ice roads may become more difficult as the season becomes shorter.

Project Title	Report: Paths to a Renewable North: A Pan-Territorial Renewable Energy Inventory (2011)
Project Description	This report summarizes the types of renewable energy, the current usage of renewable energy across the territories and policies and projects underway to increase renewable energy use.
Organizations/ Agencies	Governments of NWT, Yukon and Nunavut
For more information	http://www.enr.gov.nt.ca/live/pages/wpPages/climate_change.aspx

Project Title	Energy efficiency improvement to GNWT-owned buildings through the Capital Asset Retrofit Fund (2009-2010)
Project Description	This fund supports upgrades to the energy performance of GNWT owned buildings.
Organizations/ Agencies	Public Works and Services, GNWT
For more information	http://workingtogether.gov.nt.ca/activities/ViewActivity.aspx?ActivityId=2054

Project Title	Biomass Strategy (2010)
Project Description	This strategy promotes the use of biomass energy in NWT by promoting biomass heating options, promoting stability of biomass production and increasing awareness of biomass as an option for residents and businesses.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	http://www.enr.gov.nt.ca/live/documents/content/NWT_Biomass_Energy_Strategy_2010.pdf

Project Title	Map: Community energy profiles and renewable energy options (2009)
Project Description	This map gives visual representations of fuel use, costs, and greenhouse gas emissions for all NWT communities, as well as identifying the best renewable energy options for homes, businesses, and the whole community.
Organizations/ Agencies	Arctic Energy Alliance
For more information	http://www.aea.nt.ca/resources/map/

Project Title	Report: Energy Priorities Framework (2008)
Project Description	This document focuses on the key energy priorities and initiatives of the GNWT, including moving away from diesel energy through energy conservation and efficiency, developing alternative energy options, energy policy and planning, and reducing energy use from government operations.
Organizations/ Agencies	Industry, Tourism and Investment, GNWT

For more information	http://www.iti.gov.nt.ca/publications/2008/Energy/EnergyPriorities.pdf
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Project Title	Greenhouse Gas strategy (2007, will be updated in 2011)
Project Description	This strategy outlines 39 actions that the GNWT is undertaking to reduce greenhouse gas emissions from their own operations. This strategy is being updated in 2011.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	http://www.enr.gov.nt.ca/live/documents/content/Greenhouse_Gas_Strategy_FINAL.pdf

Project Title	Report: Energy for the Future: An Energy Plan for the Northwest Territories(2007)
Project Description	This report summarizes GNWT initiatives to support energy conservation and reduce greenhouse gases.
Organizations/ Agencies	Industry, Tourism and Investment, GNWT, and Environment and Natural Resources, GNWT
For more information	http://www.iti.gov.nt.ca/publications/2007/Energy/Energy%20for%20the%20Future.pdf

Project Title	Institutional Energy Audits (ongoing)
Project Description	Arctic Energy Alliance performs 4 levels of audits to help managers of institutional, commercial, and industrial buildings reduce energy usage. The first level of audit is free, and other levels require access to funding.
Organizations/ Agencies	Arctic Energy Alliance

For more information	http://www.aea.nt.ca/programs/commercialinstitutional_services/
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2.2 Funding Opportunities

For some of the more costly adaptation actions, such as infrastructure upgrades and renewable energy options, NWT communities may need support from other levels of government. Below are a list of past and present funding opportunities that NWT communities have accessed.

Project Title	Green Municipal Fund (ongoing)
Project Description	This fund provides below-market loans and grants to communities for planning initiatives, energy services and renewable energy, and sustainable transportation services and technologies. Communities such as Norman Wells and Yellowknife have used this funding for community energy plans.
Organizations/ Agencies	Federation of Canadian Municipalities
For more information	http://gmf.fcm.ca/Home/

Project Title	Energy Conservation Fund (ongoing)
Project Description	This fund supports projects that reduce energy and water use and encourages efficient use of northern resources. Installation and upgrade of equipment as well as research and capacity building projects can be eligible.
Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	http://www.enr.gov.nt.ca/live/pages/wpPages/Energy_Conservation_Program.aspx

Project Title	Community Renewable Energy Fund-Alternative Energy Technologies Program (ongoing)
Project Description	This fund supports community renewable energy projects such as solar wind, biofuels and ground source heat pumps, with the goal of reduction of greenhouse gas emissions.

Organizations/ Agencies	Environment and Natural Resources, GNWT
For more information	http://www.enr.gov.nt.ca/live/documents/content/Community_renewable_energy_fund.pdf

Project Title	Community Development Program: Building Rural and Northern Partnerships (ongoing)
Project Description	This fund provides support for projects in resource-based rural and northern communities. Project generally promote collaboration between communities or that support the transfer and adoption of knowledge and know-how around the use of new technologies.
Organizations/ Agencies	Rural Secretariat, Agriculture Canada
For more information	http://www.rural.gc.ca/RURAL/display-afficher.do?id=1249068275163&lang=eng

Project Title	Gas Tax Fund (2005-2015)
Project Description	NWT communities can access funding from the federal gas tax transfer agreement for environmentally sustainable municipal infrastructure. Eligible projects include improvements in management of water, wastewater and solid waste, sustainable energy and transportation initiatives and capacity building.
Organizations/ Agencies	Municipal and Community Affairs, GNWT
For more information	http://www.maca.gov.nt.ca/operations/gastax/index.htm

Project Title	Indian and Northern Affairs Canada's Climate Change Adaptation Programs (2001-2010)
Project Description	This program provided funding to help support communities

	<p>undertake risk assessments for existing infrastructure and identify infrastructure designs reduce the risks of climate change.</p> <p>There have been three iterations of this fund:</p> <ul style="list-style-type: none"> • The Aboriginal and Northern Climate Change Program operated from 2001 to 2003; • The Aboriginal and Northern Community Action Program operated from 2003 to 2007; • The ecoENERGY for Aboriginal and Northern Communities Program operated from 2007 to 2010. <p>Renewal of this funding is under consideration for 2011.</p>
Organizations/ Agencies	Indian and Northern Affairs Canada
For more information	http://www.ainc-inac.gc.ca/enr/clc/prc/ovr-eng.asp

Project Title	Municipal-Rural Infrastructure Fund (2005-2010)
Project Description	The Municipal-Rural Infrastructure Fund is provided to update municipal infrastructure and 20% of the fund went to “Green Projects” or projects that utilize innovative technologies and practices. Over 2005-2010, the Fund supported infrastructure projects (including water, sewage and energy conservation) in Hay River, Norman Wells, Fort Simpson, Fort Smith and Deline.
Organizations/ Agencies	Infrastructure Canada, Municipal and Community Affairs, GNWT, NWT Association of Communities
For more information	http://www.maca.gov.nt.ca/operations/mrif/

2.3 Outreach and Communications

Communicating the results of climate change research and adaptation is incredibly important. Organizations that are involved in communicating climate change information and conferences/workshop are included here.

Organizations

Project Title	Organizations for Climate Protection
Project Description	This program is a network of Canadian municipal governments committed to reducing greenhouse gases and acting on climate change. Fort Smith, Fort Simpson and Yellowknife are part of this network. This group is organized by the Federation of Canadian Municipalities.
For more information	http://gmf.fcm.ca/Organizations-for-climate-protection/

Project Title	Aurora Research Institute
Project Description	Through offices in Inuvik and Fort Smith, this arm of Aurora College licenses and helps coordinate research in the NWT. The institute also works to increase public awareness of science, technology and indigenous knowledge.
For more information	http://www.nwtresearch.com/

Project Title	School of Community Government
Project Description	This organization delivers training courses and provides resource tools for NWT community governments.
For more information	http://www.maca.gov.nt.ca/school/index.html

Project Title	NWT Association of Professional Engineers and Geoscientists (NAPEG)
Project Description	NAPEG conducts research about considerations for project design for cold climates and permafrost.
For more information	http://www.napeg.nt.ca/

Project Title	Northern Territories Waste and Water Association
Project Description	This organization promotes advancement of knowledge in the design, construction, operation, and management of water and waste works. It encourages sharing of information and improvement of professional status of all personnel engaged in any aspect of the provision of water and sanitation services to the public.
For more information	http://www.ntwwa.com/

Project Title	NWT Association of Architects
Project Description	This organization, through the Architects Act, regulates the professional practice and conduct of architects in the NWT, and empowers architects to be self-regulating in the NWT.
For more information	http://www.nwtaa.ca/index.htm

Project Title	Consulting Engineers of the NWT
Project Description	CENT is an association of independent engineering consulting firms that are located in the NWT and Nunavut and offer engineering services to public and private clients within and outside the Northwest Territories and Nunavut.
For more	http://www.cent-nt.ca/

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Project Title	NWT Association of Communities
Project Description	NWTAC is a non-profit, non-governmental organization that represents the interests of twenty-seven of thirty-three official NWT communities. In 2009, NWTAC developed a Climate Change Working Group, consisting of representatives from member communities and the territorial government, to promote adaptation initiatives and share information between communities.
For more information	www.nwtac.com

Project Title	Ecology North
Project Description	Ecology North's mandate is to support sound environmental decision-making on an individual, community and regional level. Ecology North's programs focus on three priorities: public education and awareness, climate change, and sustainable living.
For more information	www.ecologynorth.ca

Project Title	Pembina Institute
Project Description	The Pembina Institute is an independent non-profit research and policy organization that develops and promotes progressive public policy and provides leading edge sustainability consulting services. Pembina's Arctic Energy Solutions Program has been working with partners in Northern Canada on issues of energy and climate change since 2002, and a Pembina office was established in Yellowknife in 2008.
For more information	www.pembina.org/arctic

Project Title	Arctic Borderlands Ecological Knowledge Coop
Project Description	This group is composed of communities in the Gwich'in region from Yukon and NWT with support from government agencies and the University of Alaska. Their focus is as assessment of ecosystem changes that impact the Porcupine Caribou herd, using science and traditional knowledge to promote understanding, to improve communication and build capacity of northern communities to participate in monitoring and ecosystem management.
For more information	http://www.taiga.net/coop/about.html

Project Title	Database: Climate Change Adaptation Community of Practice
Project Description	The Climate Change Adaptation Community of Practice is an interactive online forum for researchers and practitioners could generate ideas and share knowledge on climate change adaptation with a focus on northern Canada. Membership is required to access webinars, documents and forums. This project is supported by the Ontario Centre for Climate Impacts and Adaptation Resources and the Council of the Federation.
For more information	http://www.ccadaptation.ca/ , request membership by emailing kmackenzie@mirarco.org

Project Title	Database: Climate Adaptation Knowledge Exchange
Project Description	This database is compiling information on past, current and proposed climate change adaptation activities and projects across North America. It contains examples of adaptation activities in NWT. It also hosts forums discussion, and presents case studies to provide details on the process of planning and implementing projects. This database is hosted by EcoAdapt.
For more information	www.cakex.org

Conferences and Workshops

Project Title	Permafrost and Infrastructure Workshop (2010)
Project Description	This workshop in Inuvik discussed the state of knowledge of permafrost, infrastructure considerations and new technologies and building codes.
Organizations/ Agencies	Ecology North
For more information	www.ecologynorth.ca

Project Title	Young Leaders Summit on Northern Climate Change(2009)
Project Description	This summit was attended by 60 youth from both northern and southern Canada. It was designed to build leadership capacity of the participants, create networks between youth across the country, and promote stronger climate action by leaders in the North.
Organizations/ Agencies	Northern Voices Coalition (Gwich'in Council International, Arctic Athabasca Council, Climate Action Network, Pembina Institute, and Ecology North)
For more information	www.climateleaders.ca

Project Title	NWT Climate Change Leadership Summit (2007)
Project Description	This leaders' summit was held in January 2007 to discuss climate change impacts and adaptation solutions. Community and regional concerns and priorities for action were identified.
Organizations/ Agencies	Ecology North and Dene Nation
For more	www.ecologynorth.ca

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2.4 Academic Research Programs

As mentioned in the introduction, this is a summary of only large research programs and initiatives that are significant to the NWT. Biophysical research related to climate change impacts covers a broad range of topics including permafrost, sea level and coastal erosion, climate modeling, groundwater and hydrology, extreme weather, sea ice, forests and forest fires, wildlife, ecosystem shifts, carbon cycling and invasive species. For a comprehensive list of all academic research that has taken place throughout the NWT, please see Aurora Research Institute’s yearly compendium.⁴ For a comprehensive summary of academic research that has occurred in the ISR please see the “Climate Change Vulnerability and Adaptation in the Inuvialuit Settlement Region” by ArcticNorth consulting.⁵ A database of academic research articles related to climate change and permafrost is being developed by the NWT Association of Communities.⁶

Project Title	ArcticNet (ongoing)
Project Description	ArcticNet is a research network that brings together scientists and managers in the natural, human health and social sciences with Inuit organizations, northern communities, federal and provincial agencies and the private sector to study the impacts of climate change in the coastal Canadian Arctic. The outcome of this work is to create and compile impact assessments, national policies and adaptation strategies.
Organizations/ Agencies	ArcticNet
For more information	http://www.arcticnet.ulaval.ca/

⁴ Aurora College, Compendia of Research in the NWT
<http://www.nwtresearch.com/resources/publications/Compendia.aspx>

⁵ ArcticNorth Consulting, “Climate Change Vulnerability and Adaptation in the Inuvialuit Settlement Region”
http://www.arctic-north.com/pdfs/erl10_1_014008.pdf (2010).

⁶ For more information contact Sara Brown at sara@nwtac.com.

Project Title	Permafrost Monitoring Network (ongoing)
Project Description	This network monitors permafrost condition throughout the Mackenzie corridor and along the Norman Wells pipeline corridor. Data from this network may inform community leaders about the state and rate of degradation of permafrost in their community.
Organizations/ Agencies	Natural Resources Canada and Geological Survey of Canada
For more information	http://gsc.nrcan.gc.ca/permafrost/mirma_e.php

Project Title	Report: What we know, do not know, and need to know about climate change vulnerability in the western Canadian Arctic: a systematic literature review (2010)
Project Description	This literature review assessed research pertaining to climate change impacts in the Inuvialuit Settlement Region, divided by sector and by community. It also assesses knowledge gaps, identifies adaptation actions already occurring, and identifies barriers to further adaptation action.
Organizations/ Agencies	ArcticNorth Consulting
For more information	www.arcticnorthconsulting.com

Project Title	International Polar Year -Climate Change Impacts On Canadian Arctic Tundra (2007-2009)
Project Description	The International Polar Year is a large scientific program focused on the Arctic and the Antarctic. IPY involves over 200 projects, with thousands of scientists from over 60 nations examining a wide range of physical, biological and social research topics.
Organizations/	International Polar Year Project-Canada

Agencies	
For more information	http://ipytundra.ca/ , www.ipy.org

3. Gaps and opportunities in climate change adaptation in NWT

3.1 Analysis of gaps in climate change and adaptation initiatives

Lack of territorial coordination of adaptation planning. Individual NWT communities, consultants and government departments have pursued adaptation research and initiatives, but there has been no comprehensive and integrated approach across NWT thus far. Funding and adaptation tools have been accessed on an ad-hoc basis, with little overlap in terms of planning principles or methodology between communities. While this may reflect the highly local nature of some climate impacts, this creates a disjointed framework of climate change knowledge and response. As mentioned above, the Government of NWT will be producing an updated adaptation plan in 2011.

Geographic and topic focus of climate change initiatives could be expanded. Climate change initiatives and research has been concentrated in some regions of the territory and lacking in others. It is possible that unforeseen impacts are not yet being identified in the less-studied communities.

Some aspects of climate change have been more widely studied than others. In this review of initiatives in the NWT, it was found that there has been comparatively more work completed on infrastructure and transportation, while impacts on other sectors (such as human health, food security and emergency management) have not been as thoroughly assessed. This hierarchy may be due to overlap with other planning processes, or prioritization of community needs.

Investment in infrastructure may be problematic if there is no foresight or contingencies for climate change. Given the anticipated lifespan for infrastructure, the consequence of current decisions could resonate for many years. Increasingly, there are efforts to move towards a more proactive adaptation approach.

Variety of adaptation planning tools used. Existing adaptation plans have used a number of different tools and methodologies. The selected tools and methods may be a result of established methods of the consultants involved, stated priorities of communities members, or the level of risk of climate change (real or perceived). However, for community leaders in

beginning of adaptation planning, it may be difficult to decide which approach is most appropriate.

Funding for adaptation planning may be limited and short-term. The time-frame for most funding programs (one to three years) may not be adequate to fully implement the results of research or planning work.

Most of the community adaptation work that has taken place in NWT so far has been funded through Indian and Northern Affairs Canada's Adaptation Program, but this program is set to end in March 2011, with no guarantee of renewal.

Community capacity limitations. Municipal staff and leaders have a number of responsibilities and priorities that draw from limited financial and human resources. Climate change related planning may not be as pressing in the short term as other priorities, and thus may not be completed. When adaptation planning does take place, the work may be completed by a small number of staff or residents, and/or external consultants.

Accessing existing adaptation research may be difficult. The results of academic research may not be presented in a form that is easily understandable, and or in a way that can guide decision-making. Communities may not be able to interpret and apply the results of research, or work from other communities, to their own needs.

Difficulty in measuring success. Assessing the future of a community under climate change involves measuring the changes in social, economic and environmental indicators over time. This is difficult because highly specific predictions of the impacts of climate change are unknown or unpredictable. Metrics to assess success would be helpful to advise future adaptation work.

3.2 Opportunities for moving forward

Promote information-sharing by creating a network of people and groups working on climate change issues. Increased communication of adaptation initiatives, research and experience between is the most cost-efficient way to expand adaptation actions. The establishment of a forum for sharing of lessons from adaptation between communities would be essential. An example can be found in Ontario's Climate Change Adaptation Community of Practice.⁷

Compile all academic research on climate change science and adaptation. While not covered in this report, there is a large body of academic research on climate change impacts and adaptation in NWT and elsewhere. This body of literature may only be accessible with a subscription to an academic library, and may require advanced understanding of science. A compendium of information that is hosted in one central location, with plain-language summaries, such as is being developed through the NWTAC Climate Change Adaptation Project is essential in ensuring that results of academic research can inform decision-making. Tools that

⁷ Climate Change Community of Practice, <http://www.ccadaptation.ca/>

allow searching of resources by sector and by geographic location would help community leaders find studies relevant to their region or issue of interest. This compilation would help identify areas of overlap, gaps, and communal opportunities. This could inform research agenda and policy development.

Provide additional funding for adaptation. Responding to climate change is going to be very costly for NWT communities. A reliable source of funding is required for full assessment of vulnerability and implementation. A full economic analysis of the costs of adaptation in NWT (including predicted costs if no action is taken) could build the case for the need for adaptation funding. Obtaining updated cost estimates for buildings, roads, airports, sewage lagoons, and water reservoirs will be necessary for decision-making and prioritization of action.

Support community resiliency and capacity. It should be recognized that healthy, well-educated communities are better equipped to adapt to climate change. It will be necessary to support community capacity to engage in climate change mitigation and adaptation. Additional training and information-sharing could be targeted at all community members. This would help to build awareness of climate change impacts and encourage individual action. New programs could be designed (and current programs assessed in this document) to ensure that they adequately reflect the new climate change reality. Organizations that already provide community education such as the School of Community Government and Aurora College could be the providers of these programs. This collaborative approach would promote sharing of the burden of among community members, and ensure that information and momentum is not lost if there is turnover in leadership.

Support decision-making in the face of uncertainty. Without full knowledge of the exact effects of climate change, it is difficult for community leaders to make decisions with confidence. However, some decisions cannot wait until a full suite of data is available, or the data may never be complete due to the rapid changes associated climate changes. It is thus necessary to support strengthened capacity to act in without full knowledge of risks and outcomes. To help this, tools for risk management that focus on interpreting and integrating existing information could contribute decision-making in the absence of information.

Integrate climate change planning with existing community government structures and planning processes. Another way to support adaptation planning is to tie it to existing planning processes and into municipal regulations. Through this method, the results will be better integrated into future activities and decisions. In addition, governance structure (including council, co-management boards and committees) already exist to ensure implementation. Examples of this include updating building codes and standards to reflect changes in permafrost, and incorporating sea-level rise into planning in coastal communities.

Adaptation planning could take a broader focus while still including important components. Adaptation planning should include considerations for infrastructure as well as discussions of wider community issues such as health, food, energy preparedness and economic considerations. Adaptation planning could be broadened to include community wellbeing and sustainability, yet still include important assessments of infrastructure.

Research could better reflect community priorities. Academic researchers could better align their climate change research agendas with community priorities, or ensure that a portion of their work is useful for decision-making at a municipal level. For example, researchers could attempt to collect and share data about permafrost distribution within municipal boundaries within a larger permafrost program (such as the permafrost monitoring network), or high resolution climate predictions to give communities a better ability to predict local temperature increases.

Develop metrics to measure success of implementation. While it is difficult to measure success of adaptation initiatives, without metrics it is difficult to assess existing programs and use those results to inform the development of new initiatives. Metrics will have to be adequately broad yet measurable, and flexible enough to be updated as climate change impacts.

Support individual adaptation and mitigation actions. Individual responses to climate change impacts include changes to hunting patterns, transportation and building practices. These behaviour changes could be supported and encouraged through additional public education.

Reduce the severity of climate change. Most importantly, global greenhouse gas emissions need to be reduced to decrease the severity of climate change. Estimates of future adaptation costs tend to be large in comparison with current costs of mitigation. Incremental increases in emissions today may have large climate change impacts (and associated costs) to communities in the future.