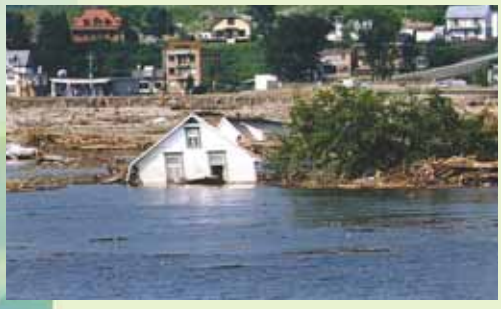
Government of Canada / Gouvernement du Canada

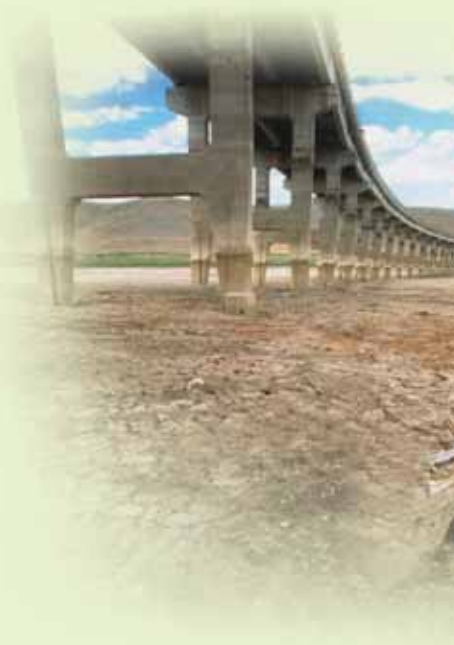
Climate Change IMPACTS and ADAPTATION Program

Water Resources



The overarching goal of the Government of Canada's Climate Change Impacts and Adaptation Program (CCIAP) is to reduce Canada's vulnerability to climate change. The research program supports cost shared research to address gaps in our knowledge of Canada's vulnerability to climate change and to provide information for adaptation decision-making. Emphasis is placed on research that examines processes, barriers, and drivers for adaptation.

The program also supports the Canadian Climate Impacts and Adaptation Research Network (C-CIARN). This network facilitates linkages between stakeholders and researchers, promotes new research techniques and methodologies, disseminates information, and provides a voice for an emerging impacts and adaptation research community.



Between 1998 and 2004, the program has supported over 150 projects to examine the impacts of climate change on Canadians and the processes by which we adapt. Many of these projects related to water resources and ranged from addressing questions of future changes in hydrology and groundwater resources to the capacity of communities to adapt.

Reports from completed projects can be found on the program's website:

adaptation.nrcan.gc.ca

Canada

Here are some brief highlights of the projects funded.

GENERAL

Water Sector: Vulnerability and Adaptation to Climate Change
(completed)

Regional workshops were used to identify broad scale vulnerabilities in the water resources sector across Canada. The resulting report addresses the nature and reliability of the new generation climate models, regional vulnerabilities for the major regions of Canada, and outlines an adaptation strategy for water management.

Principal Investigator: **Jim Bruce**
Global Change Strategies International
info@gsci.ca

INTEGRATED STUDIES

Water Resources of the South Saskatchewan River Basin
(in progress)

The South Saskatchewan River Basin (SSRB) supplies water for a significant portion of the Prairie Provinces. The CCIAP and the Prairie Adaptation Research Collaborative (PARC) are co-funding an integrated study of the vulnerability of water resources in the SSRB. Informed by the results of a workshop, three projects were funded focussing on the Alberta and the Saskatchewan portions of the Basin. The results of these projects will be integrated and the outcome will be discussed with water resources managers and experts from the region.

(i) Water Availability in the South Saskatchewan River Basin under Climate Change

This project focuses on the sensitivity of water, including runoff generation within the prairie landscape and soil moisture and snow changes under a variable climate. Given the spatial variability of the landscape types within the SSRB and the importance of mountain runoff, an impacts modeling framework that relies on an ensemble of hydrological models will be used. The results will allow partners in this project to include scenarios of future water supply in an integrated watershed management framework.

Principal Investigator: **Alain Pietroniro**
Environment Canada
al.pietroniro@ec.gc.ca

(ii) An Assessment of the Vulnerability of Key Water Use Sectors in the South Saskatchewan River Basin to Changes in Water Supply Resulting from Climate Change

This study will examine the economic and social impacts of, and capacity to adapt to changes in water supply resulting from climate change. The major water user sectors to be considered in this study include irrigation, stock-watering, rural domestic, urban municipal (including industrial), other industrial, mining, thermal energy generation, hydroelectric energy generation, evaporation, and inter-jurisdictional apportionment. Major *in-situ* water users to be included are recreation, wetlands, tourism and navigation. The primary purpose of the study is to provide more information for relevant decision-makers in the SSRB.

Principal Investigator: **Lawrence Martz**
University of Saskatchewan
lawrence.martz@usask.ca

(iii) Management Strategies to Reduce Vulnerability to Climate Change in the SSRB

This project will examine various economic policies for reducing vulnerability to climate change.

Principal Investigator: **Marion Weber**
Alberta Research Council
weber@arc.ab.ca

Participatory Integrated Assessment of Water Management and Climate Change in the Okanagan Basin, BC
(in progress)

Previous studies in this region funded by the CCIAP, provided an initial opportunity to explore climate change and water resources in the Okanagan. This project will provide more specifics on the economic and institutional aspects of adaptation and explore how various regional stakeholders' preferences could affect the selection of options for adaptation in the region.

Principal Investigator: **Stewart Cohen**
Environment Canada
stewart.cohen@ec.gc.ca

Development of an integrated approach to assessing vulnerability and directing measures for adaptation to water level variations in the St. Lawrence River
(in progress)

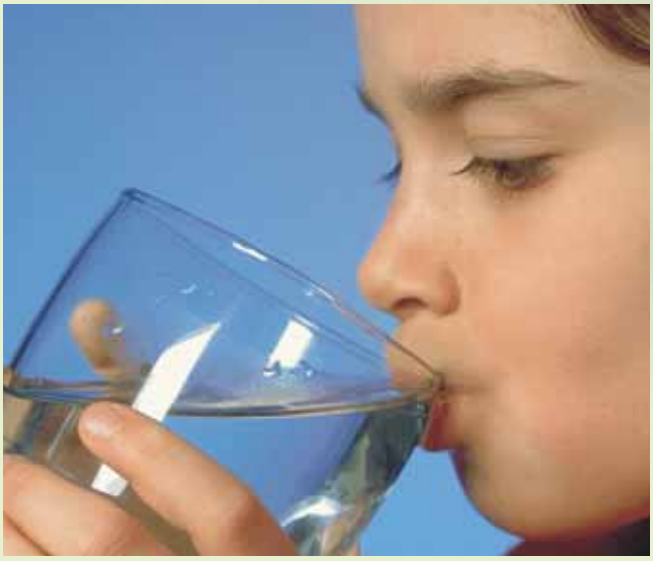
The study will focus on vulnerability and adaptation to variations in water levels of the St. Lawrence River in the Montréal/Lake Saint-Louis region, at the confluence of the St. Lawrence and Ottawa rivers. The project will provide decision-makers and users with the information they require to prepare more effectively for the effects of these changes in climate and flow regulation. The study will assess the vulnerability of certain socio-economic areas, in terms of infrastructure (potable water intakes, boating and human habitat), and environmental areas (wetlands) to a significant drop in St. Lawrence River levels expected on the basis of climate change scenarios.

Principal Investigator: **Jennifer Milton**
Environment Canada
jennifer.milton@ec.gc.ca

Adapting to Climate Change in the Grand River Watershed
(completed)

The combined impacts of population growth, agricultural intensification and climate change on water availability and water quality were examined for the Grand River watershed (southern Ontario) as part of a shared management plan that is being developed among municipalities, First Nations and other interested parties.

Principal Investigator: **Lorrie Minshall**
Grand River Conservation Authority
lminshall@grandriver.ca



WATER QUALITY

Consequences of climate changes on contamination of drinking water by nitrates on Prince Edward Island
(in progress)

This project will examine the risks to drinking water contamination in a changing climate and the capability of the infrastructure and management practices to minimize these risks.

Principal Investigator: **Martine Savard**
Natural Resources Canada
msavard@nrcan.gc.ca

Water Quality Modelling Based on Changes in Water Quantity from Climate Change
(in progress)

This project will evaluate methodologies for predicting climate change impacts on water quality (nutrients and dissolved oxygen). It will also identify and examine possible adaptive management strategies for addressing sensitivities to these impacts.

Principal Investigator: **William Booty**
Environment Canada
william.booty@ec.gc.ca

Changes in Water Quantity and Quality as a Result of Climate Change
(completed)

Twenty five years of precipitation and runoff data within the Experimental Lakes Area of NW Ontario was used to assess: 1) the interaction of runoff and climate parameters; 2) water chemistry response to historic climate and vegetation changes in the watershed; and 3) potential changes in runoff and water chemistry under projected climate scenarios.

Principal Investigator: **Ray Hesslein**
Department of Fisheries and Oceans
HessleinR@dfo-mpo.gc.ca

WATER RESOURCES MANAGEMENT

The Impact of Climate Change on Water Distribution System Design Criteria
(in progress)

Water systems are currently designed based on past climate. This study will examine how water distribution systems could take future climate change into account. Researchers will answer two questions:

- what is the link between climate change and the way water distribution systems should be designed and operated?
- what practical difference will it make to be able to anticipate or plan for climate change?

Principal Investigator: **Dr. Bryan Karney**
University of Toronto
karney@ecf.utoronto.ca

Enhancing Water Supply Infrastructure Investment Planning Practices for a Changing Climate
(in progress)

The aim of this project is to improve practices of investment in infrastructure to protect water supply systems from changes in hydrology and consumptive patterns resulting from climate change.

Principal Investigator: **François Bouchart**
University of Calgary
bouchart@ucalgary.ca

Climate Change Impacts on Low-Flow Characteristics of New Brunswick Rivers and Adaptation Strategies for Instream Flow Needs
(in progress)

The objectives of this study include evaluating low-flow characteristics in New Brunswick and associated long-term trends; quantifying potential impacts of climate change on runoff, low flows, water availability and aquatic resources; and identifying potential impacts of reduced flow on irrigation, drinking water supply and industrial water usage.

Principal Investigator: **Nassir El Jabi**
Université de Moncton
eljabin@umoncton.ca

Reducing the Vulnerability of Water Supply under a Changing Climate: an Assessment of Stormwater Reuse Measures
(in progress)

This research will assess the use of stormwater to irrigate public lands as an adaptation strategy to reduce vulnerabilty to water supply changes under a changing climate. In addition to the technical considerations of reusing stormwater in an urban setting, this project will include economic, public health, and environmental impacts and public perception issues.

Principal Investigator: **François Bouchart**
University of Calgary
bouchart@ucalgary.ca

Institutional Arrangements and Capacity for Adaptation to Climate Change at the Watershed Scale
(in progress)

This project will analyze the extent to which institutional arrangements for water management affect the ability of watershed management structures to adapt to climate change, specifically during droughts and other low-water periods.

Principal Investigator: **Rob de Loë**
University of Guelph
rdeloe@uoguelph.ca

Climate Change Impacts and Adaptation in the Field of Urban Drainage in Quebec
(in progress)

Climate change scenarios suggest that significant changes can be expected in the return periods of major meteorological events, resulting in an increased frequency of system overflows, sewer backups and flooding. This project will examine urban drainage in light of these expected changes, and will identify and assess, where applicable, possible adaptation measures.

Principal Investigator: **Alain Mailhot**
Université du Québec
Alain_Mailhot@inrs-ete.uquebec.ca

Optimization-Simulation Approach for Watershed Management under Changing Climate in the Georgia Basin
(in progress)

The objective of this study is to develop a decision-support system that involves an integrated optimization-simulation framework for assessing vulnerabilities of water resource management system to changing climate in the Georgia Basin.

Principal Investigator: **Gordon Huang**
University of Regina
huangg@uregina.ca

The Implications of Climate Change for Canada's Boundary and Trans-boundary Water Management
(completed)

This project analyzed the potential impacts of climate change on boundary and trans-boundary water basins between Canada and the United States and between provinces and territories. It examined existing water-related agreements and procedures and assessed their ability to adapt to climate change.

Principal Investigator: **Jim Bruce**
Global Change Strategies International
info@gcsi.ca

Impacts & Adaptation of Drainage Systems, Design Methods and Policies
(completed)

Addressing concerns that climate change could result in more frequent failures within urban drainage systems, resulting in increased flood damage and related health problems, a sensitivity analysis of existing design methods was undertaken using hydrologic simulations. Climate change impacts were evaluated in terms of changes to the drainage system peak flows and runoff volumes.

Principal Investigator: **Daniel Jobin**
Kije Sipi Ltd
Daniel.Jobin@KijeSipi.com

Assessment of the Impact of Climate Variability and Change on the Reliability, Resilience and Vulnerability of Complex Flood Protection Systems
(completed)

The impact of climate variability and change on the effectiveness of large-scale flood protection systems was measured against system reliability, resiliency and vulnerability. Adaptation strategies to maintain efficient flood protection in light of climate-induced changes were addressed.

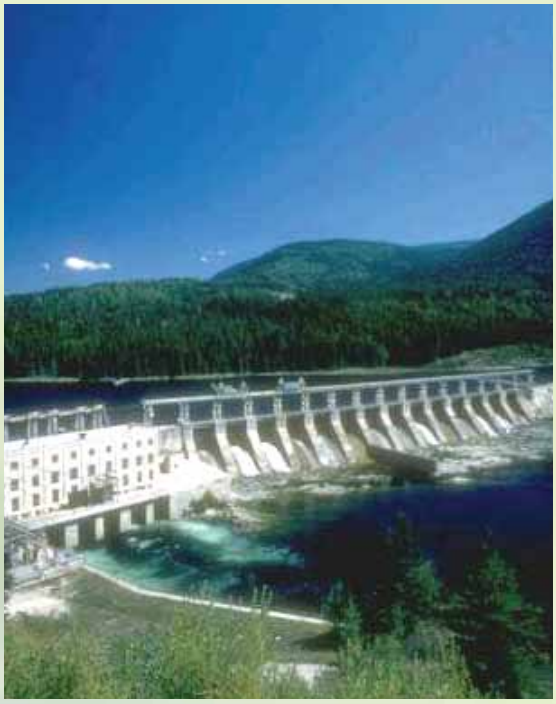
Principal Investigator: **Slobodan Simonovic**
University of Western Ontario
ssimonovic@eng.uwo.ca

Climate Change, Water Resources, and Rural Community Capacity to Adapt
(completed)

The capacity of rural communities in the upper Credit River watershed to adapt to climate-induced water shortages was assessed, recognising the need to balance human water needs with protection of water for natural systems.

Principal Investigator: **John Smithers**
University of Guelph
jsmither@uoguelph.ca

HYDROELECTRICITY GENERATION



Impacts of Climate Change on Hydroelectric Generation in Newfoundland and Labrador
(in progress)

The aim of this project is to assess the impact of climate change on hydroelectric generation on the island portion of Newfoundland and Labrador. The project will address both historic and current sensitivity of generation to climate variation and the potential sensitivity under future climate change conditions.

Principal Investigator: **Susan Richter**
Acres International Limited
srichter@acres.com

Climate Change Impacts on Northern River Ecosystems & Adaptation Strategies via the Hydroelectric Industry
(completed)

This project assessed the impacts of climate change on winter ice regimes, particularly extreme ice-jam floods, on the Peace River and the Peace-Athabasca Delta (BC & AB), and how these impacts will affect aquatic productivity of flood-dependent delta ecosystems.

Principal Investigator: **Terry Prowse**
Environment Canada
Terry.Prowse@ec.gc.ca

SURFACE WATER

Climate Change and Extreme Rainfall-related Surface Runoff Risks in Ontario
(in progress)

This study will estimate the possible changes in frequency and magnitude of extreme rainfall, surface runoff and flooding risks in the 21st century for several watersheds in Ontario. It will also quantitatively examine the socio-economic impacts of historical, current and projected extreme events.

Principal Investigator: **Chad Shouquan Cheng**
Environment Canada
Shouquan.Cheng@ec.gc.ca

Evaluating the Sensitivities of Boreal Forest Lakes to Climatic Change
(completed)

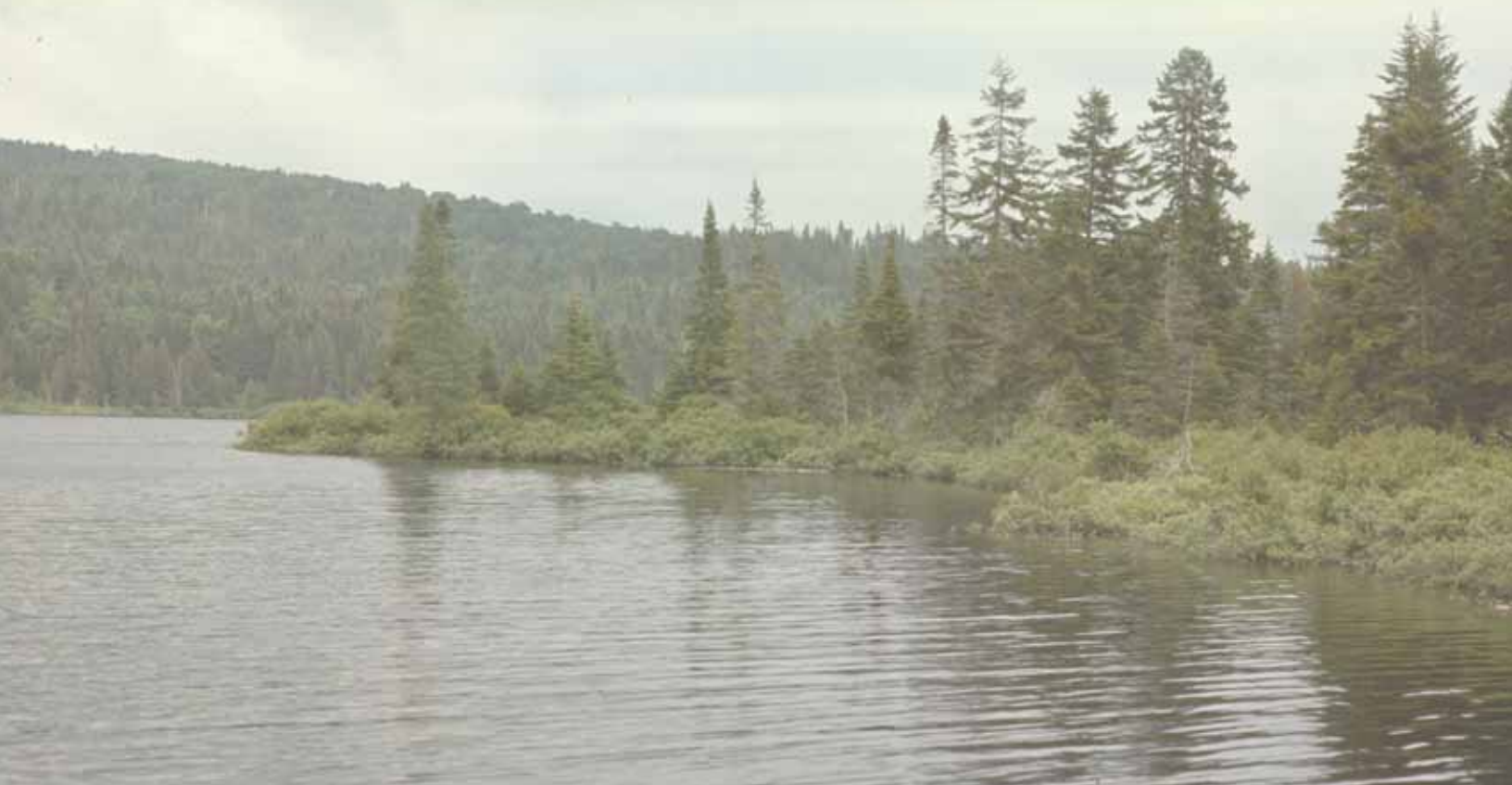
This study examined climatic sensitivities of boreal forest lakes in northwestern Ontario. Using historic data, climate change was found to potentially interfere both physically and chemically with the recovery of boreal lakes from acidification. Preliminary experimental research also suggested that some forms of dissolved organic carbon could enhance in-lake buffering of acidity. Another experiment demonstrated that increased water temperatures would modify near-shore food webs and productivity.

Principal Investigator: **Michael Turner**
Fisheries and Oceans Canada
TurnerMi@dfo-mpo.gc.ca

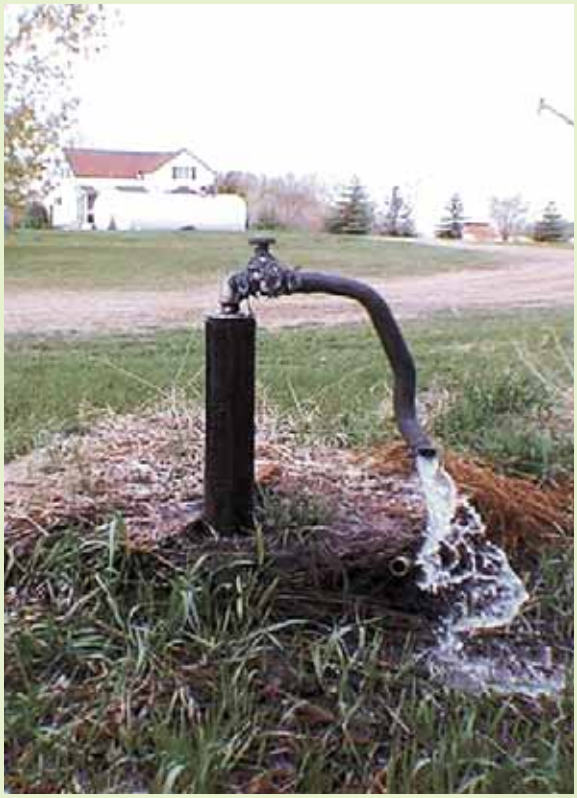
Climate Change Impacts on Canadian Prairie Wetlands & Agricultural Adaptation Strategies
(completed)

Long-term water level, climate, land-use (agricultural and habitat), drainage, streamflow and waterfowl data were compiled for prairie wetlands (sloughs) to assess potential impacts of climate change on storage of runoff waters, groundwater recharge, and possible adaptive responses to preserve these critical habitat refuges.

Principal Investigator: **Malcolm Conly**
Environment Canada
Malcolm.Conly@ec.gc.ca



GROUNDWATER



Preliminary Evaluation of the Potential Impacts of Climate Change on Ground Water Resources in Eastern Canada
(completed)

Researchers studied the impacts of climatic changes on the groundwater recharge in Quebec and the Maritimes. Data from 95 piezometric stations, 104 stream gauging stations and 65 meteorological stations spanning from 10 to 100 year periods were integrated in a user-friendly database. Objectives included trend detection for recharge and searching for indicators related to climatic data that would allow an improvement in the groundwater resource management in areas sensitive to recharge changes. Preliminary results from three sites show that recharge changes could likely be estimated using hydrologic data (baseflow), instead of available piezometric data whose time series are often incomplete and too short. Results also show that precipitation seems to have increased during the past 30 years, while the reverse trend is observed for recharge, despite the fact that oscillations in recharge and precipitation are synchronous.

Principal Investigator: **Yves Michaud**
Natural Resources Canada
Yves.Michaud@nrcan-rncan.gc.ca

Climate Change and Groundwater: A Modelling Approach for Identifying Impacts and Resource Sustainability in the Central Interior of British Columbia
(completed)

Researchers have developed a numerical model of an aquifer system to measure climate change impacts on seasonal groundwater levels, water budgets and flow direction within the Grand Forks aquifer in British Columbia.

Principal Investigator: **Diana Allen**
Simon Fraser University
dallen@sfu.ca

Groundwater and Climate Interaction in Southern Ontario
(completed)

Analyses of temperature, precipitation and stream flow data were used to determine indicators of climate - groundwater dynamics within selected watersheds of southern Ontario. Results were compared to landscape characteristics to determine relative climatic sensitivity for aquifers in different physical settings, and impacts estimated utilizing climate change scenarios.

Principal Investigator: **Andrew Piggott**
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Andrew.Piggott@cciw.ca

Further information on the program and funding opportunities can be found on the web site:

adaptation.nrcan.gc.ca

or contact the
Climate Change Impacts and Adaptation Directorate
Natural Resources Canada
E-mail: adaptation@nrcan.gc.ca