Health Policy Research Program
Summary of Research Results

Title:	**Links Between Climate, Water and Waterborne Illness, and Projected Impacts of Climate Change**
Investigator Name:	**Dr. David Waltner-Toews**
Project Completion Date:	**May 2005**
Research Category:	**Research**
Institution:	**University of Guelph**
Project Number:	**6795-15-2001/4400016**

Summary

Research goals were to investigate the incidence of waterborne illness in Canada, describe the complex systemic interrelationships between disease incidence, weather parameters, and water quality and quantity, and address possible consequences of climate change on the incidence of waterborne diseases.

Specific objectives of the research were to:

1. Review the existing state of national and international knowledge on the association between weather events, water quantity and quality, and waterborne illness, and build a combined geo-referenced database of existing Canadian weather data, water quality and quantity data, and waterborne illness data.
2. Describe the incidence and distribution of waterborne illness in Canada and weather events occurring concomitantly with illness, and test associations between weather events and waterborne disease incidence and outbreaks.
3. Model and quantify associations between weather variables, water quality and quantity, and incidence of waterborne illness, using temporal-spatial analyses in several regions of Canada.
4. Project the impact of global climate change on the risk of waterborne illness by coupling the information gained in Objective #3 to several accepted climate change model scenarios.
5. Disseminate findings to policy audience; engage decision-makers from

environment and health in an ongoing discussion of the impacts of climate change on waterborne disease hazards.

There were four main empirical conclusions of this work:

1. **Waterborne diseases are a burden to Canadians now.** Many Canadians, particularly the young and elderly, are affected by gastrointestinal disease annually, at considerable cost to society. Some of this burden of disease is waterborne, but it is not yet possible to determine how much. Outbreaks of waterborne disease are not a rare occurrence in Canada. In addition, thousands of Canadians are hospitalized each year with gastrointestinal illness. There is a need for improved integration of disease surveillance systems in order to improve our ability to assess the occurrence of endemic and epidemic gastrointestinal illness in Canada. Improvements are urgently needed in epidemiological data and in microbiological techniques to facilitate the attribution of disease to a waterborne or other source, and to enable the development of targeted control measures.

2. **Waterborne disease risk is related to ambient temperature and rainfall.** There is now substantial evidence that various types of weather affect gastrointestinal disease risk in many parts of Canada. Extreme precipitation increases the risk of epidemic waterborne disease twofold. Precipitation also contributes to the risk of endemic gastrointestinal illness, implying that some portion (as yet inestimable) of endemic gastrointestinal illness must be waterborne. Epidemic waterborne illness is linked to heat accumulation over a 6-week period – perhaps representing thawing conditions during cold months, or heat waves in summer. Warm (but not hot) weather conditions over a 6-week period (suggesting spring or autumn conditions) were found to be the most significant contributors to hospitalizations due to gastrointestinal illness in Alberta and Ontario.

3. **Climate change will alter the distribution and risk of gastrointestinal risk in parts of Canada.** Downscaling techniques allow for the consideration of climate change projections in epidemiological models of disease risk. Such downscaled data should be widely available to allow for widespread applications in research in health and other sectors. Better regional climate change models will increase future abilities to include climate change projections into disease models. Simple examination of total precipitation, maximum and minimum temperature data is not sufficient to understand the impact of climate change on future patterns of weather. Other measures, such as 5-day precipitation, seasonal averages, and degree-days may be required to ascertain climate change impact on waterborne disease risk. Preliminary results from case studies in southern Alberta found an increased risk of hospitalizations with a diagnosis of acute gastroenteritis (particularly in spring) with climate change by the end of the 21st century. Other preliminary research on extreme weather thresholds historically and under climate change conditions suggests that future weather conditions (particularly heavy

rainfall and warmer maximum temperatures) may increase the risk of waterborne disease outbreaks. Research on the impacts of climate change on waterborne disease risk is ongoing.

4. **Some Canadian populations have developed adaptive responses to extreme weather events.** The South Tobacco Creek, MB project identified a number of important aspects to adaptation to extreme weather. The organization included mainly young adults with strong social networks, who owned small mixed farms that were in close proximity, and had connections to political and government bodies (decision makers). The organization has shown the ability to be socially adaptive even as it promotes ecological resilience in watershed management. The group's network of small dams has markedly decreased water turbidity in the creek after heavy rainfall. Turbidity in the source water decreases the efficiency of drinking water treatment, a problem for communities downstream from South Tobacco Creek. Successful adaptation relies upon strong leadership locally and within government, strong social networks, successful interventions, a regulatory and legislative environment that supports community action and leadership, long-term funding, and long-term monitoring of current ecological conditions into the future.

The project produced new databases of meteorological, water quantity and quality, and meteorological data. It also generated a large database of downscaled climate change data from two Global Climate Models (HadCM3 and CGCM2) for a representative sample of Canadian locations. A comprehensive literature review, updated at the end of the project, is also included. Several new projects have been funded and will build on the work of this project.

Researchers and interested stakeholders, from policy and practice in environment and public health, met at the end of the project, to discuss avenues for policy action on the results of the research. General themes emerging from these discussions included: recognition that our understanding of the complex interactions among climate, environmental change, and health outcomes is uncertain; the need for clearer and more effective communication between scientists, the general public, and policy makers in several government departments; and the need to act now on in the considerable knowledge we already have, particularly on source water protection. Indeed, to wait for certainty when we already know, with a high degree of probability, that not protecting source waters will have strong negative impacts on the health of Canadians is to behave irresponsibly. Further, the group suggested the implementation of the O'Connor recommendations must continue in order to enhance Canada's resilience to risks posed by a changing climate. Water supply and treatment system upgrades must be designed with climate change projections in mind, such that they continue to be effective. A strong, coordinated and integrated disease surveillance system will be key to detecting and responding to the health impacts of climate change. The coordination and implementation of proactive policies must be coordinated across government sections such as Environment Canada, Health Canada, Public Health Agency of Canada, and

Agriculture Canada, and with provincial and local involvement. Finally, scientists should engage in programs of public communication and discourse so that these issues are planted firmly in the public agenda, and decisions made are informed by the best, most recent science available.

The views expressed herein do not necessarily represent the views of Health Canada

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In addition to the above summary, the full report can be accessed in the following ways:

- **A print version of the full report in the language of submission can be borrowed from the Departmental Library; requests may be sent to HCLibrary_BibliothequeSC@hc-sc.gc.ca.**
- **An electronic version of the full report in the language of submission is available upon request from Health Canada by contacting Research Management and Dissemination Division.**

This research has been conducted with a financial contribution from Health Canada's Health Policy Research Program.

Health Canada's Health Policy Research Program (HPRP) was created to increase the quantity of academic research that is directly relevant to current and future health policy issues. The Program supports research and/or policy research workshops.