Economic and social adaptation to climate change in Canadian seasonal-economy communities

Project A1319

Final Scientific Report for Natural Resources Canada

June, 2008

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Abstract

This is the final scientific report from a systematic empirical investigation of the economic and social vulnerability of a seasonal-economy community to climatic variability and change. The project was carried out with community partners in Addington Highlands, Ontario. Most of the 2,500 of the study area participate in a mixture of economic and social activities related to natural resource extraction and outdoor recreation. Employment opportunities and hence household incomes in the study area vary considerably according to season and are highly influenced by climatic variability and change. A number of significant trends in climatic conditions have been observed in the study area in recent decades, including winters that are shorter, milder and less snowy and summers that are on average warmer and windier than in the past. Such trends are consistent with available climate data and with projected trends in climate change for Eastern Ontario, but their causality can not be verified given currently available data. Given its high degree of engagement in outdoor recreation and resource-based employment, and its geographically isolated situation relative to urban Ontario, the population has developed a historically strong capacity to adapt to climatic and non-climatic stresses through a mix of household self-sufficiency and strong, localized social capital. Currently, a stable but rapidly ageing population, in-migration of retirees, rising energy prices, inadequate social infrastructure and changing currency valuations are combining in a dynamic fashion to erode residents' adaptive capacity. This project has identified a range of opportunities for and barriers to enhancing future adaptive capacity that will require all levels of government to work with community-based organizations and informal networks to maintain and enhance adaptive capacity through mainstreaming climatic change concerns into policies, programs and planning activities. Many of the factors that influence vulnerability and adaptation in Addington Highlands are not unique to that community, and can be reasonably assumed to be affecting seasonal-economy communities elsewhere in Canada.

SECTION I: PROJECT OVERVIEW

Introduction and summary of key findings

Hundreds of thousands of people across Canada live in small communities with highly seasonal economies. Their economic and social well-being is tied closely to climatic conditions. This project was designed to assess the economic and social impacts of climate change and adaptive responses and opportunities available to residents of such communities through a case study of Addington Highlands, Ontario. Addington Highlands is a geographically large township of 2,500 residents in the Bon Echo Park/Land O'Lakes tourist region of eastern Ontario, and is typical in many ways of seasonal communities right across Canada. In recent decades, Addington Highlands has seen significant changes in terms of demographic composition of the population and had been coping with the downloading of crumbling infrastructure and "rationalization" of rural services by higher levels of government. Coinciding with this, residents report that significant changes have been taking place in prevailing climatic conditions over recent decades. There is real concern among some residents whether the impacts of climate change may become the stressor that tips their community past the point of future viability.

This community-based research project has examined the potential for such a climate change-related tipping point to be reached, the adaptation needs and opportunities of the community and the barriers that may exist to achieving successful adaptation. The methodology and deliverables were designed so that the lessons learned in this case study are transferable across a broader range of similar communities and so that the research findings are available to the widest possible audience.

The findings of this project are described in the sections below, and the final project report to the community has been attached to provide further details specifically related to the case study area. The key findings of this project can be summarized as follows:

- due to their particular nature and historical trajectories of development, seasonal-economy communities and their residents have often traditionally had an inherently high capacity to cope with and adapt to changes in climate and other environmental conditions;
- this historically high level of adaptive capacity is susceptible to erosion caused by non-climatic pressures related to demographic changes and the ongoing political and economic restructuring of Canadian society;
- even where absolute population numbers may be stable or increasing, such figures may mask important demographic trends; in the study case these include the out-migration of young residents to urban areas, the in-migration of relatively wealthy urbanites "retiring to the cottage", and the general aging of the life-long permanent residents of such communities;

- adaptive capacity in seasonal-economy communities is particularly susceptible to the impacts of the rising Canadian dollar, rising fuel prices, aging physical infrastructure, inadequate health care services, and declining school enrollments and subsequent school closures;
- current changes in climatic conditions are being experienced at a time when these non-climatic stresses are undermining the economic and social well-being of residents (a dynamic described by researchers elsewhere as “double exposure” (O’Brien and Leichenko 2000));
- formal and informal community non-government organizations such as service clubs, recreation clubs, conservation groups, and church organizations represent potential vehicles for enhancing climate change adaptation through the building of community social capital (again consistent with research elsewhere, e.g. Adger et al. 2002, Smit and Pilifosova 2003);
- government regulations and policies, in many cases entirely unrelated to environmental management or climate policy, often act as barriers to enhancing the adaptive capacity of such communities;
- there is a pressing need for governments to move beyond the narrow “cost recovery”-driven public administration environment of the 1990s and recognize that climate change adaptation necessitates a broader approach to forward planning that breaks out of the policymaking “silos” characteristic of governance in Canada.

Specific details on these key findings follow in the sections that follow.

Progress on deliverables

The project was begun with three specific sets of objectives in mind, each of which was met (or exceeded) on schedule. The objectives and deliverables can be summarized as follows:

Objective 1: To deliver usable adaptive capacity analysis and planning information to the study community through systematic identification, prioritization and reporting of climate change adaptation capacity, needs, barriers, constraints and opportunities.

Delivered: Over the course of the past year, approximately 200 residents of Addington Highlands have contributed to this project through community town-hall meetings, service club meetings, ratepayers meetings, economic development committee meetings, township council sessions, formal interviews, and casual encounters. Community members were involved at every step of this project, from its initial conception through to acting as community peer-reviewers on the final public report published in March 2008. The final public report is a detailed, 35-page document describing the climatic trends currently observed in the community; the sensitivity of key economic sectors and social activities to climate change; existing barriers to adaptation; opportunities for adaptation; and,

specific recommendations for all levels of government. This report is being distributed as hard-copy and electronically through the project website www.addington.uottawa.ca. A copy is attached to this scientific report.

Objective 2: To create and use a general methodology transferable to other seasonal-economy communities and produce research products available to other seasonal-economy communities.

Delivered: The project methods and reports are and will remain available through the project website. Copies are being sent with a covering message to key stakeholders and policymakers in relevant county, provincial and federal government departments and organizations. Requests for copies from individuals living outside the study area have already been received via the project website. Residents from neighbouring municipalities attended the report launch in March, and commented that the project findings are reflective of the challenges faced in their own communities. The project team has been approached to do presentations about the project elsewhere in Eastern Ontario. At this early stage it is not surprising that outside interest has so far been limited to Eastern Ontario, but it is expected that via word of mouth and formal networks the profile of this project and its findings will grow. In coming months the project team will also be publishing peer-reviewed and trade-journal articles about the project, further expanding its profile.

Objective 3: To build project legacies including freely-available web-based reports; a sense of community ownership of the project and sense of empowerment that may allow residents to undertake proactive management of vulnerability to climate-related risks; and, training of new practitioners in climate change-adaptation research.

Delivered: Over 150 hard-copies of the final report have been distributed, with more being continually distributed electronically via the website (a hard copy is attached to this report). The public launch of the final report in Flinton on March 13, transformed into an informal brainstorming session among participants to discuss what steps might be taken to further enhance the community's future development and well-being. The township reeve, chair of the economic development committee, head of the tourism association, and other key community leaders were all present at the report launch and express an intention to use this report in the course of future community planning activities. Inspired by this project, in November 2007 the local high school organized a "climate change day" event where the principal investigator and two climate scientists from Queen's University gave presentation on climate change impacts and adaptation research to every grade and class over the course of a day. Students in one high school class worked with their teacher to electronically record and chart climate-related maple syrup production data (which appears as Figure 9 in the attached Report to the Community). One MA student from uOttawa, who is focusing on climate change adaptation in her thesis research, was engaged for

two semesters on this project. Two under-graduate students from uOttawa have also worked on this project, one to research and compile historical climate data for the study area, the other to work as the project webmaster and html report-writer.

Project methodology

A key feature of this project from the outset was its emphasis in joining community members with an experienced academic research team to achieve the project goals, using a "vulnerability-based" research approach that has already been employed successfully elsewhere (e.g. Brklacich et al. 1997, Adger 1999, Belliveau et al. 2006, Ford et al. 2006, Smit and Wandel 2006). This project grew out of a pre-existing research project that assessed impacts of the unusual winter conditions of 2006-2007 on the community of Addington Highlands. That project had begun the process of identifying the particular changes in climatic conditions being experienced in the study area. The new NRCan-supported project was designed to harness the community contacts that had already been established, to develop a broad, community-based research initiative to identify adaptive capacity, needs, barriers, constraints and opportunities in seasonal-economy communities generally, using Addington Highlands as a model. Based on results from past research in Addington and the principal investigator's experience in research projects elsewhere, it was recognized that the environmental, social and economic dynamics being experienced in Addington were not unique to it, but were likely being felt in similar ways by a range of seasonal economy communities in other regions.

The first stage of the project was to mobilize participation in the study area and prepare a baseline of climate, socio-economic and demographic data from which to begin. Early supporters in the conception of this project included the Land O'Lakes Tourism Association, members of the Lions Club, a local lodge operator and the head of the Conservationists of Frontenac-Addington. Through these individuals, news of the project was quickly spread via word-of-mouth. Early in the study period, the PI formally presented the project and its goals at a meeting of the township council and a meeting of the local economic development committee (AHEAD). As the project progressed, town- hall meetings were held in the villages of Denbigh and Northbrook, each with 30-50 residents attending (Images 1 and 2). The PI also addressed the Land O'Lakes Lions Club at a general meeting and the local business association breakfast, and participated in "climate change days" at the local high school. Meetings were pre-advertised in local community newspapers and, in one instance, by direct mail. A project-specific website was developed and maintained throughout the project, notifying residents of upcoming events and providing an e-mail drop-box for community members to contact the research team. At the same time, a mature fourth-year undergraduate research assistant and a MA student began compiling and charting data on climate, demography and socio-economic indicators for the study area from sources such as Environment Canada and Statistics Canada.

Image 1: Community advertising for town hall meeting

Photo: G. Gilbert

The data collection period for this project ended in early December 2007. The PI spent several days each month in the study area collecting data from residents, local government members and business operators through formal individual interviews, group discussions, and opportunistic contacts. These encounters were semi-structured to permit a free flow of information to be exchanged, and allow room for exploration of ideas and observations that may have not been foreseen. A mature MA student was also involved with collection of information at a town hall meeting and in follow-up interviews. Information was received from approximately 200 of 2,500 residents of the study area in this way.

Encounters typically began with a discussion of recent weather, with the informant being asked if s/he had observed recent trends in weather, and advise whether such trends were typical of past climate and in which ways. The informant was then asked to describe the ways in which climatic conditions might be beneficial or detrimental (usually phrased simply as “good” or “bad”) for the community economically or socially. A series of questions to make such observations precise then followed. The informant was then asked to consider what the implications might be for the community. Finally, the informant would be asked questions that would solicit descriptions of what might be done to enhance the future well-being of the community. Care was taken to avoid guiding informants into particular directions in responding to questions, and scientific jargon was avoided. For example, when asking what might be done to ensure that residents’ future well-being would be enhanced, care was taken to avoid suggesting what such actions could be or what actors might be responsible for undertaking such actions.

Information gathered from informants was recorded via handwritten notes taken at the time of encounter and subsequently transcribed into electronic files. The privacy of all informants was guaranteed, and so the electronic files are stored on

a memory stick kept in a locked safe. The data collection and storage protocols were conducted according to a university ethics license that was issued on July 4, 2008. Data collection continued until the PI was satisfied that representatives from all major social, economic and demographic groups identified in the baseline data had been consulted and that the research questions had been "saturated" (i.e. that similar answers were being repeatedly captured in successive encounters with participants (Berg 1998)). In reviewing the collected data, the PI was particularly focused on identifying information that "triangulated"; that is, where similar information was being given by individuals from different socio-economic groups or from participants who had probably had little or no prior contact with one another. For example, observations that increasing windiness was a recent and problematic phenomenon were made by an unmarried professional fishing guide and a group of women employed in a restaurant based on completely unrelated experiences. The fishing guide routinely observed wind conditions as part of his decision on which lake to fish each day; the women attributed their knowledge to decades of hanging out laundry to dry.

Image 2: Town hall meeting, Northbrook

Photo: G. Gilbert

Information that was unique to one individual or proportionally small numbers was not used in the reporting for this project, regardless of the expertise of the individual in question. Similarly, where contradictory information was given by different individuals, the observations from both groups on the specific topic went unreported. The goal in selection of data for reporting was to report only on those views on adaptation where there was agreement by multiple informants. A likely ramification of this is that some fruitful avenues of inquiry may not appear in the report to the community. For example, several individuals reported changes in local wildlife behaviour that may be climate related and, if they continued, could have impacts on the community. One individual noted that the colouring of deer

was changing at a different point in the year than in the past, which might have implications for future population numbers and harvesting rates given the current schedule of the hunting seasons in the area. While potentially valuable, this observation was not raised by other participants and it was not possible to obtain corroboration from other sources during the project, and so it has gone unreported.

A draft of the final report to the community was written in December 2007. Copies of this draft were sent to fifteen participants who had been active in the project and who represented the community's key social groups. These participants were given similar instructions as would be given a peer-reviewer for an academic journal, and requested to provided detailed correction and critique of the draft report. Thirteen responses were received and a final draft was prepared which was corrected and revised according to reviewers' input.

The final report was uploaded to the research project website in the second week of March 2008. A press release was issued by uOttawa's media centre. On March 13, 2008, the PI gave formal presentations of the project's findings in public meetings in Denbigh and Northbrook, which had been advertised in advance in local newspapers. Hard copies of the report have been placed in libraries in the study area and in the township hall.

SECTION II: DETAILED FINDINGS FROM CASE STUDY

Characteristics of the study area

Addington Highlands is an incorporated municipality in Eastern Ontario, located in the northern portion of Lennox & Addington County (Map 1). The municipal boundaries do not correspond with any natural features, but follow approximately provincial highway 41 from the junction of provincial highway 7 to the boundary of Renfrew County. There are several small hamlets and villages spread throughout Addington Highlands, the largest ones being (listed from south to north): Kaladar, Flinton, Northbrook, Cloyne, and Denbigh. The village of Cloyne is actually situated on the border of Addington Highlands and North Frontenac municipalities, with properties on the east side of highway 41 falling in the latter jurisdiction.

Map 1: Addington Highlands

Cartography: G. Gilbert

Addington Highlands straddles four large watersheds: the Madawaska, the Mississippi, the Salmon, and the Skootamatta-Moira. The Madawaska and Mississippi rivers drain into the Ottawa River, the others into Lake Ontario. Addington Highlands is situated on pre-Cambrian shield land that was heavily striated and fissured by glaciations in a general east-west direction, leaving behind hundreds of lakes, rivers and wetlands. Soil is scarce and poor in this region (Image 3); the few areas that support small farms are found in patches in the former Kaladar and Denbigh Townships. Forests are a mixture of deciduous and coniferous trees; the presence of particular species and their density varies considerably across the area (Table 1).

Image 3: Soil profile near Northbrook, ON

Photo: R. McLeman

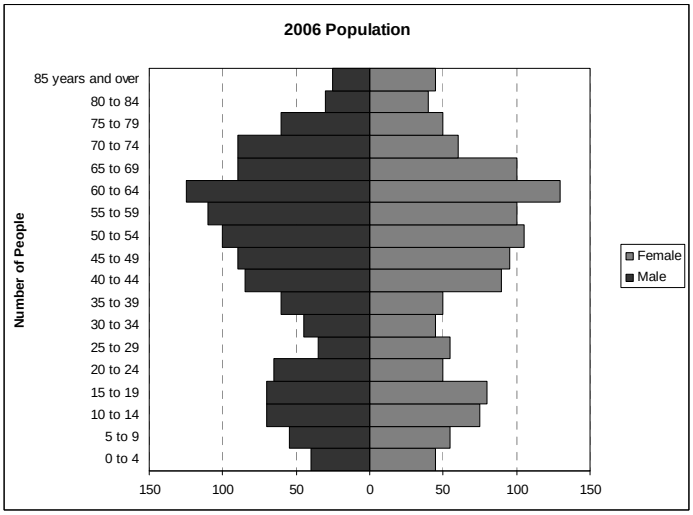
Table 1: Common tree species found in Addington Highlands

Deciduous	Coniferous
Ash, white (*Fraxinus americana*) and black (*F. nigra*)	Cedar, white (*Thuja occidentalis*)
Aspen (or polar), large-tooth (*Populus grandidentata*) and trembling (*P. tremuloides*))	Fir, balsam (*Abies balsamea*)
Basswood (*Tilia americana*)	Hemlock, eastern (*Tsuga canadensis*)
Beech (*Fagus grandifolia*)	Pine, white (*Pinus strobes*) and red (*P. resinosa*)
Birch, yellow (*Betula alleghaniensis*) and white (*B. papyrifera*)	Spruce, white (*Picea glauca*)
Cherry, black (*Prunus serotina*), red (*P. virginiana*)	Tamarack (or American larch) (*Larix laricina*)
Elm, white (*Ulmus americana*)	
Hornbeam (or ironwood) (*Carpinus caroliniana*)	
Maple, sugar (*Acer saccharum*) and red (A. rubrum)	
Oak, red (*Quercus rubra*)	

Addington Highlands and surrounding areas are promoted as the Land O'Lakes tourist region. Bon Echo, one of Ontario's more well-known provincial parks, is found at the centre of Addington Highlands on the shores of Lake Mazinaw, one of the deepest lakes in southern Ontario. Large numbers of seasonal cottages are found along the shores of Mazinaw, Skootamatta, and many other smaller lakes and rivers in the area. Water levels in many lakes are controlled to some degree by conservation authorities using dams at sites where the lakes discharge into rivers. The current, permanent population of Addington Highlands is approximately 2,500, with several hundred residents in western North Frontenac township using Highway 41 as their principal transportation corridor. The permanent population swells during the summertime with thousands of seasonal residents and hundreds of thousands of visitors to Bon Echo Provincial

Park. The average age of the permanent population is increasing, driven by out-migration of young families and in-migration of retirees who were once seasonal residents (Figure 1). In contrast to national trends, the majority of the adult population of the area lives in married households. Key employment sectors in the area are related to construction, retail/service provision (particularly tourism) and natural resources extraction. Education attainment levels tend to be below national averages. Young men tend to have lower levels of school attendance and completion rates, often electing to pursue job-training in key employment sectors. There are no post-secondary educational institutions in the area; such students must relocate to communities along Lake Ontario. Household incomes in the area are considerably below Ontario and national averages.

Figure 1: Distribution of the population of Addington Highlands by age, gender



source: Canada Census 2006

When several small townships were amalgamated in 1998 to create Addington Highlands, delivery of many key government services were downloaded to the new township government. The township does not provide potable water, sanitary sewers or garbage collection services. Home owners and businesses operate their own wells and septic systems, and garbage must be taken to one of six landfills in the area. A fee is charged for dumping garbage, but credits can be earned by returning recyclable materials for collection. The largest category of expenses in the municipal budget is road maintenance. Many of the roads leading away from highway 41 have gravel surfaces but are nonetheless maintained and cleared by the municipality for year-round use and school bus access. The local government is also responsible for providing fire and police services, libraries, parks and recreation. Social services such as Ontario Works, child care assistance, social housing services, and public health are administered by the county of Lennox & Addington, the seat of which is in Napanee, near Lake Ontario. The one public school in Addington Highlands provides education from junior kindergarten to grade 12 and is administered from Kingston as part of the Limestone School Board. Addington Highlands is governed by a municipal council, which includes a reeve and four elected councilors. The Reeve and

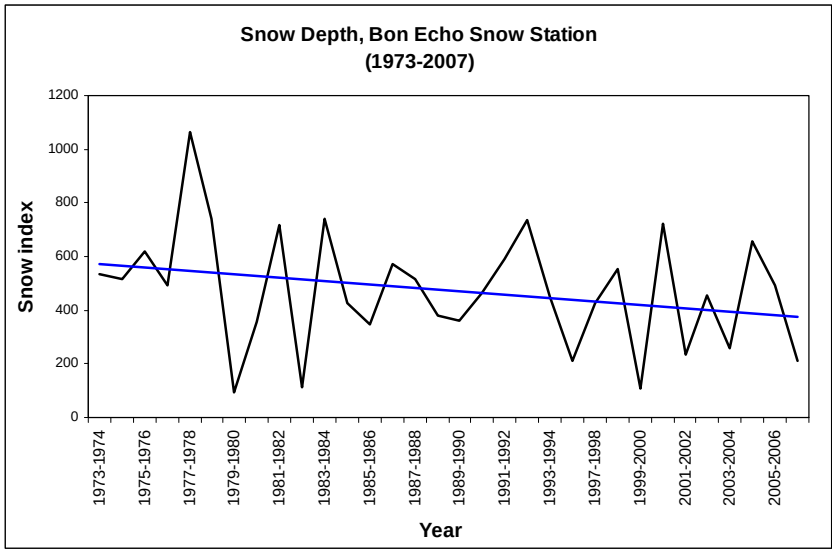
Deputy Reeve of each of the four townships in Lennox & Addington County automatically become members of the County Council. For provincial and federal elections, Addington Highlands votes as part of geographically vast electoral districts that sprawl from Napanee, near Lake Ontario, to Carleton Place, commuting distance from Ottawa.

Observed climatic trends

Long term historical climate records do not exist for any of the communities in Addington Highlands. Records of snow accumulation have been kept at Bon Echo Park since the early 1970s. The nearest weather station with long-term records is at Bancroft, 60 kilometers west of Denbigh, where weather records have been kept on and off again since the late 19th century. While there is and was microclimatic variance between Bancroft and the communities of Addington Highlands, the geography and typical weather patterns are sufficiently similar to provide a reasonable indication of long-term trends. However, Bancroft records are not continuous and the precise location of the data collection site was moved a short distance at least once during the Bancroft station's history. For these reasons, the Bancroft data were not alone relied upon to generate the area's region's climatic history, but were triangulated and corroborated with other available sources including direct measures of weather and particular climate attributes and the collection of weather information via interviews and group discussions with lifelong residents of the area. The following statements can be made with good confidence about climatic conditions in the study area.

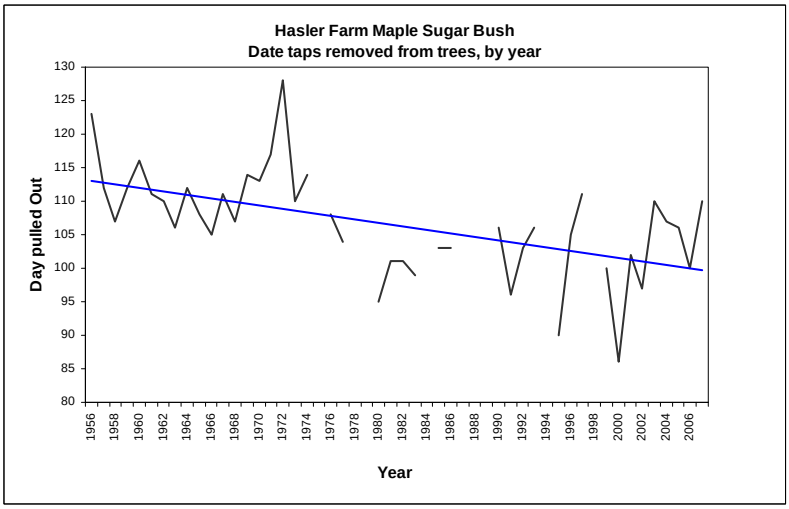
Winters are becoming generally milder in temperature, less snowy, and shorter in duration in the past. These observations were made by virtually every long-term resident consulted. Residents report that snowfall varies considerably from one year to the next, but believe the long term trend is to less snow (confirmed by Bon Echo snowfall records (Figure 2)). Many have observed that the snowy winter of 2007-2008 is a good example of the snow conditions that used to exist in the past, but that it is atypical in that temperatures have been unusually mild this winter. Until twenty years ago, it was common for midwinter nighttime temperatures to hover at minus 30 degrees Celsius or lower for weeks at a time. Today, overnight temperatures will reach such low levels on occasion, but rarely for extended periods. Large swings in temperature from one day to the next are frequent. Many residents believe that a by-product of this is that the thickness and quality of lake ice has decreased in recent decades. Winter snow and ice historically began in October or November and stretched well into late April or early May, but that in recent decades that has become rare. November precipitation often falls as rain rather than snow, and early snowfalls tend not to stay on the ground. Spring melts begin earlier now, as indicated in the dates at which maple syrup production occurs in Flinton (Figure 3) and in weather data recorded at Bancroft (Figure 4).

Figure 2: Winter snow accumulation trends at Bon Echo Park



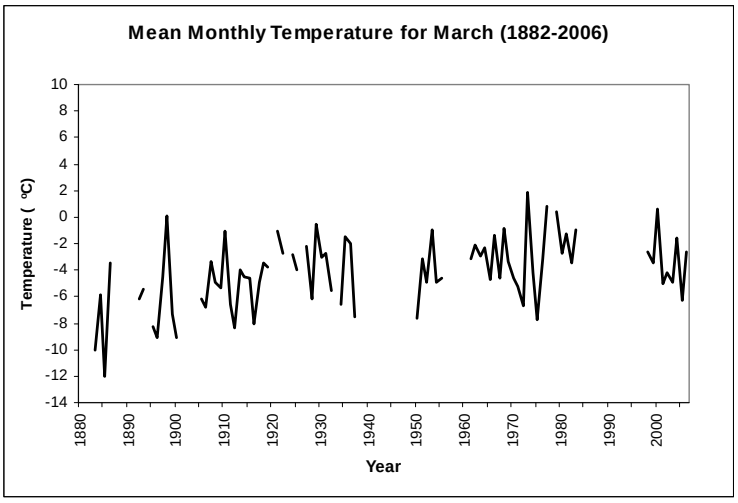
Source: Ontario Ministry of Natural Resources, Bancroft office

Figure 3: Maple syrup production date at Flinton



Source: Hasler family farm. Note: Y-axis bears Julian calendar dates. The date the spiles are pulled from maple trees is a rough indicator of when usable sap production has ceased, which is in turn influenced by the tree's response to early springtime weather conditions. The records suggest that trees in this sugar bush today come into sap an average of 7-10 days earlier than in the mid-1950s to mid-1970s period.

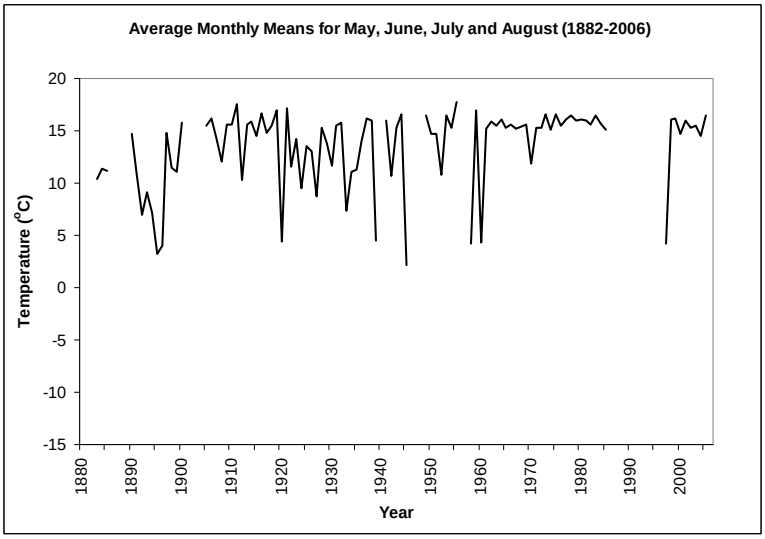
Figure 4: March temperature trends, Bancroft



Source: Environment Canada, Canadian Climate Data Online

Most residents agree that summers are now routinely hot and dry. Some suggested this may not actually be a trend but simply part of the general variability in summer conditions in the region, and recalled there having been hot summers and fire bans in past decades. Within each summer season there is typically a high degree of variability in the weather; in the summer of 2007, for example, May and June were hot and dry, July was cold and wet and August was mixed. All these observations agree with Bancroft summer temperature records, which show that average summer temperatures in recent decades are within the historical range, albeit at the high end of that range. The Bancroft records do indicate that the range of summer temperature variability has decreased, with temperatures in the cooler half of the historical temperature range observed less frequently in recent decades (Figure 5).

Figure 5: Summer temperature trends, Bancroft



Source: Environment Canada, Canadian Climate Data Online

Residents report that it is generally windier now than in the past, and that extreme wind events strong enough to bring down trees and branches are a much more common phenomenon than in the past. Referred to locally as “microbursts”, such wind events cause road closures, power outages and damage to property. One particularly strong microburst brought down hundreds of trees in the Cloyne area in 2003. While it is not evidence of such trends, it is noteworthy that twice during the summer of 2007 the PI was trapped on township roads by fallen trees and had to wait until they could be cleared before returning to the main highway (Image 4).

Image 4: Fallen tree on Addington Road 7, August 2007

Photo: R. McLeman

This project was not designed to assess the causation of reported climatic trends and variability. There is no conclusive evidence to suggest whether such trends are a manifestation of anthropogenic climate change or are characteristic of longer-term, natural variability in climate in this area. Several of the reported trends are generally consistent with projections for climate change in Ontario as described in Natural Resources Canada’s 2008 national synthesis report on climate change impacts and adaptation (Lemmen et al. 2008). Patterns in land-use change in Addington Highlands are one potential driver of climatic trends in recent decades. When non-native settlement came to this area in the 1800s, mature forests were rapidly cleared, and heavy, poorly-managed logging continued into the 1960s. Due to subsequent economic and structural changes in both the forest industry and the local economy, as well as increasing regulation of timber extraction in Ontario that has moved towards more sustainable practices, logging pressure on the land has since been reduced. Crown Lands make up more than 70% of the township, much of which are increasingly covered with mature forest stands. It is therefore possible that the local scale climatic patterns observed since the 1960s could be linked to reforestation, and are a manifestation of pre-contact climatic conditions.

Vulnerability of critical economic sectors to climate change

Recreation and tourism

Tourism and the provision of goods and services to seasonal residents and visitors are a significant source of direct and indirect employment and income in Addington Highlands. It is also an economic sector that is highly sensitive to climatic conditions. The nature of the tourism industry varies throughout the year. Summer tourists consist of seasonal residents and shorter-term visitors which include campers, renters of cottages, and visitors to fishing lodges. In the fall, hunting is the key attraction for both local sportsmen and visitors from as far as the southern United States. In the winter, snowmobiling and ice fishing attract visitors from southern Ontario and the northeastern United States.

Summer residences are typically waterfront cottage properties or mobile homes/trailers kept in one of the numerous small campgrounds in the area. Traditionally, summer cottages were modest and of simple construction, and were not often winterized. As the cost of cottage properties elsewhere in Ontario has become unaffordable for many people, the price of waterfront property has escalated in Addington Highlands in recent years. Along with this trend, seasonal residents are increasing the value and amenities of their cottages, creating growth for the local contracting and renovation industry. As seasonal residents become older, an increasing number of formerly seasonal properties are being winterized as the owners prepare to “retire to the cottage”.

The traditional start to the cottage season is the Victoria Day weekend in May, typically preceded by one or two weekend visits to open up and clean the cottage and connect the water lines. The Labour Day weekend is considered the end of the cottage season, although in practice families with school-age children begin curtailing their visits in mid-August. By Thanksgiving weekend in early October, most seasonal residences have been closed up for the winter.

Camping and related outdoor activities bring hundreds of thousands of visitors over the course of the summer. The single biggest draw is Bon Echo Provincial Park, which alone draws more than 175,000 visitors annually. Campsites at Bon Echo must be booked electronically through the Ontario Parks central reservation system, and there is considerable competition to reserve the most favourable sites during peak periods. Because Bon Echo campers have in most cases reserved their sites months in advance, they are less likely to cancel their visits because of poor weather forecasts than visitors to the many private campgrounds found in the area. Weekend campers tend to bring most of their supplies with them, but those staying more than a few days typically venture into the local community for ice and other perishables. There is no convenience store nor ice sales in Bon Echo, creating an important niche for nearby retailers.

The length of the season for visits by campers and seasonal residents is dictated more by the school calendar and statutory holidays than by the length of summer weather conditions. Visits peak during the period between July and August long weekends, and tail off noticeably in mid-August. Weather conditions can influence the duration of visitor stays. Cool and wet conditions often lead campers and cottagers to cut short their visits. Extended hot and dry periods can lead to the imposition of a ban on campfires, which can lead campers to venture elsewhere.

The primary hunting season occurs in the autumn. Many residents of the area hunt, particularly for game birds, deer and moose. Non-resident hunters will in many cases travel long distances to hunt in the area, some as far as the southern United States. Non-resident hunters stay at permanent camps in the woods, in cottages, motels or lodges. Non-resident bear hunters may engage a local outfitter to provide meals, accommodation and guiding services. Given the relatively short duration of the hunting season and the nature of the sport, hunting itself is not particularly sensitive to variability of weather conditions. Extended periods of rain may lead hunters to cut short hunting trips. The hunting economy is sensitive to the condition and quantity of wildlife, which may in turn be influenced by long-term climatic trends.

Sport fishing attracts large numbers of visitors from southern Ontario and the northeastern United States. American fishermen are attracted by the clean waters, the relative lack of development along lakes and waterways and the natural availability of bass and walleye (pickerel), game fish popular with Americans. Mazinaw and several other large, deep lakes are popular with lake trout fishers. By the beginning of July the fishing season is open on all species popular with sport fishers. Non-resident sport fishers camp, rent cottages or purchase “American plan” packages from fishing lodges. Because they must travel long distances and plan well in advance, American sport fishers are less sensitive to current weather conditions than are weekend visitors from southern Ontario. American fishers are more sensitive to factors as currency exchange rates and the quality of past experiences in the area.

Winter outdoor activities attract a considerably smaller number of visitors, but their presence provides an important source of revenue during a period when economic activity in the area is at its lowest. The principal winter attractions are snowmobiling and ice fishing. The Mazinaw Powerline Club manages snow trails that run from Kaladar north to Denbigh, by which through-riders can connect to trails in neighbouring regions (Image 5). Snowmobiling is a relatively expensive sport, with riders easily investing tens of thousands of dollars in snowmobiles, insurance, truck and trailer and accessories. Snowmobile tourists are willing to travel long distances to find good trails and will spend good amounts of money on gas, food and accommodations.

Image 5: Snowmobiles outside motel in Denbigh, January 2008

Photo: R. McLeman

Snowmobile tourism is highly sensitive to local weather conditions, and Addington Highlands competes with other destinations in eastern Ontario and the northeastern US to attract riders. When winter temperatures are mild, wetlands and lake may not freeze properly, making snowmobile trails impassable. If there is inadequate snow to enjoy a good ride, riders will go elsewhere. When conditions are extremely cold, snowmobilers may be less willing to ride in isolated areas for fear of the consequences of a breakdown. Ice fishing is a popular activity for local residents and will attract weekend visitors from southern Ontario as well. Organized ice fishing tournaments help attract visitors. This activity is evidently highly sensitive to winter ice conditions.

Construction and real estate

The growing interest in recreational properties in Addington Highlands, along with the current societal trend of retiring to the cottage, has created growth in the local building and renovation industry. This field provides one of the few semi-stable, year-round sources of employment in Addington Highlands. The nature of building activities that can be undertaken is sensitive to weather conditions. For example, digging can not be done in frozen ground, while extreme heat or extreme cold may make it difficult to work out of doors.

Weather conditions also affect access to work sites. Many seasonal properties in the area have no road access, and so large construction projects are often undertaken in mid-winter when equipment and materials can be moved safely across lake ice. Heavy snow falls may block travel to road-access properties. With the exception of lake-access work sites, mild winter conditions are generally favourable for contractors, allowing them to complete their work faster and more

efficiently and hence take on more outdoor projects. Real estate agents in the area also report that milder winter conditions now enable them to show recreational properties to potential buyers much later in the year than was historically the case.

Retailing and services

Over 70 storefront businesses and services line Highway 41 between Kaladar and Denbigh, virtually all of which are owned and operated by local families. They come in many shapes and sizes; from seasonal blueberry stands and chip wagons from particle board to the Foodland grocery store in Northbrook, which would look familiar to any Canadian suburb but for the large, natural marshland complex that spreads out immediately behind it. Many businesses are operated out of renovated sections of houses. Not all operate year-round; those that are heavily reliant on summer weekend visitors and cottagers will typically close after Thanksgiving and reopen in May. Those that remain open year-round universally experience a decline in patronage after Labour Day. Some year-round businesses reduce their daily hours and/or open on fewer days during the week in winter because the volume of customers drops off so sharply.

Retail business is highly sensitive to variations in weather conditions. In summer, the busiest retail days occur when a Saturday morning dawns cool and rainy but the forecast promises clearing and sunshine in the afternoon. In such conditions summer visitors will venture into town to purchase a newspaper and a few grocery items and end up visiting a number of businesses as they pass the time waiting for the weather to clear. Conversely, a summer day that dawns hot and sunny and stays that way means summer visitors make straight for the lake and give no thought to leaving there except, perhaps, for ice cream. A specialty shop may see not a single customer on such a day.

Extended periods of cold, damp weather in summer are bad for retailers, since such conditions will often lead visitors to cut short their trip by a few days. During extreme heat events, some older cottagers may actually choose to remain in the city where their homes are air conditioned. On the whole, though, retailers hope for warm, sunny summers to ensure that visitors do come, stay for extended periods and have a good experience so that they are likely to return again the following year.

During the winter, extreme cold, heavy snows and icy roads are conditions that will create short-term increases in patronage at local businesses, as area residents are less likely to undertake long drives to the city to go shopping. Area motels, restaurants (that remain open), garages/gas stations, grocers and general merchandisers benefit from snowy winters and good snow trail conditions that attract snowmobile tourists and ice fishers; extremely mild winters lead to a noticeable drop in revenues for such businesses.

Forestry

It was forestry that brought many of the earliest European settlers to what is today Addington Highlands, and forestry continues to be a key employer in the area. Forests of Addington Highlands contain a mixture of coniferous and deciduous species (Table 1). Area forests have in most cases been logged over several times. The majority of the township's lands are owned by the Crown, with the concentration highest in the northern sections of the township.

Three main groups make up the forestry sector in Addington Highlands. One group consists of residents who reside in Addington Highlands but who work away for large parts of the year for logging companies operating in regions to the north. A second group consists of individuals who work within Addington Highlands and surrounding areas cutting timber on private land, for lumber or for fuel wood. These individuals will typically combine logging work with other jobs in construction, road maintenance or other trades. Their logging-specific equipment may consist of little more than saws, a small skidder and a truck. A third group consists of locally-owned or operated independent logging companies. These year-round forestry operators are characterized by a small number of employees and modest capitalization, and may have been operated by the same family for generations. Some of these companies may hold a long term license to harvest timber on Crown Land. The large majority of the harvested logs are sent to mills outside the area; a smaller proportion of logs are milled locally. Some logging within Addington Highlands forests is also done by companies situated in other communities.

The right to log on Crown land in Addington Highlands is regulated and controlled by the Ontario Ministry of Natural Resources (MNR) through a Sustainable Forest License issued to Mazinaw-Lanark Forest Inc., based in Cloyne. This company, which administers a region extending beyond the borders of Addington Highlands, is owned cooperatively by several local logging and sawmill companies with traditional involvement on Crown land. This pooling of resources is necessary to meet the extensive and costly obligations stipulated in the MNR license. The company has an obligation to develop long term forest management plans, to regenerate harvested areas through natural regeneration or tree planting, and to monitor forest operations on an ongoing basis.

Forestry in Addington Highlands is highly sensitive to climatic variability and changes in prevailing conditions. Logging operations are typically suspended from the spring break-up of snow and ice (which occurs at some point between mid-March and mid-April) until late May or mid-June for several reasons. One of the most critical is that the ground during this period is saturated with water, and logging equipment can not operate without causing immediate and severe damage to soil, trails and roadways. In some cases, the movement of heavy equipment may be physically impossible. The township may also temporarily reduce the maximum allowable weight for commercial vehicles, so as to reduce

surface damage to township roads. Saturated soil conditions that slow or prevent logging activities can also be experienced in mid-summer following heavy rains and in late November and early December when the ground has yet to freeze.

From May until late July trees are growing vigorously, and the under-layer of bark (the cambium) is extremely susceptible to mechanical damage. This condition typically leads to another period of limited forestry operations, requiring deferral of logging or utilization of specialized operations, and extra monitoring. Extremely dry summer conditions can make it dangerous to use equipment in the forests, and so logging and silviculture operations may be restricted. Extreme wind conditions are a more common natural disturbance to forests in the area than fire in recent decades. Outbreaks of forest pests, including spruce budworms (*Choristoneura fumiferana*), white pine weevils (*Pissodes strobi*), gypsy moths (*Lymantria dispar*) and hemlock loopers (*Lambdina fiscellaria*), are linked to climatic conditions and typically coincide with hot, dry weather combined with other factors favourable to particular pest populations. When winter weather conditions fluctuate around the freezing mark, forests may sustain snow and ice damage.

All of the preceding conditions that affect forestry operations and forest health are very sensitive to variability in climatic conditions. A number of non-climatic factors further constrain forestry operations in Addington Highlands. In a number of areas large-scale timber harvesting in summer is logistically difficult due to the potential for disputes or conflicts with other land users, particularly cottaging and recreational land use. During the hunting season, which begins in earnest in early November, logging operations are often suspended. In the months of March through July, operations on Crown land are prohibited within specified distances from known raptor nests and other proscribed habitats.

Several forces beyond the control of forestry operators have a significant impact on their incomes. Market prices for wood and wood products are set by global markets and have been falling steadily over the past five years. Over the same period, the Canadian dollar has been rising steadily in value, as has the price of fuel, a key operating cost for forestry businesses. Consequently, forestry companies of all sizes have been scaling back their operations in Ontario. Many one-person operators in the area have adapted by doing more non-forestry work, and restricting their cutting to fuelwood. The smaller forestry companies in Addington Highlands, who cannot produce enough volume to offset the decline in marginal revenues, are particularly squeezed by the current market situation.

Road work, firefighting and other municipal services

Road maintenance and repair is the largest category of expense for the local government, and is significantly influenced by weather conditions. Heavy snow falls place a high demand on the use of snow plows. Mild winters with highly variable temperatures place great demands for both maintenance and repairs.

Freezing rain and alternating freeze-thaw conditions caused by mild daytime temperatures and cold nighttime temperatures require roads to be treated with large amounts of salt and sand. The alternating thawing and freezing of pavement and road structures increases material breakdown and reduces their longevity. Rapid spring thaws can increase the risks of flooding, damage to road culverts and washouts.

Firefighting in Addington Highlands is done on a volunteer basis, although firefighters do receive a standard hourly wage for hours worked, paid for by township government. Given the large extent of forest cover in the area and the large number of residential properties in close proximity to forested areas, extended periods of hot and dry weather can elevate the risk of wildfires. Large fires occurred in this area early in the 20th century in the aftermath of logging and slash depositions at levels much higher than those which occur today. In 1900, the northern Addington community of Vennachar was destroyed by a large wild fire. Since the 1920s, systematic fire suppression measures have occurred, while at the same time forest cover containing a high component of less-flammable hardwoods has matured. Smaller forest fires requiring active firefighting do still occur. In 2007, a forest fire broke out in Barrie Township and provincially operated water-bombers were needed to control the fire before it reached settled areas.

Social vulnerability to climate change

Adults

The communities that make up Addington Highlands are home to many groups, networks and organizations that collectively form what has been described in academia and government policy as social capital (Castle 2002). As will be seen in later discussion, this social capital represents an important vehicle for community adaptation to future stresses.

Social and cultural activities in Addington Highlands center on a mix of outdoor recreation activities, participation in community groups and organizations, and extended family activities. Outdoor recreation activities popular among residents include all-terrain vehicle (ATV) riding, snowmobiling, boating, hunting, and fishing. The area has a many very good ATV and snowmobile trails. Fish and game are consumed by many households as a frequent part of their diet. A declining number of residents operate trap lines in the area. This activity could at one time provide a reasonable income, but the declining popularity and price of fur has meant that trapping at best supplements a household's income, and is now practiced more as a hobby than a livelihood.

Community recreation groups will often organize a community event around one of these activities, such as an organized snowmobile ride that ends at a public hall for a pot-luck or evening social. An annual Trappers' Workshop, which

provides an opportunity for local businesses to showcase their products and services to sportsmen, is held each spring. Winter and summer fishing derbies are popular. All such outdoor activities are sensitive to weather conditions. The popularity of ATV riding can in part be attributed to the fact that ATVs can be used most of the year, unlike more expensive snowmobiles.

Residents participate in a large array of community groups, organizations and events. Each village and hamlet has an active church community, which in addition to Sunday worship organizes such things as community suppers, food hampers, and socials. The second-hand clothes store in Northbrook is church-run. The larger villages and hamlets have recreational committees that organize activities and festivals throughout the year. Examples of larger events include the Flinton Bluegrass festival, the Denbigh fall fair and a number of Santa Claus parades. Addington Highlands has two active Lions clubs. Fireworks events and the building of a skateboard park are two of many examples where partnerships between local government and service groups were critical in getting community projects completed. Other popular community organizations include the horticultural society, historical Society and Friends of Bon Echo Park. Many of the large lakes in the area have a ratepayers' association which organizes occasional barbecues and activities; such associations tend to be a mixture of permanent and seasonal residents.

Residents will periodically make a trip to one of the urban centres outside the region (e.g. Belleville, Kingston, Napanee, Renfrew), one that is often a combination of running errands, buying supplies and household items not obtainable in Addington Highlands, and engaging in recreation activities like eating at a favourite restaurant or seeing a movie.

Participation in community events can be affected by weather conditions, since virtually all who attend will need to travel to the site by vehicle. Dangerous road conditions discourage attendance at indoor events in winter, although the same conditions also discourage residents from traveling out of the area to shop and stimulate trade at local businesses. Most special events are organized with a contingency plan or alternate date in case of adverse conditions.

The long-term success of community social organizations is contingent more upon social factors than climatic ones. For example, the Conservationists of Frontenac-Addington and the Lions clubs have been particularly effective at bringing both long-term residents and more recent migrants into their memberships. Other community organizations tend to be favoured by one social group but not the other. In some communities or community groups, a small number of individuals may take on a disproportionate share of the organizational tasks; the gain or loss of one such individual can play a big role in the ongoing success or decline of the group or activity.

Children

The vulnerability of children to changing climatic conditions is a subject that had not been expected when this project first began, but represents a worrisome phenomenon that merits considerable future research.

Given the long distances in the area, much of the socializing among children occurs at school. The North Addington Education Centre in Cloyne provides schooling for all primary and secondary grades. There are no other public schools currently operating in Addington Highlands. When road conditions are poor in winter, many children will not attend school; virtually the entire school population lives at a distance from the school and must be transported by school bus or private car.

Activities for children outside of school are periodically organized by church youth groups, local community recreation clubs, and Lennox & Addington Resources for Children (based in Napanee). There is a summer soccer league in Cloyne, and local recreation committees maintain outdoor ice rinks. There is a skateboard park in Northbrook and playgrounds in most settlements. To participate in organized hockey or other sports, or to participate in organized training in theater or the arts typically requires travel to communities outside the Addington Highlands area. In winter, some high school-age students go downhill skiing in the Calabogie Peaks area, an hour's drive east of Denbigh. Many teenagers hunt and fish with their parents in the fall, and secondary school attendance drops noticeably during deer-hunting season. COFA members organize fishing trips for children and provide equipment to those who lack it.

The social and economic well-being of the children of Addington Highlands is closely tied to the weather in many households. Roughly one-third of students fall into a vulnerable group that may require periodic or ongoing school breakfasts and lunches and/or have other special needs directly attributable to fluctuations in the wellbeing of the household. Incomes in many households vary considerably according to the season, given the seasonality of the local economy and employment market. In many homes, one parent (usually the father) will work away for extended periods, leaving a single parent at home who is often herself working. Climatic conditions exacerbate the variability of household incomes. If weather conditions are bad for extended periods of time, parents who work seasonal jobs may be laid-off. Should electrical power go out for an extended period in remoter areas of the community (a fairly regular occurrence) children from those homes may need food and extra attention at school. In an extremely cold winter when household energy costs are high, an increased number of children will depend on school meal programs, and the school will see more behavioral problems among students. Students for whom school is a reprieve from stressful home environments will often be visibly worried in the days leading to the Christmas. During the Christmas break such children experience for an extended period the stresses their parents are under, may

experience anxiety about not having Christmas gifts and celebrations comparable to those of their peers, and/or may miss the school meal program.

Potentially beneficial impacts of observed climate trends

Table 2 summarizes the potentially positive impacts that have been identified by residents. Current climatic trends in winter conditions could potentially benefit households with fixed or modest incomes; older and less-mobile residents; and, those with jobs related to the buying, selling, construction and renovation of seasonal properties. Trends in summer conditions hold fewer identifiable benefits except for business operators whose clientele includes summer visitors.

Table 2: Potential benefits of observed climate trends

Season	Sector(s) potentially benefiting	Description
Winter	Households, businesses, institutions	Decreased expenditures on heating costs in some years
Winter	Older, less able residents	Increased mobility, less snow to clear from private drives, walks
Winter	Seasonal residents, property buyers/sellers, contractors	Longer period of road access to seasonal properties
Autumn	Retailers	Seasonal residents may stay later in the year
Summer	Tourist industry	More consistently warmer summers may lead tourists to prolong stays, make repeat visits

The decreasing frequency of extreme cold events and the reduced amounts of snow cover mean that keeping roadways, private driveways and walkways clear of snow may become less difficult, an important consideration in an area with an ageing population. Shorter and milder winters reduce household expense on energy costs and may to some extent offset the rising trend in electricity and fuel oil prices, a trend that many economic reporters believe will continue. Mild winter conditions also mean that contractors and trades people will have greater access throughout the year to work sites, with the possible exception of boat-access properties. Buyers and sellers of seasonal properties are also able to continue such activities for most of the year, allowing both groups more flexibility than existed in the past. Indeed, this phenomenon is already occurring, with seasonal property sales and purchases now occurring regularly in the winter months, something once almost unheard of. Snowbirds, who spend their summers at the cottage and winters in the US, could begin staying in Addington Highlands later into the autumn (a small number of such individuals were encountered during this project), producing some additional benefit for local merchants.

The trend towards more consistently warm and dry summer conditions could mean that summer visitors return regularly to the area each year, and that the

average duration of the stay will be relatively long. However, given the high degree of variability within the summer season, the beneficial effects a trend towards consistently warm average temperatures could easily be outweighed by a succession of summers with short periods of cool and wet conditions that inconveniently coincide with long weekends.

Negative impacts of observed climate trends

The range of potentially negative impacts for the community is summarized in Table 3. The greatest number of risks is associated with economic and social activities that take place in winter, although some summertime risks have also been identified.

Table 3: Potential risks, negative impacts of observed climate trends

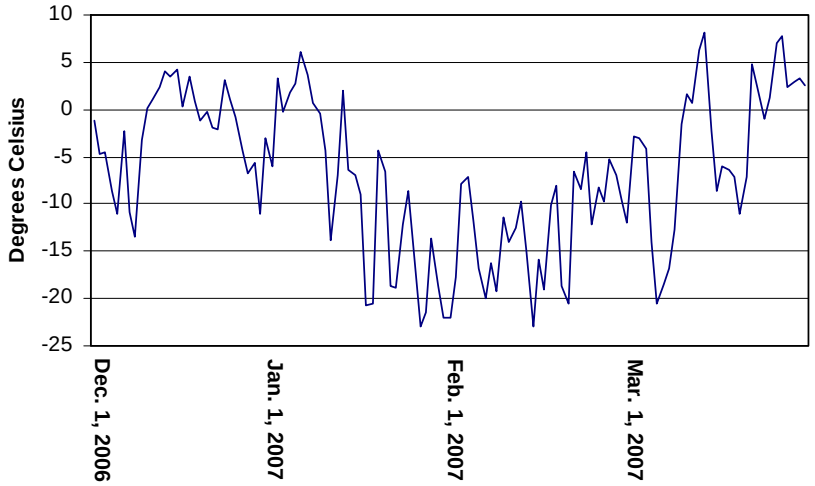
Season	**Sector(s) potentially affected**	**Description**
Winter	Tourist industry	Decreased visits from snowmobilers
Winter	Recreation	Poorer conditions, shorter seasons for ice fishing, trapping, snow sports
Winter	Local government	Increased costs for road maintenance, repair
Winter, summer	Forestry	Fewer days for winter logging, some interference with summer timber maintenance activities
Winter, summer	Emergency services	Increased risk of winter road, ice accidents, summer boating accidents
Summer	Property owners, emergency services	Increased risk of wind damage to property, power outages, fires
Summer	Property owners	Risk of falling water tables, changes in shoreline conditions, loss of wetland areas in some localized areas

The winter tourist economy is highly susceptible to the current trend of shorter, milder and less snowy winters. Snowmobile tourist numbers have been declining in recent years. The winter of 2006-2007, which was exceptionally brief and lacking in snow (Figure 6), saw almost no snowmobile tourists stay in the area, resulting in loss of revenue at local businesses and motels. The winter of 2007-2008 saw a return of snowmobile riders to the area, although anecdotal reports are that the numbers are still not what they once were, particularly of riders not resident in the area. Without the removal of barriers related to the winter closure of Bon Echo Park there is no obvious, immediate replacement for declining numbers of snowmobile tourism.

The duration of the winter period in which it is safe to travel on ice may decrease in coming years, which would have negative impacts on the ability of local residents to participate in activities such as ice fishing and trapping. This does not necessarily imply that there will be noticeable changes in the dates on which

ice appears and disappears from lakes, but the thickness and quality of ice, which are sensitive to fluctuations in temperature and snowfall, may be affected. A reduction in the ability to trap and ice fish may have a small but negative effect on those households where income from fur trapping is lost and/or access to locally-caught fish becomes less reliable and consequently substituted with store-bought food.

Figure6: Mean daily temperatures, December 2006-March 2007, Bancroft



Data source: Environment Canada, Canadian Climate Data online: www.ec.gc.ca
Note: Average daily temperatures did not remain below freezing for any extended length of time until mid January 2007, where they remained until mid-March.

For the local forestry industry, which sees its local timber-cutting season already constrained by numerous non-climatic factors, that season may be shortened further as the period of frozen ground shrinks. This will place further pressures on local workers and small companies in an industry which is already being hard hit by falling wood prices and rising energy and administrative costs.

Milder winters in which precipitation increasingly falls as rain rather than snow pose risks for road travel and place extra demands on the local government's road budget for application of salt and sand. Wet, cold road conditions that hover near zero degrees typically produce icy driving conditions more often than do colder, dryer conditions. Given the north-south temperature gradient in Addington Highlands, the likelihood of such conditions occurring and leading to greater risk of road accidents is likely greatest in the southern part of the area. Along Highway 7 traffic volume is high, as is the proportion of drivers who are not residents of the area and hence less familiar with local winter driving conditions and hazards. Slippery conditions in driveways and walkways also raise the risk

for injuries caused by slips and falls, a concern not insignificant as the average age of the population advances beyond sixty.

The increased frequency of windiness and extreme wind events or microburst raises the risk of property damage, road closures, downed power lines and/or injury from falling trees and branches, particularly given that so many homes, cottages, businesses and roadways are located in close proximity to trees. Increased strong winds may also raise the risk of accidents to occupants of small watercraft, especially tourist visitors who may be less familiar with lake conditions and are less-frequent operators of boats than are residents. Ambulance call volume is already higher in the summer, when the number of tourists and seasonal residents peaks, and any factor that might further increase call volumes is unwelcome in an area where ambulance stations are few and far between.

The increased windiness and dryness of summer periods may well contribute to an increased risk of forest fires across the region, with its attendant costs and potential to cause harm or damage to property. Fire bans have negative impacts on forest management and can reduce the number of visitors to private campgrounds. Homes in some localized areas have experienced drops in their water table during recent dry periods, and if this trend continues, such homes may require additional investment to drill deeper or new wells. Duck hunters may have in some recent seasons experienced difficulty in accessing blinds by boat due to falling water levels in ponds and wetlands (Image 6). Cottagers may notice lower lake levels in some years, although the level of many larger cottage lakes is regulated by dams managed by conservation authorities. Conservation authorities have on some occasions been accused by waterfront property owners of deliberately lowering lake levels to maintain high water levels downstream along rivers moving through urban areas, but conservation authorities report that such a practice does not exist.

Image 6: Dry beaver pond near Flinton, August 2007

Photo: R. McLeman

Barriers to adaptation

Changing trends in climatic norms and conditions are just one subset of a suite of ongoing stresses and changes to which residents of Addington Highlands must adapt. Indeed, for many households, the climatic risks and opportunities identified above may be of minor significance or are amplified by other, non-climatic stresses. It is clear that the impacts of climate change are being experienced as part and parcel of other social and economic pressures in the community, pressures that are often exerted by systems and agents operating at scales well beyond the control of the local community. The ability to adapt to changing climatic conditions in the context of other non-climatic stressors is currently impeded by a number of social and institutional barriers and deficits in infrastructure.

Many residents of Addington Highlands lack access to services that are taken for granted in Canadian urban centres. Most residents lack a family doctor, and considerable efforts by local government to attract additional doctors to the area have been unsuccessful. There is no emergency medical clinic in the area. There are ambulance stations at Northbrook and Denbigh, but there is discussion that the county may close the Denbigh station for budgetary reasons. If an ambulance is out on a call, a person in need must wait for one traveling from a farther distance or find private transportation to hospital in Renfrew or Napanee. There is no pharmacy in the area (the family doctor clinic in Northbrook operates a small dispensary to fill its own prescriptions), so most residents must travel to refill prescriptions. There is a single public health nurse based in Cloyne, and her office attempts to fill some of the missing health care needs by operating periodic vaccination clinics, for example.

Image 7: Denbigh Medical Clinic – open Wednesday afternoons

Photo: R. McLeman

This lack of health services has significant consequences. Young families find it difficult to access childhood vaccine services, pediatric care and early-years services. This discourages young families from remaining in the area and makes it difficult to attract young in-migrants. At the other end of the demographic spectrum, half the local population is now over the age of fifty and entering the period of life when health care needs are typically greatest. The climate-related trends identified above will only serve to exacerbate deficiencies in health care services.

A critical deficiency in local infrastructure is the lack of cell-phone and broadband internet service throughout most of Addington Highlands (in parts of the village of Northbrook, high-speed internet connections by telephone line are available). Local government has offered to subsidize cell-phone companies to install transponders along highway 41, but the oligopoly of cell-phone companies has refused. Internet providers have similarly refused to provide high-speed internet service to most of the area, except where residences are found concentrated in small subdivisions, and even then will do so only if the majority of residents in such pockets sign service contracts. This situation makes it difficult to attract and retain younger residents and to operate a business. It also exacerbates the difficulty of accessing emergency medical care. For example, if a road accident occurs, police and ambulance can not be called from a cell-phone. If the victim is injured and alone, s/he must await the arrival of a passing good Samaritan. Local weather forecasts are difficult to obtain except through the Environment Canada website, which can be time-consuming to access on dial-up service. Lack of cell-phone and high-speed internet access may also discourage summer visitors who must still maintain periodic contact with work and home.

The only remaining school in Addington Highlands is a critical resource for the community. It has a highly professional and dedicated staff, with a large proportion of administrative staff and teachers having grown up in the community. The school strives to fill needs that would otherwise not be filled, but a significant limitation is the vast geographic region that it serves. Virtually the entire student population from kindergarten to grade twelve is brought to school by bus or private vehicle. Students residing in the Denbigh area may travel up to 150 km daily on school buses, a significant disincentive to attendance or participation in extra-curricular activities. This situation also puts virtually the entire student population of the area at risk of road accidents, which are often weather-related, when traveling to/from school.

Rising energy costs present significant challenges for residents and businesses in Addington Highlands. Homeowners do not have access to natural gas; the available home energy choices are electricity, home heating oil, propane, firewood or wood pellets. Many residents use a combination of energy sources, to offset the high costs of oil and electrical heating and to reduce vulnerability to power outages. A small number of homes in the area have installed solar panels, geothermal systems and residential wind turbines, but the capital costs for such

alternative energy sources remain beyond the means of most households in the area. While heating by firewood requires more time and physical effort than other energy sources, it remains considerably cheaper than oil or electrical heat, especially for residents with access to a woodlot and the ability to cut their own wood. As residents become older, some find it inconvenient or physically difficult to use firewood and rely more heavily on other, more expensive fuels.

Rising gasoline prices have a direct impact on household well-being. Wages in the area have not kept pace with the rate of increase of fuel and energy prices in the last five years; the difference represents a direct erosion of household incomes. Current trends in oil prices suggest this dynamic will become much worse. Travel by personal motor vehicle is essentially the only form of transportation in the area. There is no public transportation service along highway 41 through Addington Highlands; intercity buses do travel along Highway 7, providing connections to Ottawa and Toronto if one can get to the highway. Very few residents live within close proximity to work. Because there is no municipal waste collection, residents must deliver their own household waste to a landfill or make private collection arrangements.

The rapid rise in the Canadian dollar versus its US counterpart is being directly felt by the tourism and forestry sectors. American tourists were far more common when the Canadian dollar was valued below 70 cents US, and American seasonal residents would typically stay longer and spend more money in local businesses each summer. Lodges and motels that depend heavily on a US clientele of fishing or snowmobiling guests are under particular pressure. At the same time, Canadian tourists now have greater financial ability to vacation in the US and may feel less inclined to stay at home and visit areas like Addington Highlands in coming years.

With the significant exception of the provincial park, virtually all campgrounds, resorts, lodges, and motels in Addington Highlands are independently owned and operated. Each provides a livelihood opportunity for the family that owns them and a small number of seasonal jobs for other area residents. They compete in the outdoor recreation market against Muskoka, Haliburton, and a host of other destinations in eastern and Central Ontario. A particular segment of the outdoor recreation market is attracted to Addington Highlands specifically because it is a low-key, small-scale, family oriented tourist area with few man-made attractions and relatively undeveloped lakes. However, this is neither the largest nor the most lucrative segment of the market. Competing tourist destinations are experiencing strong growth in visitors who stay for a short duration, spend relatively freely but demand higher levels of amenities than simply a cabin, a campfire and a view.

Because accommodation in Addington Highlands is typically family-owned, few operators have the capital to expand and add amenities to tap into new tourist markets. The possibility that a large corporate resort-operator might move into

Addington Highlands, as has been the experience in many competing Ontario tourist regions, does not appear imminent. It is a possibility that draws mixed feelings from local residents; while a large resort might generate more visitors and retail trade, create jobs and help grow the local tax base, it could also alter the image (if not reality) of undeveloped, unspoiled nature that appeals to both residents and current visitors alike. A key reason why such a development does not seem imminent is that, while over 70% of the township is undeveloped crown land with numerous lakes suitable for resort development, much of it is situated along waterways flowing into the Mississippi River system and are thus subject to an outstanding land claim by the Algonquin First Nation. Until the claim is resolved, neither MNR (which oversees development of Crown land) nor any outside investor is likely to consider any large-scale land developments. In 2007, the township issued a request for proposals to develop an eco-tourism resort on a parcel of Crown land at the northwestern end of Sheldrake Lake (which does not drain into the Mississippi and is thus outside the land claim). While interest was expressed by approximately thirty respondents, no proposals were received.

Finding a way to replace revenues from declining snowmobile tourism will be challenging. As snowmobile use has declined, ATV riding has grown in popularity, but it is unlikely to become a driver of tourism growth in the short term. Unlike snowmobiling, ATV riding is not organized into regional clubs to maintain trails and self-regulate the sport. ATV riders typically do not carry insurance absolving private landowners from liability, and are seen by some landowners as nuisances, meaning ATV riders are often denied permission to cross private lands where snowmobilers have such permission. Because snowmobiling is such an expensive sport, it inherently attracts a more free-spending visitor than ATV riding could be expected to attract. And finally, Addington Highlands has traditionally attracted snowmobilers because it offers better snow trails than riders from the south experience at home; the range of possible destinations for ATVs is far broader than for snowmobiles.

One significantly under-utilized tourism resource in the area is Bon Echo Park. Each year the park is closed to the public in November and does not re-open until April. While winter tourism will never draw more than a fraction of the number of visitors to the park as during summer, there is growth in winter camping, snowshoeing, cross-country skiing, ice-climbing and other winter outdoor activities. Bon Echo is familiar to many southern Ontarians, and were the park to be opened and marketed as a winter destination, visitors would come. However, the current business model being used by Ontario Parks, where provincial parks are expected to generate high visitor revenue to operational expense ratios, discourages winter park openings.

Ongoing demographic change presents both challenges and opportunities for Addington Highlands going into the future. Like rural communities across Canada, Addington Highlands continues to lose a large portion of its young and talented people to urban areas to the south. Unlike many rural communities,

however, Addington Highlands is drawing talented migrants from urban areas, albeit at a later stage in life. These new residents bring with them skills and energy that can be tapped to improve the local quality of life. The challenge is finding ways to better integrate them into the organizational and social fabric of the community.

At present, new residents are highly represented in certain local social groups such as the horticultural society, historical society and Friends of Bon Echo Park, but are less represented in others. There are, however, some very active social groups that have been able to draw strong participation from both newer and longer-established residents, including the Lions Clubs, COFA and some local recreation committees. Community organizations and church groups in Addington Highlands are not merely social outlets, but it increasingly falls to them to raise funds for and deliver support and services which in other places or in times past were provided by governments. It is essential, therefore, to not simply take these organizations for granted, but see them as foundations on which to build capacity to adapt to future challenges, climate-related or otherwise.

Opportunities for policy interventions

This study has found a significant number of opportunities for policy-makers at all levels of government to reduce or remove barriers and provide positive incentives to enhance future adaptive capacity in Addington Highlands. What is important to note is that the majority of these intervention opportunities are in areas not directly related to environment or climate policy. Rather, they fall squarely in the realm of shoring up physical infrastructure, promoting economic development and providing essential support for social well-being in the community. In other words, the key need is to address the underlying forces that erode the social and economic well-being of households so that they have the wherewithal to adapt autonomously to future climatic conditions.
Among institutions, the greatest stress related to climate change will fall on the township government. The trend towards an increased level of variability in the winter and shoulder seasons will put considerable pressure on road maintenance and repair budgets but at the same time make it difficult to project expenditures from one year to the next. Increased windiness, more frequent microbursts and icier winter conditions raise the potential for increased pressure on ambulance and volunteer firefighter services in coming years. Local government councils and managers will need to keep such possibilities in mind when allocating resources to current commitments and planning future investments and expenditures.

The local revenue streams for the township government are heavily dependent upon residential property taxes, especially seasonal waterfront residences. With no large employers in the area and none coming on the horizon, there is little likelihood of more than incremental growth in revenues in the absence of increased transfers from higher levels. There are consequently significant limits

on the possibilities for local government to proactively enhance adaptive capacity. The challenge is to find high-impact, low-cost ways of building the capacity of the community to cope with risks that are difficult to predict. As noted above, increasing scientific evidence suggests that communities with strong social organizations, networks and community trust (generally referred to as social capital) are better able to cope with unexpected shocks and stresses.

Addington Highlands is fortunate to already possess many strongly-supported social organizations, although there is still a need to ensure greater incorporation of new residents into such groups and build stronger social bridges between villages and hamlets. No opportunity should be missed to channel even small amounts of resources to such organizations, be it in terms of direct financial support, administrative support and assistance or by other means. Holding a periodic “summit” of local government officials and community social organizations to brainstorm new partnerships and ways of going forward could provide unexpected benefits and be relatively cost-effective to host.

A number of opportunities for enhancing adaptive capacity in the area are immediately available to the provincial government. Bon Echo Park needs to be seen by the provincial government as not simply a provincially-operated campground, but as an underutilized economic engine for the community. The park plays as significant an economic role in this community as a manufacturing plant plays in others. Opening the park to year-round use will help generate off-season tourism revenues for the community and improve relations between the park and the community, which are currently poor. The park boundaries exclude local residents from a provincially-significant natural heritage site, and park management is perceived by many local residents as having become indifferent to their interests and concerns about the use of the park. Additional spin-off revenues to local businesses from the park would be especially welcome during the winter season, when revenues from seasonal residents decline. In short, the business model that currently determines the park’s operations makes sense only in the narrowest of micro-scale cost-benefit calculations; when viewed in the broader context of enhancing adaptive capacity and sustainable development in a seasonal-economy community, the business model no longer makes sense.

In the 1990s, responsibility for maintenance and repair of municipal road infrastructure was offloaded from the provincial government to the local government without the transfer of revenue streams to do so. The result is that Addington Highlands has unwillingly inherited a large number of decrepit bridges which are in urgent need of repair. The main bridge in the village of Flinton has recently been closed to traffic, and a bridge on the main road to the community on Weslemkoon Lake is approaching that point. The cost for repairing the bridges is expected to exceed a million dollars; such costs represent a disproportionate financial burden for a small community and divert resources that could be spent on other critical areas of underinvestment. These are infrastructure investments that can not be avoided; the closure of these bridges

effectively cuts off local residents from the outside world. The township must therefore proceed with repairs and apply for funds from provincial funding agencies, a dynamic which creates considerable and unnecessary stress on small communities.

Inadequate access to both family medicine and emergency medical services is increasing the vulnerability of residents of Addington Highlands which, if allowed to continue, will cost lives. Residents are well aware that their inability to attract family doctors to the area is not unique, and that many Ontario communities big and small face similar challenges. Because that seems unlikely to change in the near future, the Ministry of Health must therefore work with the county to at a minimum ensure that residents have a reliable standard of emergency medical response as the community ages and climatic risks become increasingly present.

Virtually every business in Addington Highlands is individually- or family-operated, but in many fields these businesses are subject to the same regulations and reporting as large corporations. The overhead costs of complying with ever-increasing reporting requirements come directly out of those families' net incomes. For example, a family-owned timber-harvesting company must engage licensed foresters and undertake extensive pre- and post-cutting reports, yet the extent of their annual logging operations are *de facto* small in scale and could easily be directly monitored by the province for timber management and malfeasance prevention purposes at minimal expense. Instead, the province has essentially offloaded the costs of its own management responsibilities to operators in a way that favours large corporations and punishes family businesses. Similar arguments could be made for other fields.

One constant theme in discussions with residents is the lack of trust in higher levels of government, which are generally seen as indifferent to the needs of small communities and, in some cases, openly derided as being incompetent. One particular example is the role of MNR and its communications with the community, which have eroded in recent years. From the local community have emerged organizations that have the expertise and willingness to play a greater role in the conservation and management of fish and game resources, most notably the Conservationists of Frontenac-Addington (COFA) and the Trappers' Council. As just one example, COFA has developed its own hatching facilities and lake stocking program for pickerel, a key game fish for both local and tourist sport fishers. At present, the COFA facilities operate at a fraction of their potential capacity because of administrative barriers put in place by MNR that are not understood by COFA members or the community generally. MNR should be encouraged to exploit and formalize opportunities for greater co-management of fish stocking programs, which COFA is fully prepared to undertake, and remove administrative barriers.

Recreation and tourism will be the principal avenue for economic growth and development in Addington Highlands for the foreseeable future. Greater

provincial support for tourism promotion and tourism infrastructure in Addington Highlands is needed. A program that offers low-interest loans to family operators of tourist accommodations to enable them to invest in amenities and upgrade facilities should be considered. The umbrella organization that markets tourism in Addington Highlands and surrounding areas, Land O'Lakes Tourism Association (LOLTA), is a professional and active organization that currently operates on short-term grants and contributions that must be renewed every couple years. The inability to undertake longer-term plans and strategies, and to be continually obliged to develop proposals and requests for grants and grant renewals represent significant opportunity costs for this organization, which will be a key player in the area's future economic development.

One particularly notable missed opportunity relates to the absence of alternative energy development in Addington Highlands. Given the high costs of energy and frequent failure of the grid in parts of the area, many residents of would install alternative residential energy systems were the capital costs not so prohibitive. The increased windiness of the area represents an energy source that is presently going unexploited except by a few early adopters of household wind turbines. The potential is such that a large test turbine has been installed in the northwestern part of Addington Highlands by a private company exploring potential sites for corporate wind faming. The good condition of area forests suggests a reasonable potential for bio-energy production. Local efforts are under way, with Mazinaw-Lanark Forestry participation, to assess the viability and potential. Existing provincial and federal alternative energy programs do not reach most Addington Highlands households, and consideration should be given to promoting residential programs. The province and federal government should also take advantage of increased windiness and bio-energy potential by providing meaningful seed money to assist local commercial producers of alternative energy.

It has not gone unnoticed by residents that the federal government actively subsidizes by billions of dollars annually exploration and development of oil and gas reserves in Canada and in developing the nuclear industry. Incentives of similar proportion to encourage the development of wind farming would accelerate the implementation of this technology, providing clean and durable sources of energy, create job opportunities in areas like Addington Highlands and help reduce Canadian greenhouse gas emissions.

The unresolved claim of the Algonquin first nation to lands in the Mississippi River watershed represents and ongoing hurdle to future development of the area, and is one which requires cooperation of the provincial and federal government. The development of Crown land in northern and eastern Addington Highlands is essentially on hold indefinitely until the claim is resolved. Ultimate responsibility for land claims rests squarely with the Federal Department of Indian and Northern Affairs. At present, little action is being taken toward settling this claim. This is an important matter of equity and providing a stable economic

and social future for aboriginal and non-native residents of the area alike. For example, many potentially suitable sites for wind energy installations that have been identified by an energy consultant were found to be located on Crown land within the land claim, and so further investigation has not been pursued.

The regulation of telephone and cellular communications is the responsibility of the Canadian Radio-television and Telecommunications Commission. At present, telephone and cellphone services in Canada are controlled by a small oligopoly of highly profitable corporations, each of whose 2007 profits from wireless communications total in the billions of dollars. The federal Minister of Industry has the authority to give policy direction to CRTC and introduce new regulations covering the provision of cellphone services in Canada. The Department of Industry should consider issuing policy direction requiring cellphone companies to provide service along all main provincial highways in Canada as a matter of public safety and security. Should the cellphone industry be unwilling to comply voluntarily, regulation should be implemented. A similar policy direction should be considered for the provision of broadband internet service, so that all Canadians who so desire will have access to broadband within the next five years, regardless of the community in which they live, so long as a fixed telephone line/and or cable television line is present.

Recent developments in technology allow small weather data-collection equipment to be installed at virtually any physical location in Canada, no matter how remote, at very reasonable costs. Environment Canada should be taking a lead role in installing such equipment in areas such as Addington Highlands where no automated data is being collected locally and made available to residents. Given the climatic trends being observed in the area, the absence of access to reliable weather forecasts is increasingly becoming a matter of public safety.

SECTION 3: GENERAL LESSONS ABOUT ADAPTATION; FUTURE RESEARCH NEEDS

Over several generations, residents of Addington Highlands developed an impressive capacity to adapt to the inevitable stresses, environmental or otherwise, that accompany a life on the geographic and socio-economic margins of Canadian society. In this and many other respects, their experience has not been unique – similar development trajectories took place in rural communities in every province and territory. The economic and social activities of rural Canadians, particularly those residing in seasonal economy communities, are often tied closely to a mixture of land-based harvesting, resource extraction, and outdoor recreation. Consequently, residents of such areas develop high levels of environmental knowledge and individual self-sufficiency, essential skills given how sensitive their livelihoods are to changes in environmental and climatic conditions. Through this project, a number of general lessons were learned about how to maintain and enhance adaptive capacity in these types of communities.

Climate change is only one component of a suite of risks, challenges and opportunities faced by seasonal economy communities. The capacity of residents to adapt to climate-related stresses is susceptible to erosion by non-climatic stresses that are in turn the product of demographic, economic, political and/or social change. Societal and cultural preferences drive some of these erosional changes (e.g. the desire to retire to the cottage; the unwillingness of young people to live in areas without broadband access), others may be unintended outcomes of institutional decision- and policy-making (e.g. forestry regulation; provincial park policy). Still others are driven by global-scale, macroeconomic forces (e.g. currency exchange rates; energy prices). One challenge for Canadian policy makers at all levels of government is to assess more holistically the impacts of regulations, policies and programs on the general adaptive capacity of the communities affected by them.

It is plainly evident that the maintenance and enhancement of social capital in smaller communities will be critical in ensuring their capacity to adapt to future climatic stresses. If there is one simple finding of this project, it has been that socially strong communities (or groups within communities) can and do adapt to a wide range of climatic stresses. However, adaptive capacity can be highly variable between social groups within communities, and within social groups themselves. This means that expanding future adaptive capacity involves not only expanding the overall availability and functioning of social capital and the social networks along which it is transmitted, but also promoting the integration of social networks between social groups within communities. To this end, government policymakers should modify the language of public engagement on questions of adaptation from “stakeholders” to “partners”, and cultivate non-governmental organizations within communities as partners in delivering goods and services. Government policy-makers must also recognize that continued underinvestment in social infrastructure in non-urbanized areas is a key factor in the erosion of adaptive capacity, and that failing to reverse that trend will lead to declining well-being in seasonal economies, to increasing gaps between haves and have-nots between and within communities, and to a generally heightened degree of vulnerability.

Finally, it became very clear in this project that there is an important lack in local- and regional-scale information about climate change. Canadians living in seasonal-economy communities are well-informed about the general warnings about global warming, and they have a better latent knowledge about human-environment relationships than do the majority of Canadians who live in urban and suburban areas. The problem is that there is a clear disjoint in scale between their traditional environmental knowledge and the model-based projections coming out of climate change research. For example, when 50% of a municipality’s budget is spent on road maintenance and repair, the type of future climate projections needed by local planners is how much snow (not just precipitation) their particular region is likely to receive in coming years, how much

variability there will be in temperatures, and how often they will encounter rapid freeze-thaw cycles that cause materials and structures to break down. At present, such fine detail is difficult to achieve, and is further compounded by the lack of current weather forecasting and record-keeping. As this project has shown, it is still possible to assess adaptive capacity on the basis of existing knowledge about climate change, but the continued pursuit of better scientific knowledge of climatic processes will continue to be essential. One immediate step forward would therefore be to expand the network of local weather station coverage across Canada.

This project has established a baseline understanding of adaptation processes in seasonal-economy communities. While it represents a significant step forward, there remain a considerable number of avenues to be explored. There are future opportunities for comparative research across communities and regions, for even though a goal has been to search out lessons transferable to a broad range of communities, given its focus on one particular region this study may well have failed to consider factors and stressors that are pressing in other regions but are less of a factor in Addington Highlands. The institutional context in which Addington Highlands is situated will have both communalities and significant differences from that of communities in other provinces, which may well create variability in adaptive capacity between communities that are otherwise socially and economically similar.

It was not within the parameters of this project to undertake an economic costing of current adaptation practices and future options in the study area. The Stern Report on Climate Change (Stern 2007) demonstrated the power of communicating climate change impacts, risks and adaptation and mitigation options in monetary terms. While not all factors in adaptation easily lend themselves to monetization (e.g. social capital is notoriously difficult to monetize (Wall et al. 1998)), the process of attempting to do so could help reveal in relative terms the potential outcomes of the various future paths communities like Addington Highlands might take to pursue greater adaptive capacity. Yet another potential avenue is to look at the linkages between adaptation and mitigation. Many of the suggested adaptations that came to light during this study – such as getting residential buildings off the grid, exploring biomass opportunities in forestry, de-emphasizing snowmobiling in favour of other winter tourism options – are also linked to greenhouse gas emissions mitigation, and represent possible win-win outcomes. A more targeted and systematic attempt to reveal more adaptation-mitigation linkages in seasonal economy communities could prove very fruitful, particularly given the access to water bodies, wetlands and forests such communities typically have. There may well be other potential opportunities for future research in areas in small communities related to perceptions of climatic risks, analyses of institutional capacities, building public-private partnerships to enhance adaptive capacity, health risks and opportunities, and other directions suggested in the project's findings. In conclusion, this report

should be received as a starting point for future analyses of adaptation processes and potentials in Canada's seasonal economy communities.

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