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Responding to Change in a Northern Aboriginal Community (Fort Resolution, NWT, Canada): Linking Social and Ecological Perspectives

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RESPONDING TO CHANGE IN A NORTHERN ABORIGINAL COMMUNITY (FORT RESOLUTION, NWT, CANADA): LINKING SOCIAL AND ECOLOGICAL PERSPECTIVES

by

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ABSTRACT

Human and environmental systems in the circumpolar north are particularly affected by the Earth's changing climate, thus acting as a bellwether for other parts of the globe. Rural indigenous communities are most visibly impacted due to their close relationship with the land. These challenges are compounded by socio-economic transformations typical of peripheral communities within a larger, centrally governed system.

This dissertation links a community-based study of environmental change in Fort Resolution, Northwest Territories, Canada to evolving adaptation science. The study was prompted by local concern about changing environmental conditions caused by climatic, hydrological and resource development drivers. Its collaborative research approach incorporated a combination of participatory methods (e.g. semi-structured interviews, a household questionnaire, focus groups, and experiential excursions on the land) during ten months spent in the field between 2004 and 2008. This methodology provides a basis for including traditional knowledge in a detailed assessment of environmental change, evaluating both individual and collective adaptive capacity, and analyzing contextualized information that may be used to forecast future conditions.

The study draws on elders' and harvesters' knowledge to address the primary relationships among changing environmental conditions, impacts on human livelihoods, and past and current adaptation strategies. Residents, who have shown significant

resilience through past adaptations, are dealing with multiple and cumulative pressures. Adaptive capacity is strongly influenced by social dynamics at the local scale, as shown through an analysis of trust, reciprocity and sharing, social values and collective action, group participation levels, and regional relationships. Our evolving understanding of the social-environmental context in Fort Resolution provides a basis for further progress in adaptation planning. Key areas of individual and collective vulnerability to potential climate- and resource development-driven changes are identified, and a range of adaptation options are examined. While residents feel more able to adapt to climate-driven changes, the types of response strategies they propose under different scenarios show significant overlap.

Environmental change affects people through multiple pathways; as well, groups are differentially impacted depending on their social and economic circumstances. Dealing with rapid, non-linear change requires a collective response. Actors and institutions play important roles in building adaptive capacity and supporting adaptation within a context of transition and uncertainty. While endogenous determinants of adaptive capacity (knowledge and skills, access to resources and technology, institutional support, social networks and equity) are vital, important exogenous influences (government support programs, regional economic development, aboriginal-aboriginal and aboriginal-state relations, emerging self-governance arrangements) also influence outcomes. Each community is a complex system (within a nested hierarchy of systems) where different drivers act at multiple levels; however, to be effective, capacity-building and adaptation must be grounded in the local context.

Study findings contribute to the growing literatures on both community vulnerability and environmental change impacts and adaptations in the north. They provide a better understanding of the nature of social dynamics and their influence on adaptive capacity at local levels, with particular relevance to rural aboriginal communities. The emergent themes emphasize resilience and adaptation, and have implications for environmental change research and policy-development. Primary contributions include theoretical advancements regarding social capital, traditional knowledge, and the relationship between local-scale social dynamics and adaptive capacity in rural aboriginal communities; methodological advancements relating to the mixed methods approach and application of qualitative scenarios; and practical outcomes including an improved understanding of the applicability of adaptation options, and the identification of challenges and opportunities for both multi-level governance and capacity-building for adaptation.

This dissertation offers practical recommendations for actions at the local level and for policy at multiple levels in a number of areas, including environmental quality, visioning, adaptation planning, and governance. This study adds to our knowledge of community-based adaptation research and offers leads for developing more effective strategies to support rural, northern aboriginal communities as they face changing social-ecological conditions.

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LIST OF ACRONYMS

AAROM: Aboriginal Aquatic Resources and Ocean Management

ANCAP: Aboriginal and Northern Community Action Program

ATG: Akaitcho Territory Government

ATV: All-Terrain Vehicle

C-CIARN North: Climate Change Impacts and Adaptation Network North

DCC: Deninoo Community Council

DFN: Dene First Nations

DKFN: Deninu Kue First Nation

DKLRMP: Deninu Kue Land and Resources Management Plan

FREWC: Fort Resolution Environmental Working Committee

GNWT: Government of the Northwest Territories

GPS: Global Positioning System

HBC: Hudson Bay Company

IBA: Impact Benefit Agreement

IMA: Interim Measures Agreement

INAC: Department of Indian and Northern Affairs Canada

MRB: Mackenzie River Basin

NGO: Non-Governmental Organization

NWC: North West Company

NWT: Northwest Territories

NWTMN: Northwest Territory Métis Nation

PAD: Peace-Athabasca Delta

RCMP: Royal Canadian Mounted Police

SK: (Western) Scientific Knowledge

SRD: Slave River Delta

TK: Traditional Knowledge

UNFCCC: United Nations Framework Convention on Climate Change

UV: Ultraviolet

CHAPTER 1:INTRODUCTION

Human and environmental systems in the circumpolar north[1] are particularly affected by the Earth's changing climate. The region acts as a bellwether for societies in other parts of the globe (ACIA, 2005), which are generally subject to more gradual change. Responding to these environmental challenges is compounded by socio-economic transformations typical of peripheral communities within a larger, centrally governed system.

Northern environments have historically reflected both vulnerability and resilience. Change has been a constant, and human inhabitants have had to adapt accordingly for millennia. However, current and projected trends of variability and change in environmental systems, due in large part to human-induced climate change and resource development, are in many cases beyond the scope of historically documented extremes (Cohen, 1997b; McDonald et al., 1997; Riedlinger, 1999; Gill et al., 2001; McCarthy et al., 2001; Fox, 2002; Jolly et al., 2002; Krupnik & Jolly, 2002; ACIA, 2004). Considerable uncertainty still exists regarding both the pace and degree of change (Riedlinger & Berkes, 2001) and how regional impacts will be variably distributed (Cohen, 1997b).

[1] The circumpolar north is defined by a combination of physical and human characteristics. These include a cold, fragile environment with low diversity and productivity; remote, vast wilderness; sparse human populations, often with a significant Aboriginal component; combined subsistence and resource economies; and a high cost of living. In Canada, the north is generally defined as including the three territories, as well as the northernmost parts of most provinces (AHDR, 2004; Bone, 2009).

This raises the question of whether and how social and ecological systems will be able to cope. Aboriginal populations that rely on northern environmental resources may be disproportionately affected, as changes occurring in socio-cultural systems compound environmental impacts. Although these populations have time-tested abilities to learn adaptively and to craft effective survival strategies in the face of constantly shifting and sometimes harsh conditions (Batterbury & Forsyth, 1999; Berkes & Jolly, 2001; Riedlinger & Berkes, 2001; Fox, 2002), the coping mechanisms inherent in these socio-cultural systems may be eroded by escalating rates of change (Krupnik & Jolly, 2002; ACIA, 2004).

Significant work has been done at national and international scales to better understand how climate is changing, the resultant impacts on biophysical and socio-economic systems, and the ability of humans to mitigate and adapt (IPCC, 1995, 2001a, 2001b; ACIA, 2004, 2005; IPCC, 2007a, 2007b; Lemmen et al., 2008; WWF, 2008). However, the nature of these aggregate analyses tends to obscure critical impacts and vulnerabilities at the local scale. In Canada, rural resource-dependant communities, including aboriginal communities with significant reliance on the subsistence economy, are often particularly vulnerable. This is due in part to elevated sensitivity of land-based sectors to climate change, and elements that constrain adaptation (e.g. limited economic diversification, low resource availability for adaptation, restricted access to services, and in some cases an aging population; Warren & Egginton, 2008).

Recent scientific focus on climate change impacts in northern regions, both actual and predicted, is complemented by work to further understand the human dimensions of vulnerability and the adaptation process (Klein & Smith, 2003; Lemmen & Warren, 2004), to develop strategies to build adaptive capacity, and to identify policy directions that build community resilience to deal with change (Berkes et al., 2003b; Berkes et al., 2005b). This research intends to improve understandings of both environmental conditions and human capacity to adapt to stresses to inform policies and programs being developed in anticipation of future changes.

This study links adaptation science with a traditional knowledge (TK) study of environmental change through a community case study in Canada's Northwest Territories. An analysis of both historical and current changes and adaptations (as captured by traditional and other local knowledge), offers a holistic understanding of the community's adaptive capacity and social context, while concurrently creating a TK database through documentation. A complementary analysis of existing social capital provides further insight into community structure and function in the modern context, while highlighting both potential constraints and opportunities for building adaptive capacity to deal with future change. The research methodology provides a basis for including TK in a detailed assessment of environmental change, for evaluating both individual and collective adaptive capacity, and for analyzing contextualized information, which may be used to forecast future conditions.

A main motivation for this research was the potential for identifying and analysing evidence of change and adaptive capacity to benefit the local community. In this case, the Fort Resolution Environmental Working Committee (FREWC) requested a TK study focused on environmental change to complement ongoing hydroecological studies being carried out in the Slave River Delta (SRD; see Figure 1.2; Wolfe et al., 2007). This research has responded to that need, while providing opportunities for capacity development in the community. Fieldwork was undertaken in collaboration with the Deninu Kue First Nation (DKFN) in Fort Resolution, a Chipewyan Dene and Métis community of approximately 485 people located on the south shore of Great Slave Lake, Northwest Territories.

1.1 Project Goal, Objectives and Research Questions

The overall goal of this research is to examine relationships among environmental change, impacts and adaptations in a complex social-ecological environment undergoing rapid change. I focus in large part on stakeholder knowledge, perceptions and actions related to environmental change and adaptation at the local level, and draw on this understanding to determine implications for theory and practice. Specific objectives and research questions are outlined below.

Objective 1: Understand the relationships among change, impacts and adaptations in a hydrological and climatic change context.

- Question 1.1: What are the valued components and relationships within the ecosystem?

- Question 1.2: What historical and current trends are these components and relationships showing?

Objective 2: Examine the capacity of the local community to adapt to change.

- Question 2.1: How have local residents adapted to past changes?
- Question 2.2: How do social dimensions at the community scale influence adaptive capacity?
- Question 2.3: What are the dominant determinants of adaptive capacity at household and community levels?

Objective 3: Identify how understandings of adaptive capacity help in planning for environmental change.

- Question 3.1: What are the primary adaptation options and barriers?
- Question 3.2: Which opportunities exist to build adaptive capacity and encourage adaptation within a changing multi-level governance context?

1.2 Case Study Site

This study was undertaken with the intention of gathering detailed information at the local level. Fieldwork was concentrated with residents of the small, mostly aboriginal settlement of Fort Resolution, henceforth referred to as a *community*[2]. This study is

[2] Community can be defined in a number of ways, with a main distinction in the literature being between communities of purpose and of place. The term *community* is often used to indicate a localized human system, and in this context I refer to a "small group of people who share a common place of residence and a set of institutions based on this fact" (Chopra et al., 2005).

centred on a definition of community as one of both identity and place. In geographical terms, it encompasses the political unit of the settlement, but includes all inhabitants, whether band members or non-band members. Members living outside of the settlement are considered part of the community through connections with in-settlement community members (Mignone & O'Neil, 2005).

Of the approximately 485 residents in Fort Resolution, over 90% are aboriginal (Statistics Canada, 2007a). Whether Dene or Métis, most residents have knowledge about, and strong inter-generational ties to, the surrounding traditional land-use area. This land area was initially informally demarcated based on historical land use, and is now more formally referred to as DKFN traditional territory, which forms a part of the Akaitcho Territory land claim[3]. In the context of this study the traditional territory of Fort Resolution residents will be called 'DKFN territory' or 'traditional territory', although it also refers to land used by the Métis. 'Akaitcho Territory' will be used when referring to the entire proposed land claim area (which encompasses the traditional territory of four First Nations).

DKFN traditional territory is located along the south shore of Great Slave Lake, making up the south-western portion of Akaitcho Territory (Figure 1.1). It encompasses three river systems – Little Buffalo River, Slave River and Taltson River – which act as primary land use nodes for Fort Resolution residents. The Fort Resolution settlement is

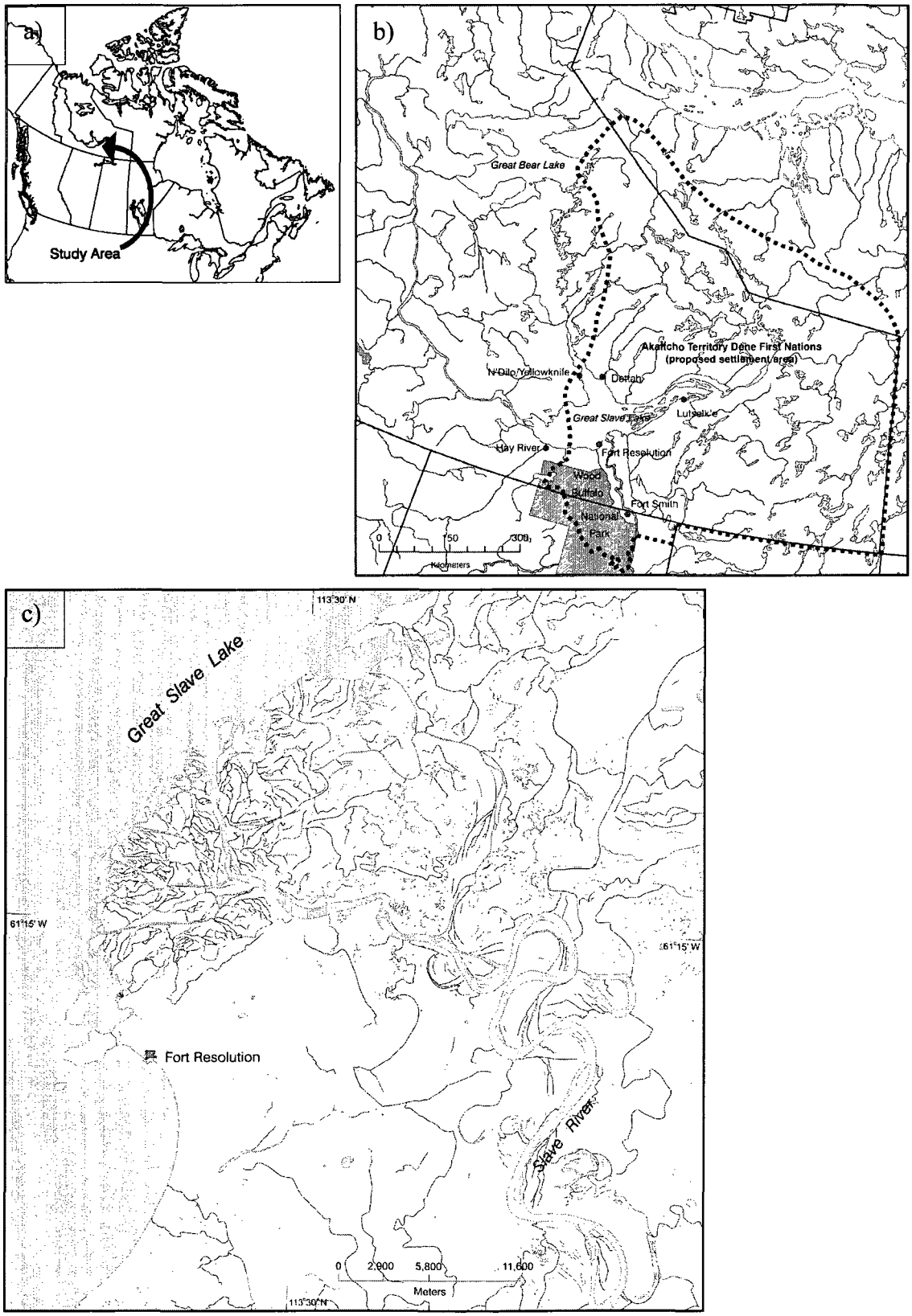
[3] The Dene First Nations distinguish between the Treaty of 1900 and Treaty 8. The former refers to the oral understanding of the treaty, which includes substantially more territory than the written Treaty 8 document. This study makes reference to the oral definition (Figure 1.1).

located ten kilometres west of the SRD, the central ecological support system for the community.

The SRD (61°15'N, 113°30'W) is the smallest of the three major Mackenzie River Basin (MRB) deltas – Peace-Athabasca, Slave River and Mackenzie. It covers an area of approximately 640 square kilometres of braided river channels and alluvial deposits where the river empties into Great Slave Lake from the south. The Slave River is an important basin feature, providing 74% of inflow for Great Slave Lake (Gibson et al., 2006a). The delta is fluvially dominated and arcuate in shape, its riverine deposits causing it to prograde into the southern portion of the lake (English et al., 1997; Gardner et al., 2006).

The SRD is a complex and dynamic ecosystem characterized by periodic flood events, numerous vegetation and habitat types, and significant biological diversity. It provides critical habitat for fish, muskrat (English, 1984) and other wildlife, such as moose, beaver, lynx, mink and marten. The larger area, including the SRD and south shore of Great Slave Lake to its east, has been designated an Important Bird Area that supports tens of thousands of migrating waterfowl, including many swans, geese and ducks (IBA Canada, 2004).

Figure 1.1: (a) The case study area, (b) Traditional territory of the Akaitcho Dene (Treaty of 1900 land), (c) The Slave River Delta and community of Fort Resolution



Like other large fresh-water deltas in northern Canada, the SRD is naturally changing and evolving. It is also highly sensitive to climate change and human-induced changes such as upstream impoundment (Prowse et al., 2002; Prowse et al., 2006) and consumptive water use (Brock et al., In review), which influence ecosystem dynamics and, by extension, local resource activities. The delta's habitat diversity and wildlife resources are of central importance to the subsistence livelihood strategies and socio-cultural integrity of community members in Fort Resolution, who use the area for hunting, trapping, fishing, transport, and recreation (Hoare, 1995).

For residents in Fort Resolution, ongoing changes in the socio-cultural system also play an important role in influencing land and resource use patterns, and the ability to adapt to change. As in other northern contexts (Duerden, 2004), lifestyles in the community have become more sedentary, globalization pressures have increased (e.g. western media and merchandise, access to drugs and alcohol, declines in local resource industry viability), western education systems have become the norm, demographics have shifted, and traditional land-based activities have decreased, all virtually within a generation. These changes have prompted shifts in community structure.

Since most surviving Dene and Métis have lived the greater part of their lives in permanent settlements rather than on the land, a significant amount of traditional skills and related knowledge are not being transferred to the younger generations, resulting in an overall reduction in both the range of land-based activities and number of current land users. For example, rather than camping out on the land for extended periods during

specific seasons, it is now common for land-users to take day-trips for hunting, trapping or fishing, thus concentrating resource-use in areas closer to town. Social change has also been driven by fluctuations in individual access to the market economy during the past decades. Declines in the viability of the fur trade, combined with past eras of abundant alternate employment in the resource sector (e.g. mining, forestry, and the commercial fishery) have reduced reliance on local natural resources for food and economic well-being for large segments of the population. Regardless of these changes, resource harvesting activities are still important to social and cultural systems in Fort Resolution.

The location and population of focus in this research provide a unique combination of conditions. At a local scale, the people and environment around the SRD may not be experiencing climate change impacts as extreme as Inuit communities in the high Arctic, however the relative effects for residents of Fort Resolution will be significantly higher than those in southern Canadian regions. Furthermore, the community is dealing with an elevated number of other stressors stemming from increased influence from the south (e.g. road access, dam development, contaminants, etc.), which affect the capacity of both individuals and the community to cope with change.

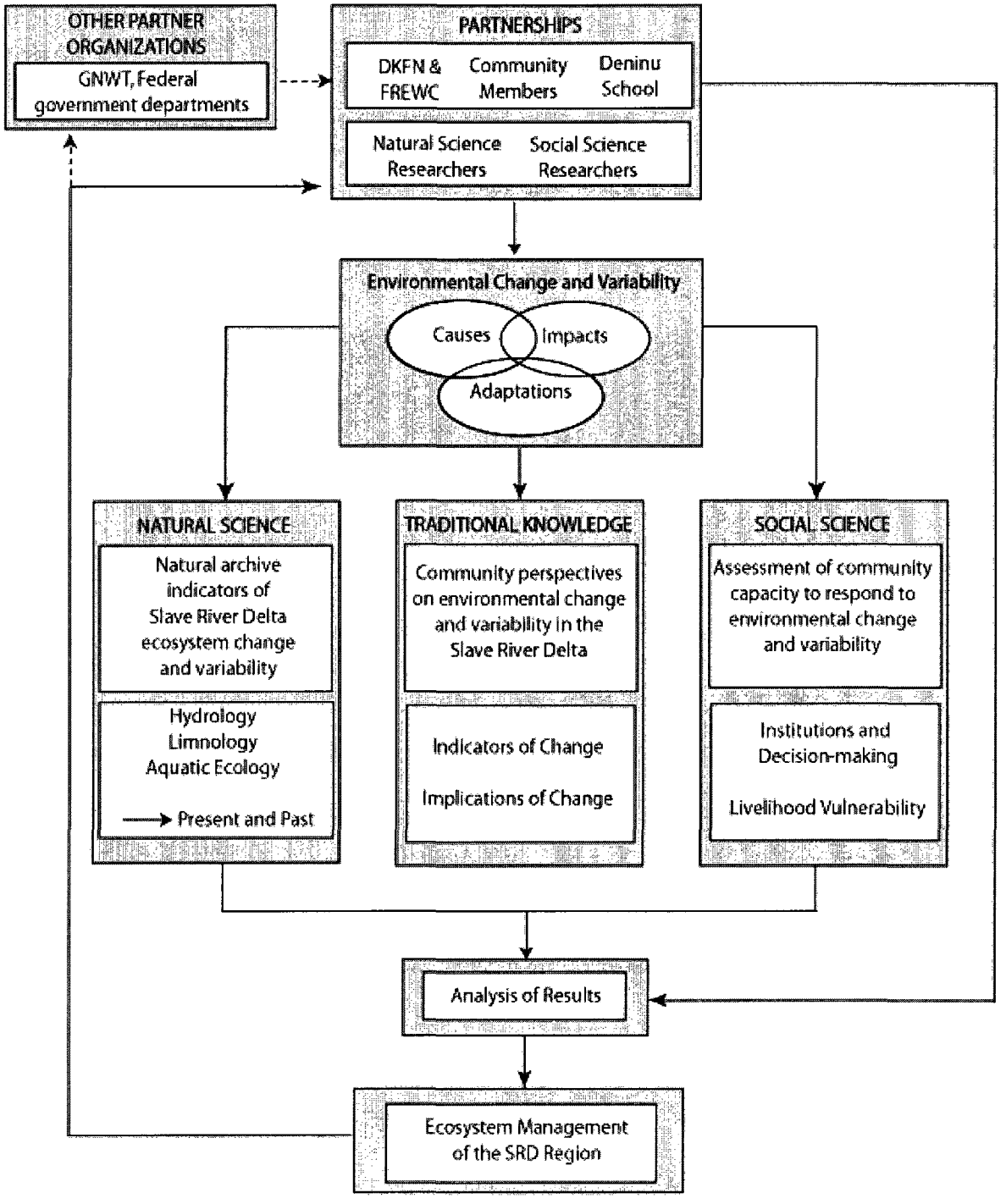
The current political climate is also in flux. Both Dene and Métis groups are involved in government negotiations for rights, and in the former case, treaty implementation. The future framework for governance over the surrounding traditional territory and its resources continues to evolve through the Akaitcho Treaty 8 negotiations

(NWT Treaty 8 Tribal Corporation, 2006), providing opportunities for incorporating adaptive measures into the nascent local integrated management process to improve environmental planning and increase resilience to change.

1.3 Environmental Change Research

Interdisciplinary environmental change research in the SRD evolved as a natural extension of similar work being undertaken in the Peace-Athabasca Delta (PAD). Local concerns about the influence of various stressors – river regulation (particularly the W.A.C. Bennett dam on the Peace River in Northern B.C.), climatic variability, and upstream industrial development – stimulated the SRD research initiative, which has been ongoing since 2002. The initiative involves a study of various facets of environmental change and variability through three primary lenses: natural science, traditional knowledge and social science (Figure 1.2; Wolfe et al., 2007).

Figure 1.2: Process-oriented framework of the interdisciplinary environmental change research initiative in Fort Resolution and the Slave River Delta, NWT (from Wolfe et al., 2007)



The human dimensions study detailed in this dissertation was developed in response to requests by members of the Fort Resolution Environmental Working Committee (FREWC) that human perspectives be studied in conjunction with biophysical parameters to provide a holistic perspective on environmental change and its relationship to local livelihoods[4]. This research draws primarily on TK and social science perspectives to better understand the perceived causes of environmental change, specific impacts on Fort Resolution residents, and the implications for adaptation. While some natural science elements are incorporated into this study (Section 3.4), further integration of both natural science and human dimensions components is beyond the scope of this dissertation, and will be explored elsewhere (e.g. Brock et al., In review).

1.4 Dissertation Structure

This dissertation is organized in a structure that explicitly uses information from different data sets to address specific research questions. Each results-based chapter (Chapters 4-6) draws primarily from a unique set of data (e.g. interviews, questionnaire, scenario-based focus groups and workshop), while information from other data sets (e.g. literature review, participant observation) and chapters is used as supporting evidence. In this way, each results-based chapter is fairly self-contained, with a focus on addressing a specific research objective. However, the supporting data provides a thread of continuity that links these sections together.

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[4] While the term 'livelihood' is generally defined as the means of sustenance or subsistence, I am using it in a broader context that relates to a more holistic concept of well-being. Here, livelihoods include the structures and processes that allow individuals and households to sustain themselves physically as well as socially, emotionally, mentally and spiritually.

The results-based chapters are arranged chronologically, both in terms of the temporal framework that is encompassed within this research (historical, contemporary and future), and in terms of the sequence in which the data were collected (methods used in later stages were informed by preliminary data). As such, the context for each chapter is defined in part by those that come before it. Furthermore, the structure creates a logical progression towards the overarching objective of improving adaptive capacity in small, northern, First Nations communities.

The body of this dissertation begins with a literature review of relevant themes and theoretical underpinnings for this study (Chapter 2). Chapter 3 describes the methodological approach used, outlines the various data collection activities, and briefly summarizes data analysis procedures. The following three sections are based on empirical study results. Chapter 4 provides an examination of past socio-environmental change and the resulting impacts on local livelihoods in Fort Resolution. A discussion about past adaptations provides the context for the subsequent section (Chapter 5), which focuses on the range of social relationships and institutions that influence opportunities for adaptation in a complex and evolving social-environmental context. Chapter 6 examines current and future challenges and risks associated with two major drivers of change, climate and resource development, and outlines a number of adaptation strategies to prepare for possible future scenarios. Drawing on the three results-based chapters, Chapter 7 synthesizes main themes and discusses their relevance for research and policy-development on environmental change, with specific focus on resilience and adaptation.

Chapter 8 summarizes the main findings, proposes directions for future research, and offers recommendations for improving adaptation planning, action and research.

CHAPTER 2: LITERATURE REVIEW

This chapter provides a concise overview of the foundational knowledge that informs this study. The first section provides contextual information on the types and nature of environmental change being experienced in the north, and the resulting human impacts. It also discusses the increasing involvement of indigenous stakeholders in research endeavours, and the importance and application of TK. The second section focuses on the theoretical concepts that underpin this research. They include social-ecological systems, resilience, vulnerability, adaptation and adaptive capacity.

2.1 Environmental Change and Impacts in the North

Environmental systems are constantly undergoing inherent processes of change, and indigenous communities that derive subsistence from them have had to adapt accordingly over many generations. However, this capacity may be threatened in the face of increased intensity and variability in climatic and other environmental conditions, due in part to anthropogenic influences. This section introduces the multiple dimensions of environmental change at play in northern regions and the impacts on human (mostly indigenous) societies. Researchers in this field are increasingly recognizing the importance of partnering with indigenous people and drawing on their detailed and long-standing knowledge of the environment around them to achieve more holistic and realistic understandings of social-ecological dynamics in these systems. This section provides some background on the issue of indigenous participation in research, which is

further discussed in Chapter 3. The concept of TK is introduced and its utility and application is discussed in the context of community-level northern environmental change research.

2.1.1 Environmental change

The global climate is now widely recognized to be changing in part due to anthropogenic influences (Houghton et al., 2001; IPCC, 2007b). The north is experiencing these changes at a far greater rate than other regions around the globe (ACIA, 2004, 2005) and is particularly susceptible to the resulting impacts due to the fragility of its ecosystems (Bone, 2009). In this way the north acts as an early warning system for the rest of the planet. As climate change[5] has gained currency over the past decade, a series of major reports has been commissioned to synthesize known information about its extent, potency and likely future reach, and to determine strategies to limit negative impacts. Entire reports or substantial components thereof have focused on northern regions (e.g. ACIA, 2004; AHDR, 2004; ACIA, 2005; Chapin III et al., 2005; Anisimov et al., 2007; IPCC, 2007a; Furgal & Prowse, 2008; WWF, 2008), all of which indicate that ecosystem services (environmental processes that produce resources on which humans depend; e.g. water purification, pollination, etc.) and human well-being in the north are being affected (Chapin III et al., 2005).

[5] Following IPCC usage of the term, *climate change* in this dissertation refers to both variability and change in climate over time, whether natural or anthropogenic in nature, or any combination thereof.

As a region, Canada's north has experienced considerable changes in climatic conditions over the past half century. Particularly notable are increases in both temperature and precipitation, and both trends are projected to continue into the future. These changes have significant impacts on the physical environment, particularly the cryosphere (snow, glaciers, permafrost, and river/lake/sea ice), and on biological systems (ACIA, 2004, 2005; Furgal & Prowse, 2008).

Scenario models of Arctic regions project continued average warming of approximately 3-5°C over land and 7°C over water during the next century, with even more pronounced increases in winter temperatures (ACIA, 2004, 2005). Impacts on the physical system include decreases in snow and ice cover, shorter and warmer winters, permafrost degradation, and melting of glaciers and sea ice. Associated biological effects include shifts in foraging, migration patterns and habitat range of animal species (e.g. polar bears, caribou, migratory birds); altered vegetation patterns (e.g. changing composition, ecozone boundary shifts); changes in the intensity and distribution of disturbances such as forest fires and insect pests (e.g. increased proliferation; ACIA, 2004, 2005; Furgal & Prowse, 2008); and the spread of contaminants (Cohen, 1997c; Indian and Northern Affairs Canada, 2003a; Macdonald et al., 2005). Such shifts may occur gradually or rapidly, and trends are not necessarily linear. Additionally, the natural variability associated with environmental cycles may be disrupted, potentially changing the intensity of change in unpredictable ways and registering new extremes.

Biophysical change in the Arctic is not solely climate related. The cumulative pressures of other stresses such as ozone depletion, overfishing, resource extraction, hydroelectric dam development, growing human populations, and an influx of long-range pollutants cause contamination, habitat alteration and other pressures on land and resources (ACIA, 2004, 2005). Any combination of these environmental outcomes and climatic changes are collectively referred to in this dissertation as *environmental change.*

Furthermore, there are changes occurring in the socio-economic system, some of which are directly linked to changing environmental conditions. The north acts as a resource hinterland that is now locked into a globalized economy. The northern economy continues to be based largely on natural resources, having transformed from one that is primarily subsistence-based to a mixed economy that includes mining, oil and gas development, and tourism. Government services and the military also play a significant role (ACIA, 2004, 2005; Bone, 2009).

After an initial boom between World War II and the 1970s, Canada's north is again experiencing major resource exploitation largely driven by mega-projects (Bone, 2009) such as the Diavik diamond mine (NWT), Voisey's Bay ore mine (Labrador), the James Bay hydro-electric project (Quebec), and the anticipated Mackenzie Gas Project (NWT; Furgal & Prowse, 2008). Aside from hydro-electric projects which physically alter the character of river basins at a regional scale, most resource project impacts tend to be highly localized. Regardless, impacts are especially damaging to northern ecosystems due to a) the impacts of activities and effluents on permafrost, b) the

extended time needed for biological rehabilitation in colder regions, and c) the northward transport of industrial pollutants due to global atmospheric and oceanic currents (Bone, 2009). Further work is required to address the combined environmental effect of a series of resource projects as well as the cumulative impacts of industrial development and climate change.

2.1.2 Human impacts

The strong link between the biophysical environment and aboriginal socio-economic systems and culture continues to persist in the north. The effects of climate change on physical and biological systems pose particular challenges (as well as some opportunities) for aboriginal people who continue to rely on the land and water for food, to support their local economy, and as a basis for social and cultural identity. As an overarching concept, these pressures can be seen, at the local level, to impact northern livelihoods. The *livelihood* concept refers to the assets (natural, physical, human, financial and social capital) and the activities that are necessary for maintaining a means of living, as well as the access to these elements. A livelihood is sustainable when it supports continued well-being of a person or household over time through the maintenance or enhancement of these elements (Chambers & Conway, 1991; Allison & Ellis, 2001).

Many indigenous households and communities continue to rely on traditional food harvested from the land (Paci et al., 2004; Kuhnlein & Receveur, 2007). Climate

change-induced impacts on the health and availability of, and human access to particular wildlife and plant species, and concerns about weather predictability and travel safety pose severe challenges to the quality of human health and well-being (AHDR, 2004; Chapin III et al., 2005; Furgal & Prowse, 2008). This is amplified by the potential spread of infectious diseases through shifting animal populations, and increases in other health-related problems like cancer (due to increased ultraviolet and/or contaminant exposure; ACIA, 2004, 2005).

Climate change is also having major impacts on northern infrastructure and transport. Shorter, warmer winters and permafrost thaw are increasingly disrupting land-based transportation and industrial operations by destabilizing roads and buildings and limiting the seasonal duration of ice road transport. Coastal towns and industrial facilities are also experiencing erosion due to sea level rise, and are in some cases forced to relocate. Furthermore, declining sea ice extent and duration will allow access to new transport routes and seabed resources, with associated risks to environmental quality (e.g. oil spills; ACIA, 2004, 2005; Furgal & Prowse, 2008).

Other impacts are being felt in the socio-economic sector. While northerners now rely on resource development to feed their economy, they have relatively limited control over projects that are run mostly by international companies or Crown corporations. Furthermore, residents are susceptible to the economic 'boom-and-bust' cycles associated with limited project lifespans in remote, single-industry towns, as investments are short-lived and most profit flows southward (Chapin III et al., 2004; Bone, 2009). Past projects

have left legacies of often irreversible environmental damage, social upheaval, and human health problems (Kuyek & Coumans, 2003; Bone, 2009) which can amplify climate-related changes and influence the ability of communities to deal with change (Furgal & Prowse, 2008).

At the same time, northern populations are dealing with additional socio-cultural changes. Three major trends are having particularly significant effects on small-scale indigenous societies and cultures. First, the rate of socio-cultural change has increased dramatically over the past half century, with its foundations in northern colonization and paternalistic welfare policies of the state. Second, a combination of declines in indigenous languages and spirituality, a more recent focus on cultural revival, and persistence of aspects of holistic worldviews have resulted in shifting modes of cultural expression. Third, traditional kin-based social networks and relations have been altered, and in some cases transplanted into new (often urban) settings (Csonka & Schweitzer, 2004). Social structure and dynamics have shifted dramatically, changing the way communities function on a day-to-day basis, and how they deal with uncertainty and change.

2.1.3 Indigenous participation and knowledge

Understanding and responding to environmental problems has traditionally been perceived solely as a scientific and technological endeavour. More recently, however, there is increasing consensus that "more creative forms of collaboration between

scientists and society, involving a broader range of disciplines and skills" (Berkes et al., 2003a) are required to create approaches that deal with a broader set of issues and enhance the potential of moving towards sustainability. Indigenous partners are recognized to be part of the solution. Recent, growing consideration of the important place of indigenous peoples, their rights, and their in-depth understanding of the environment they live in (Bone, 2009) has initiated attempts to document and incorporate their unique knowledge into environmental policy and planning processes (Ferguson & Messier, 1997). Such processes are increasingly formalized in the Canadian north through co-management agreements formed during the resolution of outstanding land claims (Nadasdy, 2003b; Peters, 2003). TK is also increasingly accepted within the academic community as a valuable source of information for environmental change research (Gill et al., 2001; Riedlinger & Berkes, 2001; Krupnik & Jolly, 2002; Laidler, 2006).

Through several thousand years of living off the land, indigenous inhabitants have developed profound understandings of the environmental processes that make up their local and regional sphere. TK systems are dynamic and evolving (Winslow, 1996), thus continually incorporating new information while still maintaining foundations in time-tested understandings, beliefs and practices. TK may be described as a complex that includes *knowledge* of the environment, *practices* associated with environmental use and management, and spiritual *beliefs* about the role and interactions of humans within the broader ecosystem (Berkes, 2008).

TK has now been recognized, through a growing body of research-based literature, as an accurate and reliable source of information (Ferguson & Messier, 1997; Nichols et al., 2004) that has legitimacy as a field of environmental expertise (Freeman, 1992), thus holding current relevance to the management of resources and other environmental assets (Agrawal, 1995). Elements of TK are clearly useful and applicable to resource and environmental management in a number of ways. First, TK includes much empirical data that is beyond the scope of scientific discovery. Second, indigenous people provide alternate and distinct interpretations of such information from those offered by conventional science. Third, the study of traditional resource management systems provides useful insight into more effective and sustainable methods for interacting with and managing environmental resources (Kalland, 2004). TK research has thus proliferated in many developing country contexts and in other remote regions such as the Canadian north. Indeed, northern researchers are now encouraged – if not expected – to work with indigenous communities towards mutual benefit (where appropriate), and to incorporate indigenous perspectives and knowledge into the research process (ACUNS, 2003; Graham & Fortier, 2005; Inuit Tapiriit Kanatami & Nunavut Research Institute, 2007).

Traditional cultural values play a large role in the way decisions are made in indigenous communities (Cohen, 1997a); TK is thus nested in a particular emotional, spiritual and cultural context that gives it meaning (Ellen, 2002). As such, the attempt to combine or integrate knowledge from scientific and indigenous systems has proven difficult so far; lack of definition and direction have resulted in haphazard application

(e.g. in the context of existing co-management agreements in Canada's north). TK loses much of its inherent value when scientifically-compatible elements thereof are extracted to be analyzed and used in environmental management processes guided by the dominant western paradigm (Gadgil et al., 2003). Consequently, TK has been placed in a vulnerable position where it can be easily misappropriated and decontextualized (Stevenson, 1998). As these pitfalls are recognized, it becomes evident that the integrity of both scientific and traditional knowledge systems must be individually recognized, respected and treated as equal in its own right (Berkes, 2008). How to effectively apply this in practice is a challenge that requires continued innovation and vigilance.

Combined science-TK studies will likely gain popularity in Canada's north as the importance of interdisciplinary research and of more holistic, systems approaches become more widespread. The Northwest Territories (NWT) government already has an explicit policy on TK. By providing structured guidance, it hopes to better incorporate TK into decision-making, programs and services (Davis & Ebbe, 1995). The success of this policy depends, of course, on if and how it is implemented. At the very least, however, its designation reflects the current era where TK is more commonly recognized and valued, and its incorporation into the research process is even expected in many realms.

2.1.4 Local observations of change

Relatively recent recognition of the elevated susceptibility of northern regions to climate change has prompted a series of empirical, location-specific TK studies focused on documenting environmental change and impacts on human livelihoods, offering insight into the historical relationship between communities and their environmental milieu. In Canada, Inuit communities in coastal regions have received the bulk of academic attention in this area (Riedlinger, 1999; IISD, 2001; Fox, 2002; Jolly et al., 2002; Krupnik, 2002; Ford & Smit, 2004; Ford et al., 2006b, 2006a; Nickels et al., 2006; Ford et al., 2007; Ford et al., 2008); however, changing environmental conditions influenced by both climate and development pressures are also affecting other aboriginal territories and communities (McDonald et al., 1997; West Kitikmeot Slave Study Society, 2001; Wesche & Armitage, 2006; Wesche, 2007; Wolfe et al., 2007).

Northern aboriginal people have shared their observations of a range of environmental changes in the recent past, focusing on the following themes: weather, temperature, precipitation, storms, water, ice, land, vegetation and wildlife. General trends observed by cultural groups in different regions show a high degree of overlap (e.g. several noted higher winter temperatures, more unpredictable weather conditions, and reduced ice quality and thickness; Fox, 2004; Ford et al., 2006a; Nickels et al., 2006; Wesche, 2007). Furthermore, these studies have outlined impacts on various aspects of aboriginal livelihoods (Berkes & Jolly, 2001; Riedlinger & Berkes, 2001; Krupnik & Jolly, 2002; Huntington et al., 2004; Guyot et al., 2006; Laidler, 2006; Nickels et al.,

2006). Participants indicate concern about changing culture and knowledge, harvesting and land-based activities, travel safety, traditional food, hydrological systems, equipment requirements, infrastructure and housing, the economy, and human health.

Such work has brought TK research to the forefront in the north, providing detailed local and regional evidence that emphasizes the human dimension and complements broader scientific findings. Within the context of increasing aboriginal control over land and political processes, community leaders are now showing interest in supporting such endeavours if carried out on their terms. Such research is increasingly valued as a means of a) understanding social-ecological relationships (Berkes et al., 1998; Krupnik & Jolly, 2002), b) documenting TK before it is lost due to a lack of intergenerational transfer (Gwich'in Elders, 1997; McDonald et al., 1997), c) informing environmental and resource management processes (Sadler & Boothroyd, 1994; MacDonald & Milburn, 1996; Stevenson, 1996), and d) illuminating adaptive processes, building capacity and improving awareness of environmental issues at the local level (Berkes & Jolly, 2001; Ellis, 2005; Parlee et al., 2005).

2.1.5 Themes

Two issues of note arise from the above outline of environmental change in Canada's north. First, there are multiple drivers of change and multiple types and levels of impacts. As such, it is unproductive to treat sectors as isolated entities. Rather, a holistic social-ecological systems perspective is important. Second, environmental

changes in the north are having significant impacts on small aboriginal communities. This elicits questions about the extent of both vulnerability and resilience of these communities and of specific population segments within them. It is clear that new approaches are required to effectively manage for human and environmental sustainability under conditions of uncertainty and rapid change.

2.2 Theoretical Underpinnings

There are several bodies of theory that underpin this research, most of which have overlapping themes. This section first outlines social-ecological systems and various aspects of resilience. It then discusses the literature on vulnerability, adaptation and adaptive capacity, with particular focus on social dimensions and the northern aboriginal context.

2.2.1 Social-ecological systems and resilience

Contrary to long-held beliefs that guided natural resource management until recently, it has become clear that neither social nor ecological systems can be fully understood, predicted or controlled without consideration of the larger context and of the interacting forces between systems. Furthermore, systems are now understood to be constantly changing, often in unpredictable ways, requiring new approaches. These ideas have led to the development and application of concepts like complex systems and adaptive management (Holling, 1978; Gunderson et al., 1995), resulting in an evolving

body of literature that is concerned with issues of change and scale within linked social-ecological systems (Gunderson et al., 1995; Berkes et al., 1998; Gunderson & Holling, 2002; Walker et al., 2002; Berkes et al., 2003b; Walker et al., 2004; Walker & Salt, 2006).

A systems approach challenges the reductionist view that resources can be treated as discrete from the surrounding environment. Rather, it promotes the conceptualization and study of entities as networks of interacting components (Slocombe, 1999). A growing body of work around resilience thinking argues that each interactive entity or system is hierarchically nested within a broader set of systems (Gunderson et al., 1995; Holling, 2001; Gunderson & Holling, 2002). Resilience thinking also stresses the importance of thresholds that mark the boundaries between different possible stable states. If a system changes too much it may cross a threshold and undergo a 'regime shift', where its structure, behaviour, and feedback mechanisms are altered (Walker & Salt, 2006).

In resource management, uncertainty about how variables at different scales will act and react within these systems has led to the development and application of more flexible approaches based around learning and adapting over time (e.g. Holling & Meffe, 1996; Walker et al., 2002; Slocombe, 2004; Olsson et al., 2006; Plummer & Armitage, 2007) and the necessary role of stakeholders in the process (Ludwig, 2001). A resilience approach focuses on social-ecological system elements that facilitate absorption of or rebounding from the impacts of fluctuating conditions. This is a particularly useful approach to studying environmental change as it elicits a system's capacity to respond to

stress, learn, self-organize, and adapt, and seeks to understand how feedbacks function at multiple scales (Berkes, 2002). Resilience can be applied as a tool for assessing how systems maintain their integrity of structure and function in the face of disturbance, providing insight into mechanisms for enhancing the process of sustainability (Berkes et al., 2003b).

Berkes et al. (1998) have derived a number of resource and environmental management principles for building resilience in local-scale social-ecological systems (Table 2.1). The goals for operationalizing resilience include maintaining diversity, variability, flexibility and redundancies within the system by avoiding pushing it to extremes, while supporting the development of adaptive capacity (Berkes et al., 2003b). The ability to cope or adapt to changing conditions is one of the ways that societies reflect resilience. Understanding past social-ecological patterns can guide decision-makers in determining which assets or capacities may be available, employed, and usefully developed in the process of building adaptive strategies to respond to future change.

Table 2.1: Principles for building resilience in local social-ecological systems (Berkes et al., 1998)

• Incorporating management practices based on local and traditional knowledge
• Designing management systems that 'flow with nature'
• Developing local and traditional knowledge to aid in understanding cycles of natural and unpredictable events
• Enhancing social mechanisms for building resilience
• Promoting conditions for self-organization and institutional learning
• Re-discovering adaptive management
• Developing values consistent with resilient and sustainable social-ecological systems

2.2.2 Vulnerability

For societies dealing with changing environmental conditions, it is important to understand system vulnerability to help determine adaptation needs and evaluate how adaptive capacity can be strengthened (Ford & Smit, 2004). The study of vulnerability has developed along two lines. Biophysical vulnerability is generally equivalent to the natural hazards concept of risk, emphasizing the primary importance of the nature of the physical event to which the human system is exposed. On the other hand, social vulnerability focuses primarily on the human determinants (e.g. social, political and economic conditions) that influence the system's ability to cope with exposure (Brooks, 2003; Adger, 2006). The climate change literature draws on both of these streams, contributing to the development of a more systems-oriented vulnerability analysis. Here, vulnerability refers to the degree to which a coupled social-ecological system is susceptible to experiencing harm due to the adverse impacts of change, while taking into account its ability to adapt (IPCC, 2001a; Turner et al., 2003; Ford & Smit, 2004; Adger, 2006).

Vulnerability and resilience are highly interconnected concepts. While a system's vulnerability indicates its susceptibility to harm, resilience entails its capacity to withstand or recover from such harm. Thus, heightened vulnerability correlates with increased exposure to environmental changes, while heightened levels of resilience act to moderate damages and enhance the speed and effectiveness of recovery.

Recent research recognizes the role of multiple stressors and the potential for vulnerability to be realized through multiple pathways (Adger, 2006). It is unevenly distributed across and within societal groups (Adger, 1999; Turner et al., 2003), and its level and nature depend critically on context (Brooks et al., 2005). From a social-ecological systems perspective, vulnerability has the dual nature of being influenced by both external and internal factors (Allison & Ellis, 2001). In essence, vulnerability is a function of the system's exposure to a hazard (whether climatic or other), its sensitivity to change (the degree to which it responds to positive or negative effects), and its adaptive capacity (the degree to which it offsets potential damage or takes advantage of new opportunities; see Section 2.2.3; IPCC, 2001a). Exposure and sensitivity are often grouped together as one term (exposure-sensitivity), which depends on both the characteristics of changing environmental conditions (e.g. magnitude, frequency, spatial dispersion, duration, speed of onset, timing, and temporal spacing) and the nature of the community in question (e.g. its structure and location in relation to risk; Ford et al., 2006b).

Vulnerability varies and can be assessed at a range of scales. To clearly identify the unit of analysis, Adger (1999) suggests disaggregating the distinct aspects of individual vulnerability and collective vulnerability. Although these are inter-related, they have different determinants. Drawing from a range of literature, Agrawal (2008) has compiled a list of key variables that influence vulnerability at both household and community levels (Table 2.2), noting the strong influence of socio-economic factors. Poverty levels, resource dependency, access to skills and resources, and household

composition are key factors in determining household vulnerability, whereas the role of social networks and institutional structure and dynamics is more pronounced at higher levels of social organization. The structural variables noted here suggest that marginalized populations with limited resources (e.g. indigenous peoples, women, children, the elderly, and the economically poor) are more likely to be both vulnerable to environmental change (Agrawal, 2008) and excluded from decision-making processes (Pelling, 1998).

Table 2.2: Key vulnerability variables at household and community levels (Agrawal, 2008)

Household level (individual vulnerability)	Community level (collective vulnerability)
• Poverty	• Poverty
• Dependence on risky resources	• Inequality
• Asset portfolios	• Social capital
• Occupations	• Social entrepreneurs
• Skill sets	• Institutional interconnections
• Information availability	• Institutional density
• Labour availability	• Institutional effectiveness
• Institutional access	• Gender composition
• Literacy	• Cultural factors
• Gender balance	• Age compositions
• Age distribution	

Building vulnerability analyses around the central concept of social and economic well-being, or sustainable livelihoods, is important for improving understandings of human adaptation (Handmer et al., 1999; Kelly & Adger, 2000). The study of vulnerability has contributed directly to understandings about the sectors and actors that will be most affected by change, while providing insight into both the type of adaptation interventions required (Agrawal, 2008) and the nature of human capacity needed to carry them out (IPCC, 2007a). The concepts of adaptation and adaptive capacity are further addressed in the next section.

2.2.3 Adaptation and adaptive capacity

While much natural science research on climate change is focused on better understanding the physical causes and effects of environmental phenomena, a more recent social science focus on the human implications is emerging. From an environmental management perspective, it is the impacts on the land and its people that are most relevant and most likely to incite individuals and communities to plan and take action to sustain themselves in an increasingly variable environment. In light of our global lag in reducing emissions and the many impacts already being experienced, it is now broadly recognized that mitigation strategies are insufficient to curb all future change. Thus, both ecosystems and socio-economic systems will necessarily have to undergo some adaptation (McCarthy et al., 2001; Lemmen & Warren, 2004).

Recent advances in climate change science have highlighted the notion of human adaptation as one of several alternative response strategies that can both limit negative impacts and enhance positive ones (Smit, 1993; Smithers & Smit, 1997; McCarthy et al., 2001; IPCC, 2007a). In reference to human societies, *adaptation* is defined here as adjustments in social or economic practices, processes, or structures in response to observed or expected changes in environmental stimuli in order to alleviate adverse impacts of change or take advantage of new opportunities (McCarthy et al., 2001; Adger et al., 2005). Adaptation includes practices that either enhance resilience or reduce vulnerability to existing or projected environmental changes (IPCC, 2007a). It can occur

at multiple levels (e.g. individual, collective, systems) and scales (e.g. local, regional, national; Government of Canada, 2001).

The current interest in adaptation as a policy concept (UNFCCC, 1992; McCarthy et al., 2001; IPCC, 2007a; Lemmen et al., 2008; UNFCCC, 2008) complements an earlier focus on mitigation, both nationally and internationally, where efforts targeted emissions reduction strategies to limit human modification of the climate (Smit, 1993). Scientists and others have now accepted that some impacts are inevitable, requiring a more active societal response to address the impacts of climate change across all sectors to secure human livelihoods (IPCC, 2007a). At the international level, the United Nations Framework Convention on Climate Change commits countries to active preparation for and facilitation of adaptation measures. Specific needs include funding, insurance and technology transfer, with a special focus on meeting the needs of developing countries (UNFCCC, 1992). The Canadian government has also recognized the importance of adaptation, releasing an overview report in 2004 that outlines issues by sector (Lemmen & Warren, 2004) and a national report in 2008 that highlights the vulnerability of northern regions (Lemmen et al., 2008). A key regional finding indicates that while climate change may challenge the maintenance and protection of aspects of traditional and subsistence ways of life, there will also be new opportunities to engage with. For example, increased access to economic and technological resources can extend harvesting capacity, improved training and skill development facilitates entry into the wage economy, and the expansion of marine and land-based transportation offers increased access and job opportunities (Furgal & Prowse, 2008).

The complex relationship between anticipated environmental changes and consequent impacts results in high levels of uncertainty for determining how individuals and communities will respond and adapt (Duerden, 2004; Adger & Vincent, 2005; Vincent, 2007). Accordingly, much recent research in this field has shifted from identifying specific adaptation actions toward improving understandings and enhancing the capacity of various groups to adapt to change (Smit & Pilifosova, 2003). In this study *adaptive capacity*, or adaptability (Denevan, 1983), refers to a system's ability or potential to respond successfully to environmental variability and change. It includes adjustments in behaviour, resources, technologies, (IPCC, 2007a) or system structure, as well as capacity-building initiatives. While *adaptive capacity* refers to attributes that denote a system's potential to adapt, the term *adaptation* refers to actual processes or specific actions undertaken to respond to change (Warren & Egginton, 2008). Adaptation practices can include both the development or strengthening of adaptive capacity and the transformation of that capacity into outcomes (Adger et al., 2005; Brooks et al., 2005).

The adaptive capacity of a coupled social-ecological system is defined by the attributes that allow it to prepare for, adjust effectively to, and recover from existing or anticipated disturbance while maintaining critical structures and functions (Walker et al., 2002; Adger, 2003a; Smit & Pilifosova, 2003; Olsson et al., 2004). Folke et al. (2003) further expand the concept by outlining four main dimensions: 1) learning to live with uncertainty and change, 2) promoting diversity and redundancy, 3) integrating different types of knowledge, and 4) developing opportunities for self-organization. Systems have different 'coping ranges' beyond which resources are strained; these vary over time in

response to changing economic, social, political and institutional conditions (Smit & Wandel, 2006).

The degree to which a system is both required and able to adapt depends on its vulnerability to the stressors in question. The choice of adaptation strategies is not based on climate (or other environmental) change alone, but is rather considered in conjunction with a range of other factors, which together pose the possibility for both synergies and conflicts (Lemmen et al., 2008). The specific characteristics of environmental change (e.g. long time-scale, combined discrete and continuous events, high uncertainty) require a dynamic and evolving approach that focuses on future risks and accounts for shifts in socioeconomic and biophysical vulnerability factors through time (Füssel, 2007).

Conceptually, adaptations can be differentiated based on a number of different factors. Table 2.3 provides a summary of some of the primary concepts that have been discussed in the literature. In the Arctic and globally, a range of adaptation strategies are already being used at localized scales. Most of these activities are reactive (after the impacts have been felt) and spontaneous in nature (IPCC, 2007a). However, it is possible – and likely necessary in this era of rapid change – to plan both anticipatory and reactive adaptations through deliberate policy decision-making. Planned, anticipatory adaptations are likely to be more effective and less costly over the long term (Lemmen et al., 2008), which emphasizes the need for pre-planning, action and investment. Adaptation may also take multiple forms. The UNFCCC (2008) outlines the following examples: increasing and improving sea defences (technological), improving risk management practices

(policy-based), reducing water use in times of drought (behavioural), and improving forest management practices (managerial).

Table 2.3: Basis for differentiating adaptation
(Smit et al., 1999; UNFCCC, 2008)

Concept for differentiation	Type of adaptation
Purposefulness	• Spontaneous • Planned
Timing (relative to climate impact)	• Anticipatory • Concurrent • Reactive
Temporal scope	• Short term • Long term
Spatial scope	• Localized • Widespread
Form	• Technological • Policy-based • Behavioural • Managerial

When faced with change at the local scale, residents may take adaptive actions to protect or improve individual assets or well-being, or engage in activities that affect the broader group (Adger et al., 2005). For example, a land user may choose to diversify his economic activities to maintain asset production in reaction to environmental change-related declines in fur revenues. This indicates household-level adaptive capacity and also reflects likely reductions in exposure to risk, thus reducing vulnerability through two pathways. Similarly, this individual can contribute to road-building in his community to improve general access to viable fishing rivers. Both of these types of adaptation decisions and actions are carried out within a broader institutional context. As such, adaptive capacity is not isolated to distinct levels within societies (e.g. local, regional, national). Rather, the ability to effectively respond to extreme or variable conditions is influenced in part by the broader enabling environment, the availability of resources at

higher scales of organization, and access to those resources through cross-scale linkages (Yohe & Tol, 2002; Brooks, 2003; Smit & Pilifosova, 2003; Adger et al., 2005; Smit & Wandel, 2006). The nature of this broader social context may differentially facilitate or hinder access to adaptation resources and opportunities for specific groups depending on social attributes (e.g. race, class, gender; Cutter, 1995; Pelling & High, 2005; IPCC, 2007a).

As an emergent property of social systems (Pelling & High, 2005), adaptive capacity is socially and geographically differentiated, with localized processes often dictating how specific groups respond to exposure. The vulnerability, international development and community development literatures recognize the importance of identifying and strengthening existing endowments or assets (Kretzmann & McKnight, 1993; Beck & Nesmith, 2001) held by households and communities, and building on strategies that are already being implemented in response to changing conditions (Agrawal, 2008). These endowments may take a variety of forms. While a system's operational context (e.g. requirements and issues of a technical, financial, social, institutional, or political nature) plays an important role in determining adaptive capacity, other strategic and largely informal attributes such as power, scale of operation, knowledge valuation, culture, and community characteristics are often more influential in localized contexts where common resources are shared (Armitage, 2005). Thus, in such settings adaptive capacity relies largely on the state of social and institutional relationships, the nature of social interactions regarding conflicting interests, and the

means by which these factors permit positive collective action (Adger, 2003a; Armitage, 2005).

It is important to note that the benefits and opportunities achieved through adaptation are not likely to be evenly distributed, thus creating winners and losers. At the collective level, the rules that govern decision-making and the power dynamics among actors influence the equitability of adaptation outcomes for those affected by the process (Adger et al., 2005). For this reason a number of local, place-based studies stress the importance of participation in decision-making processes as an important variable for strengthening adaptive capacity (IPCC, 2007a).

2.2.4 Social dimensions of adaptive capacity

Adaptation activities often occur at the local scale where impacts are most keenly felt. Burton (2003) suggests two main facilitators: a) local control and empowerment regarding resources and decision-making, and b) the quantity, distribution and delivery of resources for adaptation. While these factors provide an outline of the institutional framework under which adaptation activities may take place, they do not adequately address the role of social relationships, networks, values and norms in either advancing or limiting the capacity of individuals, households and communities to take collective action to achieve common goals (Schuller, 2001; Adger, 2003a). Collectively these dimensions are often referred to as social capital, a concept that recognizes the importance of inter-personal relationships as a resource for binding society together and achieving both

individual and joint goals. Recent scholarship outlines the scope for drawing on social capital theory to better understand how social relationships influence and continually reshape adaptive capacity and action over time (Adger, 2003a; Pelling & High, 2005).

Three principle theorists are widely recognized for their seminal contributions to social capital theory: sociologists Pierre Bourdieu and James Coleman, and political scientist Robert Putnam. Bourdieu understood social capital to be attributable to and consciously invoked by privileged groups to maintain power and class status (Bourdieu, 1980, 1984). In Coleman's mind, social capital was a resource belonging to individuals and families at all class levels, that was inadvertently developed through social interactions (Coleman, 1988, 1994). Putnam stretched the application of the concept, declaring it a societal level resource that enables and encourages people to work together toward collective goals (Putnam, 1995). He has been credited with popularizing the concept, which quickly became one of the key terms in the field of international development (Harriss & de Renzio, 1997).

Although its individual elements have long been discussed in a number of disciplines, the encompassing concept of social capital has furthered thinking around the idea of networks and relationships as assets or resources (Field, 2003). A review of recent empirical studies from a range of disciplines reflects "clear and often strong positive links between social capital and educational attainment, economic success, health and freedom from crime" (Field, 2003: 62), recognizing its significance among a range of other enabling factors.

Although a concept with much promise, social capital has endured significant critique around its designation as a form of capital (implying adherence to economic principles), the disproportionate focus on its benefits while neglecting its potential malignance, inadequate regard toward the role of power and conflict, limited treatment of its dynamic and evolutionary nature, lack of empirical specificity, and its overly broad application across scales (Fine, 1999; Woolcock, 2001; Field, 2003). Partially in response to these critiques, authors have developed on the initial foundations of the concept. There is increasing consensus across disciplines on the empirically-backed definition of social capital, summarized as "the norms and networks that facilitate collective action" (Woolcock, 2001: 13). Woolcock differentiates between three types of connectedness that are important for networks within, between, and beyond communities. Bonding and bridging ties are horizontal in nature, the former referring to relationships among family members and close friends, and the latter to more distant friends and associates. Linking ties refer to the vertical, cross-scale connections that facilitate community member access to resources from external institutions. The mobilization of different combinations of these dimensions can create a broad range of outcomes (Woolcock, 2001).

There has been substantial recognition of social capital's 'dark side' (Ostrom, 1997; Putzel, 1997; Rubio, 1997). In contrast to broad conceptions of social capital as an unqualified 'good', recent work indicates that different forms or dimensions may exist, and that they may not all produce positive outcomes (Pretty & Ward, 2001). Some groups may possess too much or too little (Woolcock, 1998), or a negative balance of productive and perverse (Rubio, 1997). In its perverse forms, associations may a) be based on fear or

power, b) be used to benefit individual over collective interests, or c) provide resources for one group while marginalizing another. As such, social capital can be both positive and negative, or enabling and constraining, and is a resource to be optimized rather than maximized (Woolcock, 1998) for efficient and mutually beneficial social and economic exchange. Furthermore, the nature of social relationships tends to be self-reinforcing, where constructive interactions encourage trust and reciprocal behaviour and where neglect or exclusion encourage the opposite.

As the importance of the influence of social linkages on community development and sustainability is realized, social capital research is gaining prominence in studies of the human dimensions of environmental change and resilience (Adger, 2003a; Matthews, 2003; Pelling & High, 2005). Despite the critiques outlined above, the concept of social capital remains a useful shorthand to denote the types of intangible social resources being examined in this study. Following are brief introductions to the different elements of social capital in the context of their relationship to adaptive capacity.

2.2.4.1 Connectedness: Ties and networks

Individuals connect with each other in diverse ways at different scales. In the realm of environmental management, bridging (or networking) ties that exist with members of other communities, and linkages with supporting organizations (e.g. government departments, corporations) are important for facilitating resource access and mitigating risk. However, the internal bonding relationships and informal institutions

(norms, codes of behaviour) within a community also play an important role (OECD, 2001; Adger, 2003a; Mignone, 2003; Pelling & High, 2005). Bonding ties may play a particularly significant role in small First Nations communities where the functions of formal institutions are heavily influenced by inter-personal relations. Strong survival-based bonds still exist among and within resident families in most First Nation communities, developed through generations of localized, resource-based livelihood activities on shared territory.

The mobilization of such bonds may be impaired, however, if the influence of cross-scale linkages is ignored. Onyx (2005: 6) notes a "recurring tension between the interests and needs of the small community and national agendas, between the discourse of the parochial and the discourse of big science" and argues that the validity of each of these requires recognition and consideration.

2.2.4.2 Trust and reciprocity

As trust is a predominant factor underlying the various components of social capital, it can be regarded as a proxy for assessing many of the shared norms, values and understandings that contribute to collaboration. In the context of adaptive capacity, trust exists in three relevant types that relate loosely to the types of social ties outlined by Woolcock (2001): interpersonal trust among familiars, interpersonal trust among strangers, and trust in public and private institutions (OECD, 2001). These trust relationships are played out as individuals engage with each other at multiple levels,

creating networks that cut across different dimensions of the social fabric. Pelling and High suggest that this web of interactions "forms the social raw material that shapes capacity to identify new information, learn and cope with change" (Pelling & High, 2005: 311) and is equally important as oft-cited formal structures for developing long-term adaptive capacity.

Trust can be enacted through reciprocal behaviour involving the interpersonal transfer of information or resources. Reciprocal relationships can be either balanced or generalized. The former involves direct or regular exchange of equally valued items, whereas the latter implies an offer of help in anticipation of heightened predisposition by the receiver or an affiliated third party to return the favour (Pelling & High, 2005). Generalized reciprocity benefits individuals with good reputations and large networks. However, such people can also use their power and influence to ameliorate their own adaptability (e.g. by stockpiling resources or encouraging decision-making that benefits higher social classes) while undermining that of the broader collective, leading to marginalization of vulnerable groups in the adaptation process (Pelling & High, 2005).

Reciprocity often develops through existing trust relationships and, if successful, it tends to be self-reinforcing, contributing to further trust-building. Such relationships lower transaction costs and encourage longer-term investment in collective efforts based on the tacit notion that counterparts will take equal responsibility for group outcomes, or risk norm-based sanctions for free-riding.

Trust relationships often take time and are difficult to build; however, these bonds are much more easily destroyed. Evolutionary changes in social relationships are heavily influenced by the initial state of social capital in a given society, thus a society pervaded by mistrust and conflict is unlikely to develop collective arrangements (Baland & Platteau, 1998). Considering the history of mistrust created between aboriginals and non-aboriginals through colonization and the rapidly changing cultural relationships within First Nations communities, gaining perspective on the types and distribution of trust relationships provides key insights into both barriers and opportunities for capacity-building at the local level.

2.2.5 Local-level analysis

Until recently, vulnerability and adaptation research has focused in large part on national and larger regional-level analyses, which may not be applicable at local scales (Klein & Smith, 2003). Complementary localized assessments are required to achieve a holistic understanding of the various influences at play (Brooks et al., 2005) and to pinpoint location-specific issues. These are particularly important since impacts are often most keenly felt locally (Burton, 2003) and much adaptation activity occurs at this scale (Klein & Smith, 2003).

A particular strength of local-level assessments is the ability to draw upon a wide range of knowledge sources (Bill et al., 1996; Berkes & Jolly, 2001; Riedlinger & Berkes, 2001; Folke et al., 2003; Huntington et al., 2004). Relatively recent recognition

of the elevated susceptibility of northern regions to climate change has prompted a series of community-level, place-based research with Inuit communities. These studies focused on documenting TK about environmental change and variability, while addressing dimensions of vulnerability, resilience and adaptation (Berkes & Jolly, 2001; Riedlinger & Berkes, 2001; Krupnik & Jolly, 2002; Ford & Smit, 2004; Nichols et al., 2004; Ford et al., 2006b, 2006a; Nickels et al., 2006; Ford et al., 2007; Ford et al., 2008). Collectively, these studies show that multiple processes are influencing Inuit vulnerability to environmental change (e.g. increased exposure to hazards, systemic challenges to the socio-cultural and economic dimensions of adaptive capacity). Nonetheless, the Inuit have shown remarkable abilities to adapt at the local level, facilitated by TK, social networks, harvesting flexibility, incorporation of new technologies, and economic support. Reducing vulnerability at the collective level may be aided by the development and implementation of policies around specific themes, such as the preservation of culture, co-management of natural resources, and harvester support.

A localized perspective provides useful insight into the history and development of aboriginal socio-cultural systems and the manner in which human roles and relationships are intertwined with broader ecosystem processes. TK offers information about the types and relative successes of historical management strategies and responses to past environmental stimuli and impacts, and provides detailed local and regional evidence that complements broader scientific findings. Localized studies also facilitate the detection of adaptive capacity elements in the system which may otherwise remain latent if untested (McCarthy et al., 2001; Vincent, 2007).

2.3 Conceptual framework

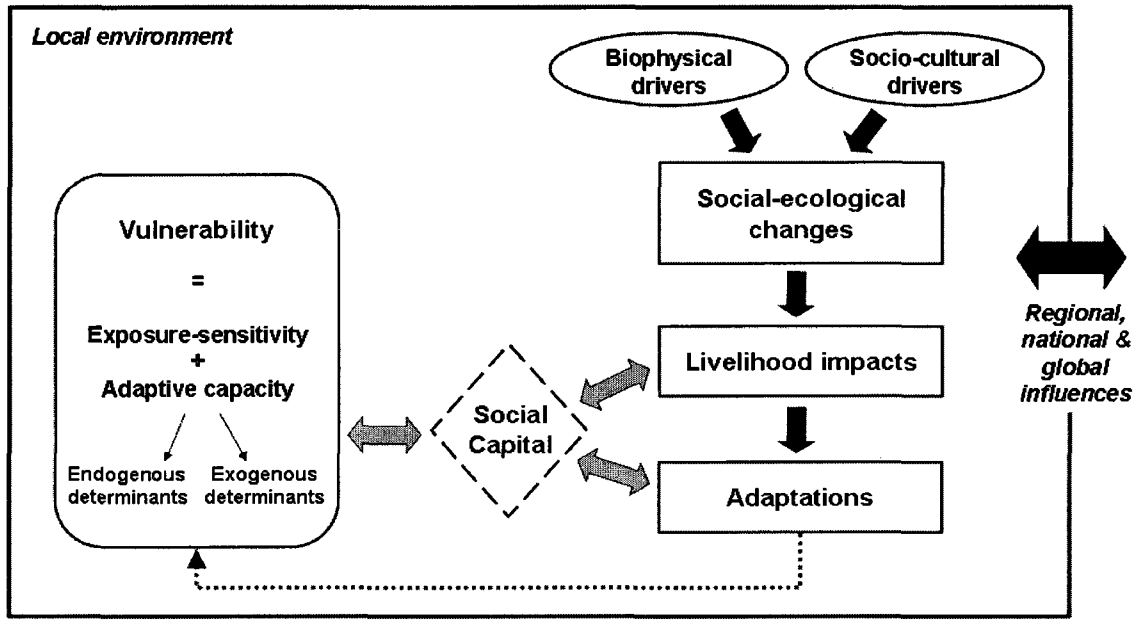
The conceptual framework for the present study is drawn from the theoretical and contextual information reviewed above. As shown schematically in Figure 2.1, it involves a dynamic human system at the household/community scale, integrated within its local natural environment. At the same time, the influence of external forces and linkages on the local environment and all elements of the system is recognized, placing the case study in a integrated local-global context. In this study, the *local environment* encompasses the human settlement and traditional territory of DKFN. The decision to take a local-scale approach in this study responds to the need for more adaptation research to be focused at this level, as discussed above.

Within a linked social-ecological system, both *biophysical* and *socio-cultural drivers* of change are operative. These drivers expose the local-scale system (the community and its households) to a range of *social-ecological changes*. These changes lead to a variety of *impacts* – whether direct or indirect – on local livelihoods, to which community members either adapt or fail to adapt.

The nature and severity of impacts differs based on the system's vulnerability, which is determined by two primary components: *exposure-sensitivity* and *adaptive capacity*. The likelihood that the system will adapt depends primarily on its *adaptive capacity*. As the local-scale system is nested within larger systems, its capacity to adapt is influenced by both *endogenous* and *exogenous determinants*. The relationship of a

system's vulnerability to both the impacts it sustains as well as the adaptations it is able to undertake is mediated to a large degree by social capital.

Figure 2.1: Conceptual framework for a community-based study of social-ecological change and adaptive capacity



The mere existence of adaptive capacity does not necessarily translate into adaptation actions being taken, as it may remain latent. When capacity is activated, however, multiple types of *adaptation* are possible (e.g. technological, policy-based, behavioural, managerial). While adaptations often include actions that respond directly to specific changes (e.g. travelling to alternate harvesting areas to access birds that have shifted their migration route), adaptive capacity-strengthening (e.g. through education and training, improving access to resources, etc.) is itself a form of adaptation that can be implemented at any time.

When they occur, adaptations cause the system to shift in some way, in turn influencing either the system's exposure or sensitivity to change, or its adaptive capacity. Thus, a cyclical feedback loop is created and persists over time. For example, if autumn harvesters choose to hunt moose from the road rather than travel out on Great Slave Lake, they reduce their exposure to stormy conditions, thus reducing potential livelihood impacts such as delayed return travel and boat swamping due to high wave action. Feedbacks may, however, be either positive or negative. In this study I am particularly interested in capacity-strengthening as an important form of adaptation that reinforces the ability of the system to respond to change.

2.4 Summary

This chapter began by exploring some of the contextual factors that frame and influence the study of environmental change in northern aboriginal communities. It provides an outline of the important environmental, social and economic changes occurring in the north, and the impacts of these changes on aboriginal residents. It also considers the changing nature of indigenous participation in research and decision-making, highlighting the contribution of TK to understanding northern change, impacts and adaptations. Focus then turned to the theoretical concepts that underpin this study. The nature of linked social-ecological systems and elements of resilience theory are examined. The concepts of vulnerability, adaptation and adaptive capacity are also introduced, followed by a focused section on the social dimensions of adaptive capacity. The themes discussed in this chapter contribute to a conceptual framework for this

research (Figure 2.1) and its placement within the broader context of a linked social-natural science study of multiple facets of environmental change in the SRD area (Figure 1.2).

CHAPTER 3: METHODOLOGY

This study focuses on a combination of the two main questions addressed by human geographers. We seek to understand the shape of societal structures – whether social, cultural, economic, political, or environmental – and their influences, and individual experiences of places and events (Winchester, 2005). Effectively addressing a range of perspectives from individual to collective requires a mix of methods. These can be used to provide detailed understandings of the different components and relationships among these components in social-ecological systems of interest. In this case, the methods described below were chosen to offer insight into the changing nature of the system and the resultant effects on biophysical and human communities, both at individual and collective levels.

This in-depth study takes a collaborative approach, and uses a mix of predominantly qualitative methods, including semi-structured interviews, focus groups and a household questionnaire, as well as other aspects of participatory research such as participant observation. The focus group discussions were centred on structured qualitative scenarios, which are addressed later in this chapter. The study also draws selectively on quantitative data from the SRD area and surrounding region to provide context, recognize complementarity between data sets, and help improve rigour through triangulation.

3.1 Methodological Approach

The past several decades have shown substantial growth in the acceptance and use of non-traditional research approaches and methods in the social sciences. In conjunction with this 'new frontier' in qualitative research methodology there has been more concrete attention to the notion of collaboration and partnership between researchers and those into whose lives the research is delving (Eisner, 1997). After a long history of research that has been both exploitative and extractive, researchers and indigenous people alike are helping to shift this endeavour progressively away from its colonial roots, from an approach where work is done *on* and *about* indigenous subjects (to benefit people and organizations) to one where studies are done *with* and *for* them. There is increasing recognition that local participation is integral to indigenous research (Grenier, 1998; Smith, 1999; Cleveland & Soleri, 2002), especially in cases where such research is conducted by non-indigenous 'outsiders'.

The current research has been undertaken using a collaborative approach, following a number of ethical guidelines for research involving indigenous people (RCAP, 1996; CIHR et al., 1998), some of which are northern-specific (ACUNS, 1997; Inuit Tapiriit Kanatami & Nunavut Research Institute, 2007). Authentic collaboration must be initiated at the conception of a research project, and actively maintained throughout. It requires a redefinition of the research subject's role to recognize both partners as equal participants in a shared enterprise (Eisner, 1997). Collaborative partnerships can improve cultural sensitivity and ensure that issues of importance to the indigenous community or people in

question are addressed (Smith, 1999). These relationships are also more likely to stimulate a sharing of 'insider' knowledge (Eisner, 1997) which, if received and used in an ethical manner, can enrich the experiences of the parties involved and improve the authenticity and utility of research outcomes.

The collaborative methodological approach taken here is consistent with a more theoretical systems perspective, one that stresses holistic thinking, recognizes real-world complexities and uncertainties, and views individual entities as nested in a broader context and as part of a multi-level hierarchy of wholes. This type of perspective encourages the use of methods that are collaborative, field-based, and interdisciplinary within a process that is interactive, dynamic and adaptive (Patton, 2002). This research attempts to draw on and bring together different types of information from TK, social science and natural science perspectives (Wolfe et al., 2007) to develop a holistic understanding of the conditions, actions/interactions and consequences (Strauss & Corbin, 1990) experienced in this complex social-ecological system.

The cross-cultural nature of this research must also be recognized, in that I am a non-indigenous outsider who is conducting research in a culture different from my own. This type of field-based research takes place in a space where cultures meet and interact (Gibbs, 2001), and requires "respectful listening, difficult and challenging engagements, careful attention to nuances in the lives of 'others', and a critical, long-term consideration of the implications of methods in the construction of meaning" (Howitt & Stevens, 2005: 30). Both collaborative and cross-cultural research (or research that combines these two,

such as the current study) rely heavily on mutual respect and the space and time for continued open dialogue throughout the duration of the project and beyond. Relationship-building is a key component of new research partnerships in this context, and must be approached as a long-term endeavour.

3.1.1 Building partnerships for collaborative research

Initial contact for this human dimensions study was made through colleagues already engaged in paleoenvironmental research in the SRD. From the early planning stages, community engagement and participation were recognized as essential to ensuring that the project resulted in information that made a contribution to both theory and practice. Initial discussions with the FREWC in 2004 led to an open community presentation and discussion about project direction and scope. Community support for the project emerged from this meeting, as did concerns about how TK would be used and whether holders of TK and participants in the study would be compensated. The community Environment Manager, supported by FREWC members, took on the role of overseeing the project and negotiating a research protocol.

Collaborative community research requires that significant time and energy be devoted to preparatory work before data collection activities can begin. Table 3.1 outlines the major research stages and activities, indicating that a full year and a half of preparation, relationship-building, knowledge-sharing, and project planning was necessary before research activities were undertaken.

3.1.1.1 Fieldwork

In the summer of 2004 I spent six weeks in Fort Resolution on a preliminary scoping trip to initiate a collaborative research process. This trip enabled me to introduce preliminary project ideas and receive feedback from residents, to begin the relationship-building process with people and relevant organizations, and to develop my understanding of the context in which I would be working. Although I did not perform formal data collection activities, this trip was essential in establishing the working researcher-community relationship necessary to engage in research on sensitive topics such as TK. Later trips to Fort Resolution were made possible through the establishment of this foundation.

During this scoping trip, I had the chance to speak with many community members, and became a familiar face in the community. The friendships I developed with community members facilitated logistical organization during subsequent trips. For example, I was more readily able to find accommodation with a local family, organize ground transport to and from Hay River, organize guided trips on the land, hire local research assistants, and access equipment and resources when necessary (e.g. snowmobiles, public space to hold interviews and focus groups). Furthermore, this initial trip was essential for understanding local context and concerns, which informed the development of project goals, objectives and research questions. The primary steps toward enduring collaborative partnerships with DKFN and Deninu School were also taken, where both parties had the opportunity to engage with each other over several

weeks and begin the process of building solid, mutually-beneficial relationships. Spending substantial time in the community identifying important local issues and community-sanctioned research directions prior to undertaking data collection, and returning at a later date, reflects a long-term commitment on the part of the researcher. This approach enables the development of positive relationships between community members and researchers, improves trust and communication, and reduces concerns about extractive research.

After the scoping visit, I returned to the field to undertake formal data collection activities and share preliminary findings from May to September 2005, and during shorter visits in December 2005, February 2006, March to May 2006, November 2006 and March 2007. I undertook a final trip in fall 2008 to disseminate research results. During this timeframe, the project and relationships with community members evolved to incorporate a variety of activities designed to meet the research objectives developed in collaboration with community partners in Fort Resolution, as highlighted in Table 3.1 and described below.

Table 3.1: Research project stages

Project Stage	Activities	Dates
Identification of research topic	• FREWC proposed TK study to complement ongoing paleoenvironmental and contemporary hydrological studies	September 2002
Familiarization with topic and context	• Literature review	September 2003-May 2004
Initiation of research partnership	• Initial liaison with FREWC Manager regarding the TK study	March 2004
Scoping visit	• Meetings with community leaders • Open presentation and feedback session with community members • Relationship- and trust-building with leaders and members • Development of understanding of community context • Informal discussions • Collection of grey literature	Fieldwork: • June-July 2004 (1.5 months)
Project planning	• Literature review (continued) • Methodological development • Comprehensive examination • Approval of project proposal	August 2004-April 2005
Data collection and methods development (iterative)	• Interviews • Household survey • Focus groups • Workshops • Participant observation	May 2005-November 2006; Fieldwork: • May-Sept 2005 (4 months) • December 2005 (1 month) • February 2006 (1 week) • March-May 2006 (2 months) • November 2006 (2 weeks)
Data analysis and verification of interpretations (iterative)	• Periodic presentation of preliminary findings to community leaders and members • Review and discussion of findings with community members	October 2005-March 2007 Fieldwork: • March 2007 (2 weeks)
Dissertation writing	• Development of PhD dissertation • Supervisor feedback on drafts • Dissertation submitted, defended and finalized	April 2007-October 2009
Reporting back and knowledge-sharing	• Oral and written reports: community meetings (open, school, FREWC), summary pamphlet, summary poster, final reports, copy of dissertation (once finalized) • Publications: journal articles, book chapters (ongoing)	Fieldwork: • November 2008 (1 week)

A further element that contributed to my learning was my 'adoption' by a local family. As of my second field trip in summer 2005 I lived with a local family while in town, providing me with substantial support and friendship, credibility with other community members, and direct access to individuals – both family members themselves, and others with whom they are connected – from whom I continuously learned about the community. Members of this family also use the land for travel and recreation, and I was invited several times to travel with them either by boat or snowmobile to parts of the traditional territory that I would otherwise not have experienced.

Throughout my fieldwork I engaged extensively in community activities (e.g. community feasts, weddings, funerals, graduation ceremonies, winter carnival events, Aboriginal Day events, Canada Day events, and bingo). I also volunteered my time for events put on by the community (e.g. feast clean-up, dance monitor), school (e.g. international day, poetry competition), and by local individuals and families (e.g. wedding helper). A further role included acting as an academic resource for local individuals and organizations. Fortunately, as most community members speak English, my ability to talk directly with many people during my extended stays in Fort Resolution contributed greatly to my understanding of the place, salient issues, and socio-ecological dynamics.

During the project an important partnership developed with the staff at Deninu School, which services all kindergarten to grade 12 students in the community. All researchers involved in both social-ecological and paleoenvironmental components

collaborated to transfer knowledge and build capacity with community youth, where feasible. During field visits we made several presentations and demonstrated research techniques to engage students in the project and communicate the value of both social and natural science research. In collaboration with the school principal and staff, I also launched two capacity-building initiatives: a video-interview project, and scenario-based workshops on environmental change.

The first initiative involved two planning and practice sessions with grade 10-12 students to initiate a video-interview project of local TK with community elders. After a group discussion about their conception of the 'land' and environmental changes experienced in their own milieu, students learned about research design, developed and practiced administering interview questions, prioritized a list of interviewees, and received equipment training. Unfortunately, implementation of the second project phase involved significant staff and student time and coordination for off-campus activities during school hours. Thus, although much interest was expressed in the project, Deninu School was unable to provide the necessary resources to continue these activities due to other constraints.

The student workshop initiative involved students from grades 7-12 in a discussion of environmental change at different scales, including trends of change for the local region, followed by a discussion about alternate future scenarios. Students were then asked to create images of Fort Resolution as they would expect or desire to see the community and traditional territory in 25 years, focusing on two major drivers of change:

climate and resource development. Both of these activities engaged students in experiential learning about the state and future of their local and regional environment, while introducing skills related to concept development, research design and project implementation.

3.1.1.2 Research assistance

It is important, for both logistical and moral reasons, to engage local research assistants to facilitate the implementation of community-based research. In this project, local research assistants were involved as much as possible in all major data collection activities and knowledgeable land-users were engaged to conduct guided field trips. Various training and capacity-building opportunities for locals include organizing, facilitating and interpreting (where required) semi-structured interviews in both English and Chipewyan; implementing a survey of local heads-of-household; and facilitating community workshops.

While working with local research assistants on all aspects of the project is desirable, achieving this can be a challenge in small communities such as Fort Resolution. While individuals in some other small northern communities are able to make a career out of research assistance, the volume of social science research in Fort Resolution is not high enough to support the development of specialized individuals in this field. For example, in this case, while a number of people in the community have the capacity to fill the role of general research assistant, far fewer are able to interpret in

Chipewyan, the local language spoken by many elders. Regardless, the reality is that the most capable and reliable people are often already engaged in the wage economy, or in caring for children or other family members, and are thus unable to take on additional work. Of the few people in town with the linguistic capacity to act as interpreters during elder interviews, many are periodically engaged in other projects being run by the local First Nation or Métis Council. For these and other reasons, it was difficult to consistently engage high-quality research assistants during my field trips, leading me to alter my methods accordingly.

I used several strategies to address the consequent uncertainties and logistical challenges, including organizing and undertaking several interviews on my own, and engaging the help of a high school student to deliver research pamphlets and set up interviews while fulfilling some of her mandatory community hours for graduation. Fortunately, few people in Fort Resolution (only eight elders whom I interviewed) preferred to communicate either fully or partially in Chipewyan, which reduced my need for an interpreter. Thus, while the process was less efficient than working consistently with a local assistant, I benefited from the flexibility afforded by my prolonged field visits and was able to conduct almost all of the desired interviews either by myself or with the help of an interpreter.

3.1.1.3 Key informant identification and compensation

In most cases, studies of TK are more effective if based on a careful selection of key informants rather than a random sample of community members (Huntington, 2000). Surprisingly, despite the recent proliferation of TK studies, there has been little emphasis in the literature regarding the methods by which local knowledge 'experts' are identified (Davis & Wagner, 2003). Following techniques used successfully in similar studies, the method used in this study combines peer recommendations with chain referrals (Huntington, 2000), where experts are identified in a systematic way through a number of sources. Expert identification for individual activities is outlined below.

The practice of monetary compensation for attendance at meetings or participation in research studies has been normalized in many northern communities, including Fort Resolution. Accordingly, all interviewees, focus group participants, and survey participants were financially compensated at a rate determined in collaboration with the DKFN Environment Manager.

3.2 Participatory Methods

A range of participatory methods are useful for documenting information about social-ecological change, including semi-structured interviews, focus groups, and participant observation (Dene Cultural Institute, 1991; Grenier, 1998; Huntington, 2000; Fox, 2002; Armitage, 2003). While participatory methods are common in developing

country research, a number of authors have used similar techniques for environmental change research in the north (Huntington, 2000; Berkes & Jolly, 2001; Riedlinger & Berkes, 2001; Fox, 2002; Krupnik & Jolly, 2002; Parlee et al., 2005; Ford et al., 2006b, 2006a).

This dissertation offers a qualitative, inductive analysis (Miles & Huberman, 1994) based on a single case study design (Yin, 2003; see Chapter 3). A mixed methods approach was used to allow for the varied dimensions of each research question to be addressed, while providing an effective means of triangulation.

Table 3.2 provides a summary of the different methods used in this study and links them to the individual research questions outlined in Chapter 1. Data collected using these methods was complemented by many informal discussions with community members and others familiar with environmental management issues in the region and through reviews of both white and grey literature. This project followed an iterative research approach where insights gained during field trips were incorporated into the planning for subsequent trips (e.g. development of interview questions and scenarios). Archival and other secondary written and visual sources provided essential background material to help enhance the historical record, to structure the direction of the participatory research, and to help corroborate results through triangulation (Miles & Huberman, 1994). Data were captured using written notes, audio recordings, and video recordings where feasible. While each data set is internally consistent, analysis also shows consistency among and between them.

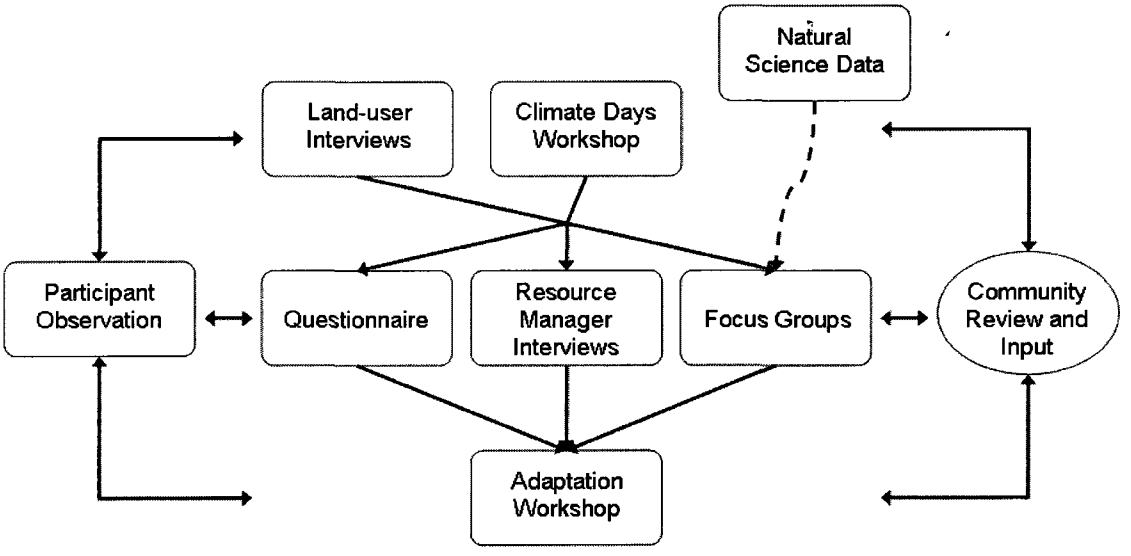
Table 3.2: Summary of project methods and links to research questions

Method / Data source	Participants	Content	Research question
Climate Days workshop[6]	• 2-day public workshop	• Results from scientific climate change studies • Local observations of environmental change	1.1, 1.2
Semi-structured interviews	• 33 land-users and elders	• Land use, environmental conditions and changes (weather, water, ice, animals) • Past impacts of environmental change • Past adaptations to environmental change • Includes some land use maps: trails, resource locations (berries, animals), flood dynamics	1.1, 1.2, 2.1, 2.2, 2.3
Social dimensions questionnaire	• 104 heads of household in Fort Resolution	• 35 questions -Individual information -Environment and quality of life in the community -Groups, networks, linkages within and beyond community -Trust, sharing and social cohesion -Cooperation and collective action	2.1, 2.2, 2.3
Scenario-based focus groups and interviews	• 5 focus groups (20 participants) • 1 adaptation workshop (11 community leaders) • 3 interviews (3 community leaders)	• Scenarios of change -Climate change -Resource development • Projected vulnerabilities • Adaptation strategies -Opportunities -Barriers	2.3, 3.1, 3.2
Semi-structured interviews	• 19 individuals involved in environmental governance at multiple levels	• Incorporation of climate change into planning and decision-making; major influences on policy-making • Cross-level linkages with other departments and governance organizations	3.1, 3.2
Participant observation	• 15 field visits with local guides • Daily life with my 'adoptive' local family	• Knowledge of land use during different seasons • Environmental changes and impacts • Photographs	1.1, 1.2, 2.1, 2.2, 2.3, 3.1 3.2

[6]The workshop was hosted by DKFN and GEWEX-MAGS, the Mackenzie Basin component of the Global Energy and Water Cycle Experiment.

Figure 3.1 shows the interconnected nature of the methods used, and depicts how the results from specific project components informed subsequent method development. Throughout the project, input from community leaders was solicited and helped to shape subsequent phases. Participant observation also occurred naturally throughout, both during guided trips on the land and during everyday life in the community. A description and details regarding implementation procedures for each method is provided in subsequent sections.

Figure 3.1: Interconnected project methods



3.2.1 Climate Days workshop

On July 11-12, 2005, during the early stages of data collection for this project, a 2-day 'Climate Days' workshop was jointly organized by DKFN and GEWEX-MAGS (the Mackenzie Basin component of the Global Energy and Water Cycle Experiment). To

improve local awareness about climate change and raise the profile of research in the community, our project was included as one of the workshop features. A representative proportion of community members of all ages attended and participated. The workshop was used as a mechanism to explore both scientific and traditional knowledge understandings of change, and reflect on areas of overlap. Results from a range of natural science studies undertaken in the Mackenzie Basin were presented by GEWEX-MAGS members. Human dimensions were discussed during presentations about climate change activities being undertaken by Dene Nation, more specifically the Dene Environmental Working Group, and a presentation about the research outlined in this dissertation.

Beyond the formal presentations, ample time was provided for community member discussions about observed environmental changes and livelihood impacts in and around Fort Resolution. A key feature included two TK focus groups, one consisting of a group of elders and the other consisting of middle-aged adults. Members of each group told stories about the past and present, and generated a list of observed environmental changes that closely mirrored those described by interviewees.

There were several items of note that emerged from this workshop. First, there was recognition by several leaders that climate change is not selective about which individuals it will impact; all community members are 'in it together' and must work collectively to respond effectively. Second, it was noted that developing partnerships and forums for knowledge exchange with scientists was essential for providing a more holistic understanding of the challenges northerners are facing. Third, participants

recognized the role that environmental monitoring can play in contributing locally-relevant understandings of change among a range of parameters.

3.2.2 Semi-structured interviews

Semi-structured interviews provide an effective method for engaging participants in guided discussions around issues of interest, while providing them freedom to elaborate on their own lines of thought (Huntington, 2000). Semi-structured interviews are particularly useful in more exploratory situations where the researcher may not understand or anticipate the multiple ways in which different social and ecological variables interact, for example in cross-cultural research on TK (Dene Cultural Institute, 1994). Specifically, oral history interviews are particularly relevant in studies of environmental change, helping to produce a more comprehensive picture of the causes and processes than can be elicited through physical science methods (Dunn, 2005).

In the case of research that documents local or traditional knowledge, "the quality and impact of data assembled ... depends to a large extent on who is identified as 'knowledgeable' and whether information is gathered systematically from a large enough group of knowledgeable individuals" (Davis & Wagner, 2003: 475). Purposeful sampling was used in this study to select 'information-rich cases' (Baxter & Eyles, 1997) that allow the development of an in-depth understanding of specific phenomena (Patton, 2002). Key informants (e.g. hunters, trappers, elders, resource managers) were targeted, since neither knowledge about the land nor knowledge about management policy and

practice is uniformly distributed within communities (Chambers, 1994). A standardized interview guide (Table 3.3) was used to prompt discussion during the interviews, while allowing room for the introduction of and discussion about unanticipated topics. Participant recruitment was continued until 'saturation' occurred, where new themes and constructs ceased to emerge (Baxter & Eyles, 1997).

Table 3.3: Guide for land-user interviews

Theme	Sample questions
Introduction and context • Life history • Land-use area • Seasonal cycle of land-use activities	• Where and when were you born? • How long have you lived in Fort Resolution? • Which area of the land are you most familiar with? • What activities did/do you do on the land (past and present)?
Land-use management • Protocols • Land-use changes over time	• How did you choose what to harvest? • How did you choose how much to harvest? • Which groups hunted together and shared food? • Do hunting and trapping restrictions affect your land-use?
Environmental resources • Baseline conditions • Changes in quality or abundance	• What was the weather like during each season? • What changes have you observed? • How have animal populations changed in abundance or health? • How have flood conditions on the delta changed? • What have you observed about ice freeze-up/break-up conditions over time?
Environmental change impacts • Impacts on livelihoods	• How has land use changed? Why? • How do changing environmental conditions affect land use? • How have people responded?

Semi-structured interviews were undertaken with two groups of people: individuals with significant TK about the land (elders and land-users) and individuals involved in environmental management decision-making at various levels (resource managers).

3.2.2.1 Elder and land-user interviews

During the initial phase of fieldwork 33 individuals (APPENDIX A) – all current land-users or elders who have spent parts of their lives on the land – agreed to participate in an in-depth interview through which the main project themes were explored. Initial interviews focused on environmental change, impacts and adaptations in the surrounding traditional territory, and follow-up interviews were undertaken as necessary. To make interviewees feel comfortable, this activity was often conducted in their home. When this was neither feasible nor desirable, a room in the local office complex was used.

3.2.2.1.1 Identification of knowledgeable experts

In July 2004, complete lists of Fort Resolution elders and land users were obtained, the former through DKFN and Métis Local offices, and the latter from the Economic Development office. To initiate a peer recommendation process (Davis & Wagner, 2003), the amalgamated lists were reviewed separately with two male FREWC members (both of whom have substantial experience with local environmental issues, and one of whom is a long-time land user), one female research assistant (who has substantial experience on the land), and two male community members (a DKFN Band Councillor and a long-time land user). Initially, the land area around Fort Resolution was divided into three categories, following local land use patterns: Rocher River/Taltson River, Slave River and Delta, and Little Buffalo River. The consultants indicated the area of knowledge, if any, for each elder and land-user. In each case the list was then divided

into priority and non-priority informants, based on knowledge of the land and active land use. To reduce possible personal biases, the three lists of priority informants were then compared, and all names that appeared on at least two of the three lists were selected. A total of 24 elders (20 male, 4 female) and 23 land-users (all male) were determined to be key informants, while the remaining (the 20 elders and 22 land users that appeared on only one of the three lists) were designated as secondary informants.

Interviewing was then initiated with high priority informants. In a process of chain referral, interviewees were asked to identify other people (both male and female) they considered to be knowledgeable about the land in specific geographical areas. These suggestions generally corresponded with the key informant list, providing further indication that it was fairly complete in its scope. Throughout the duration of the project informants were approached based on priority ranking and availability. Some potential interviewees were unavailable or unwilling to participate in the study for various reasons.

3.2.2.2 Resource manager interviews

This series of interviews focused on the inclusion of climate (and, more broadly, environmental) change and adaptation into decision-making and policy at various levels of governance, from local to territorial. These interviews with environmental managers in different organizations explored the type of support structures available to help Northwest Territories (NWT) communities deal with changing environmental conditions, with a focus on capacity-building and adaptation at the local level (Table 3.4).

Table 3.4: Guide for resource manager interviews

Theme	Sample questions
Climate change	• How is climate/environmental change being incorporated into decision-making in your organization? • To what degree is your organization involved in decision-making about land and resource management under changing conditions?
Adaptation	• What does adaptation mean to you? • Which organizations will be important in supporting adaptation to climate/environmental change? Why? • What kinds of linkages or formal partnerships exist between organizations to support adaptation?
Capacity-building	• Where is capacity lacking in your organization to deal with climate/environmental change? • Is your organization involved in building capacity for adaptation? How? • What kinds of barriers limit capacity-building for adaptation?
Governance	• As an individual in your institution, how much power do you have to influence decision-making regarding climate/environmental change and adaptation? • Once treaty negotiations are resolved, how will the role of your organization change to deal with climate/environmental change and adaptation? • How will future governance structures affect the capacity of NWT communities to adapt to change?

3.2.2.2.1 Identification of knowledgeable experts

As with the elder and land-user interviews, I used a peer recommendation process (Davis & Wagner, 2003) to determine resource management experts with whom to conduct interviews. Through local contacts in Fort Resolution and Yellowknife, I identified several individuals working on environmental and resource management issues in both government and non-governmental organizations (NGOs) at local, territorial and national levels. Individuals with relevant knowledge were approached and interviewed where feasible. Each individual was also asked to suggest others involved in work on climate change and adaptive capacity. Following up on the list of chain referrals, I interviewed a total of nineteen individuals (APPENDIX B), and had many informal discussions about relevant topics with other individuals representing the Aurora Research Institute, Dene Nation, Environment Canada, Government of the Northwest Territories

(GNWT), Department of Indian and Northern Affairs Canada (INAC), Northwest Territory Métis Nation (NWTMN), and WWF-Canada, among others. One caveat is that due to the limited nature of climate change impacts and adaptations work being conducted at the time of the interviews, a majority of interviewees were unable to answer many of the questions due to a dearth of information. All were, however, able to provide useful contextual information on policy direction and inter-organizational relationships.

3.2.3 Social dimensions questionnaire

Studying social dynamics can help researchers understand how a community's strengths and weaknesses affect its capacity to function effectively and to generate collective benefits. A common approach involves the use of questionnaires or survey tools, which may be complemented by targeted interviews (Grootaert & Van Bastelaer, 2002; Matthews, 2003). To better understand the social dimensions of adaptive capacity in this case study, this approach was taken to generate information about social norms, networks, relationships and attitudes within Fort Resolution (APPENDIX C).

A concise questionnaire (taking approximately one half hour to administer) was developed and carried out in face-to-face meetings to collect detailed data from a broad cross-section of adult heads of household (either male or female) in the community. In total 104 individuals were surveyed, representing approximately two-thirds of community households.

Early drafts of the questionnaire were constructed at the mid-way point of the project. Questionnaire development was based on preliminary data about community trends in Fort Resolution and themes distilled from a collection of other publicly available questionnaires from studies in different parts of the world (Walker et al., 2001; Grootaert & Van Bastelaer, 2002; Stone & Hughes, 2002; Harper & Kelly, 2003), one of which was specifically designed for First Nations communities in Canada (Mignone, 2003; Mignone et al., 2003). Specific themes linking social capital and collective action were distilled from the literature (Pretty & Ward, 2001; Pelling & High, 2005), and lists of questions were developed to examine each theme. The themes included: a) our community, b) groups, networks and linkages, c) trust, sharing and social cohesion, and d) cooperation and collective action (APPENDIX C). Based on my experience in Fort Resolution, I selected the most relevant questions and adjusted the terminology to suit the situation. Sources of potential error were minimized where possible (Table 3.5).

An early questionnaire draft was reviewed by the Environment Manager and comments were incorporated into the working draft. A pilot test was conducted with two community members, after which question wording and order was altered where necessary. Three local research assistants were hired to administer the survey to heads-of-household in the community, with the intent of capturing the broadest sample possible. The quantifiable data provide an important complement to the qualitative information generated through other methods.

Table 3.5: Potential sources of error and steps taken to minimize them

Potential source of error	Steps taken to minimize error
Inconsistencies in the Chipewyan translation of the questionnaire	Translation checked by two Chipewyan speakers who are known for language competence and have experience working in interview and survey implementation. All eight Chipewyan surveys were undertaken by one assistant.
Potential misinterpretations of meaning, especially by the elders and those with less formal education	The survey question design used very straightforward terminology and phrase structure. Research assistants were trained and encouraged to relay potential content and structure problems; subsequent questionnaires were adjusted accordingly.
The questionnaire was administered by three research assistants and the study lead (myself), and several were completed in written form, allowing for differential influence on responses.	Research assistant activities were regulated and responses were cross-checked to identify potential inconsistencies.
Individual answers may have been influenced by a respondent's personal feelings about the interviewer (i.e. answers may have been censored to avoid offending the interviewer).	Research assistants were asked to select which people they were comfortable interviewing. Furthermore, most residents are generally outspoken, and the questionnaire was likely seen as a vehicle to ensure documentation of their concerns.
Individual interviewee results are all relative, and must be interpreted as such (e.g. a rating of 'strongly agree' for one person may be equivalent to a rating of 'agree somewhat' to another individual).	While the questionnaire categories represent an inherent order (more to less, stronger to weaker), the numbers assigned to the categories do not represent the magnitude of difference between the categories as with an interval or ratio scale, and were interpreted accordingly.
Some respondents may have interpreted the 10-year timeframe (used in questions about trends) to mean 'in the past, before things changed to the way they are today', which may reflect anywhere from several years to several decades in reality.	The decadal timeframe must be interpreted liberally. In retrospect, the 10 year timeframe may not have been the most effective reference point, as many residents noted that the 70s and 80s were the worst times in Fort Resolution due to high levels of alcohol abuse and violent behaviour.

3.2.4 Scenario planning: Focus groups and workshop

From its early roots as a military tool, scenario planning has been adapted for corporate management, and more recently for environmental planning (Miller & Waller, 2003; Peterson et al., 2003b). Scenarios are not meant to be probabilistic forecasts of future conditions, but are rather images of possible alternate futures based on assumptions about key relationships and drivers of change (Nakićenović, 2000; Peterson et al., 2003b). This approach is especially useful where uncertainty is high and where it is impractical or impossible to test system response through manipulation (Peterson et al., 2003b), as is the case in regional social-ecological systems like the SRD area.

In Fort Resolution, qualitative scenarios were used to examine the specific themes of community vulnerability and adaptive capacity under changing social and environmental conditions through a series of five focus groups, two student workshops, several individual interviews, and a culminating planning workshop (APPENDIX D). The development and use of these scenarios provided a mechanism through which to feed some of the information gleaned from interviews back to participants and have them react and further extend and elaborate on ideas. Furthermore, this method draws on and integrates information from both TK and western science, helping to create a holistic picture, and increasing the relevance of scientific projections for community members. These scenarios were intended to help stakeholders and decision-makers envision possible futures and plan response strategies in a way that increases the possible benefits of change and reduces associated losses (Miller & Waller, 2003).

3.2.4.1 Scenario development

Based on current northern trends and confirmed by early project work in Fort Resolution, scenario development focused on two main drivers of change: climate and resource development[7]. Drawing in large part on descriptions of past and current trends elucidated during the TK interviews, the climate change components also incorporated scientific projections determined through a detailed synthesis of existing and on-going TK and scientific research on climate change impacts, trends and projections in the Mackenzie Basin region. A summary of past (1950-present) and future (2050 and 2100) climate change-related trends was collated from existing studies focusing on the Arctic and/or Subarctic regions, and more specifically on the Mackenzie Basin and/or SRD region. Table 3.6 summarizes the main themes and parameters that were examined, and identifies the primary references that were consulted in this exercise.

The resource development components were mostly extrapolated from past trends during the period of the Pine Point lead and zinc mine (1964-1988), located 60 km west of Fort Resolution, narrated experiences from other communities, and literature on resource boom towns (Kendall, 1992; Bone, 2009).

[7] While these drivers of change are prevalent across the north, the narratives were created specifically for Fort Resolution and the surrounding area and may incorporate some unique characteristics that have limited applicability in other communities.

Table 3.6: Climate change trends summarized for scenario development
(Cohen, 1997d, 1997c; Rouse et al., 1997; Couture et al., 2000; Health Canada, 2002; Smith et al., 2002; ACIA, 2004; Environment Canada, 2004; Lemmen & Warren, 2004; State of the Canadian Cryosphere, 2005)

Theme	Parameters			
Climate	Temperature change	Precipitation change	Evaporation change	
Land and animals	Mammals	Birds	Insects	Pests
Water resources	Snow cover	Ice cover	Surface water	Groundwater
Permafrost	Coverage	Rate of change	Seasonal change	
Forestry	Plant species	Productivity		
Fisheries and aquatic systems	Species health	Species population numbers	Species distribution and migration	Hydrology
Transportation	Infrastructure	Access		
Human health and well-being	Safety	Physical health	Mental health	

Initially, four alternate storylines were developed to cover the variability of possible futures, while the even number reduced the perception of a 'most likely' or 'central' case (Nakićenović, 2000; Table 3.7, Table 3.8). The timeframe of 25 years was chosen to ensure relevance to current residents.

Table 3.7: Outline of scope of four scenarios of change

		Resource Development	
		Moderate	**Extreme**
Climate Change	**Moderate**	Small Town	Boom Town
	Extreme	Shifting Seasons	Akaitcho Mines

Working with a graphic artist, an image was developed for each scenario, including a series of symbols depicting both environmental and socio-economic variables

(Figure 3.2). A descriptive title and narrative storyline was paired with each image, and simplified bullet points of prevailing trends were created for use in the focus groups (APPENDIX E). The 'Small Town' scenario illustrates the status quo, where little change in climate and development occurs. 'Shifting Seasons' combines more extreme climate projections for the north with limited development, while 'Boom Town' illustrates the opposite scenario. 'Akaitcho Mines' incorporates substantial change on both climate and development fronts.

Table 3.8: (a) Environmental and (b) socio-economic trends under proposed scenarios

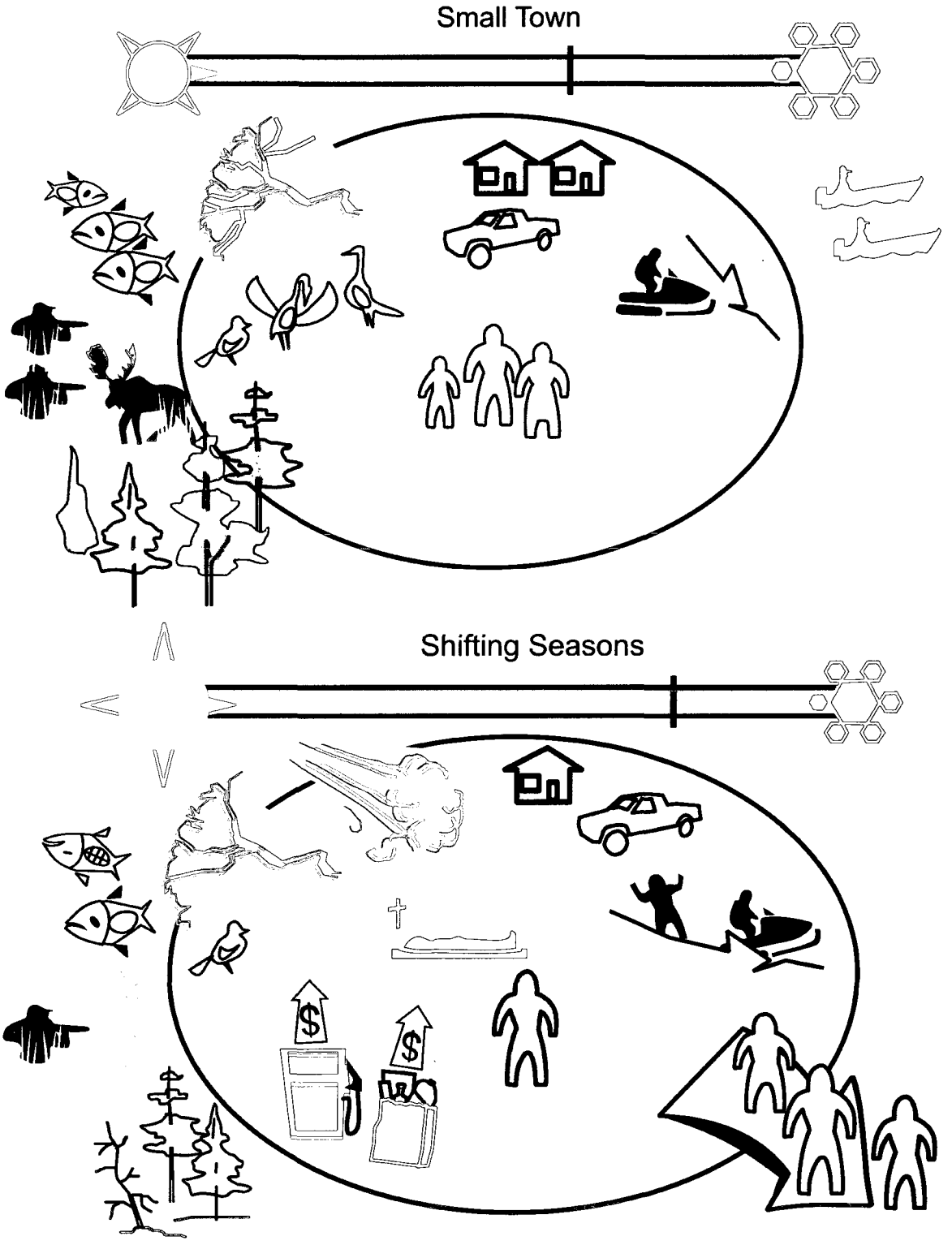
(a)

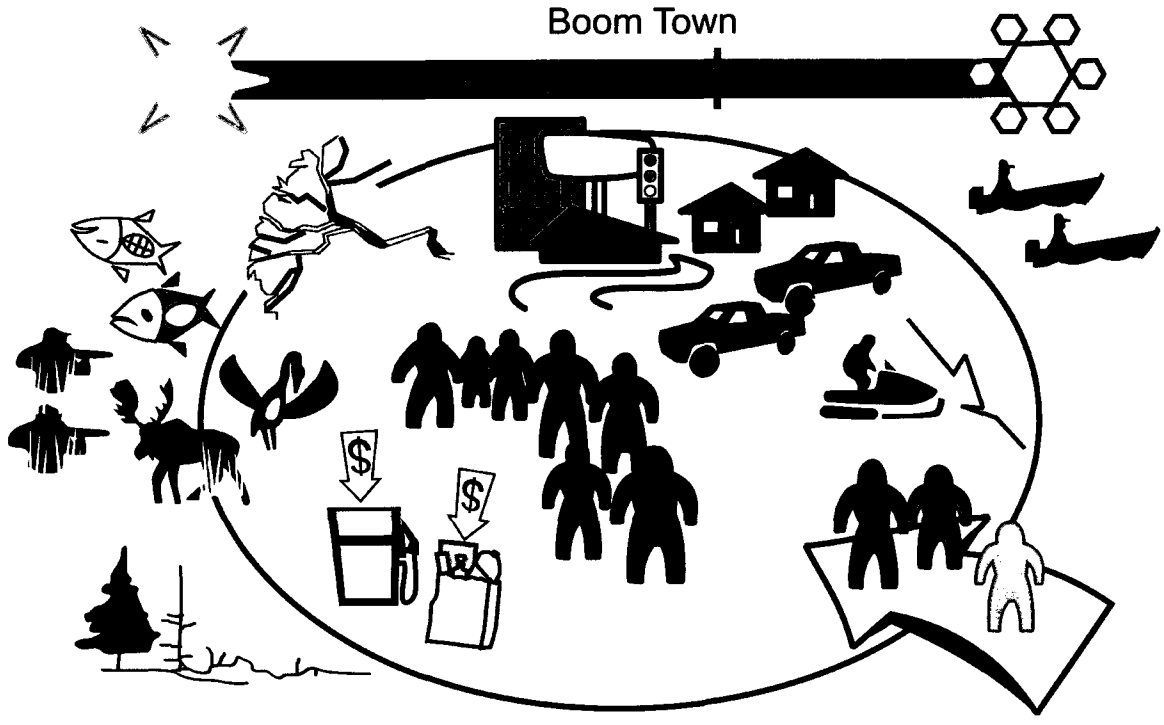
Scenario	Small Town	Boom Town	Shifting Seasons	Akaitcho Mines
Environmental conditions	• Slightly longer and warmer summers • Slightly shorter and warmer winters • Ice freezes one week later, melts one week earlier • Slightly less predictable ice conditions – winter land users must be careful • Lake, river and delta water levels remain stable; sloughs continue to dry slightly • Slight increase in fish and wildlife deformities	• Slightly longer and warmer summers • Slightly shorter and warmer winters • Ice freezes one week later, melts one week earlier • Lake, river and delta water levels remain stable; sloughs continue to dry slightly	• Much longer and warmer summers with increased winds and storm events • Much shorter, generally warmer winters with increased frequency of extreme events and temperature fluctuation • 1 month longer ice-free season • Winter lake and river ice very unpredictable • Lower river, delta, slough and lake water levels; only main river channels accessible	• Much longer and warmer summers with increased winds and storm events • Much shorter, generally warmer winters with increased frequency of extreme events and temperature fluctuation • 1 month longer ice-free season • Winter lake and river ice very unpredictable • Lower river, delta, slough and lake water levels – only main river channels accessible • Water quality declines in Resolution Bay • Increase in fish and wildlife deformities and disease

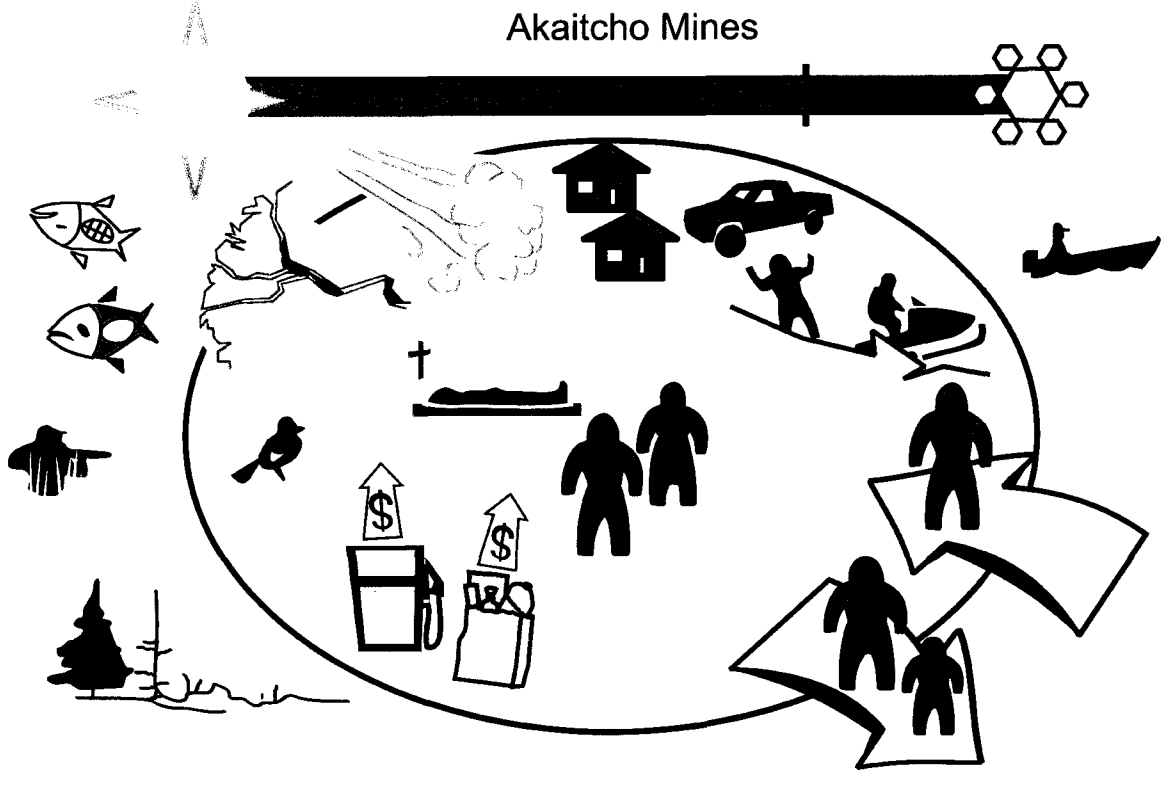
(b)

Scenario	Small Town	Boom Town	Shifting Seasons	Akaitcho Mines
Human conditions	• Fort Resolution population size stays fairly stable • Employment level stays constant • Trapping, hunting and fishing continue at similar levels to today	• Mining development brings jobs and infrastructure development, but causes localised environmental degradation • Young adults take advantage of training provided and work in the mine • Increased valuation of education and technical training in Fort Resolution • Influx of workers and families, including some returnees – moderate population increase in size and diversity • Increase in community services – food, accommodation, entertainment • DKFN and Métis Local collaborate to invest money, build capital and develop community services • Increased resources and effort to rebuild cultural identity • Working age individuals and households increase their expendable income • Reduced cost of food and goods • Increased housing prices • Increased hunting and fishing by workers • Fishing, hunting and trapping mostly done as a weekend/recreational activity • Local education and lifestyle campaigns on health and well-being issues	• Slow decline in population size, with hourglass demographic (people aged 18-35 leave town to seek work and education elsewhere; number of children declines thereafter) • Decline in local services as workers leave or retire • Increased cost of goods, especially fuel and gas • Trapping limited to local area by lack of ice – younger trappers increasingly seek employment elsewhere • Reduced income for most individuals and families – reduced use of snowmobiles, boats and vehicles • Increased number of accidents on thin ice (reduced travel safety)	• Mining development brings jobs and infrastructure development, but causes localised environmental degradation • Young adults not taking advantage of the training provided, so workers brought in from outside • Workers fly in from Hay River or Yellowknife, and local residents do not profit • Money from Impact Benefit Agreement (IBA) is distributed to individuals, but no local investments made • Decrease in services • Increased cost of living, especially fuel and gas • Fishing, hunting and trapping severely limited due to bad ice, lack of snow, increased summer winds, reduced animal health and population numbers, high costs for machinery and fuel • Increases in health-related conditions

Figure 3.2: Scenarios of future change for Fort Resolution and surrounding area




Boom Town


Akaitcho Mines

For each scenario, participants were led through a structured discussion of key implications for local livelihoods (e.g. environmental impacts, social impacts, traditional activities, economy, health and well-being), major issues relating to adaptation (e.g. governance, resources, leadership, community cohesion), and identification of actors who should be involved in planning for change. Likely and desirable future states were also explored.

During the first focus group it became evident that the combination of factors in Akaitcho Mines scenario made the outcome difficult to conceptualize, and participants felt it was repetitive. To reduce redundancy, the process was streamlined by eliminating the fourth scenario, which focused the discussion around vulnerabilities and adaptive strategies for each major driver in turn. Small Town, Shifting Seasons and Boom Town were used in the remaining focus groups, individual interviews, student workshops, and a leadership-focused adaptation workshop.

3.2.4.1.1 Identification of participants

The scenario-based focus groups were targeted to involve a cross-section of residents from the community. Through discussions with the DKFN Environment Manager, it was deemed appropriate to work in part with established groups of individuals who were already comfortable working together. Three focus groups were held, involving the FREWC (five people), and two groups of local Métis leaders (nine people total). To include other community members, a sign-up sheet was placed in the

central office complex and notices were posted in public spaces encouraging interested residents to sign up. These individuals were divided into two further groups: a group of elder women (three people), and a group of middle-aged and elder women from Rocher River (three people). To complement the focus groups and broaden the participant inclusion, the scenarios were also used to discuss local issues and governance responses with three individual community leaders (who had not participated in the focus groups) through one-on-one interviews (APPENDIX D).

The scenarios were also used as a basis for two student workshops (14 students from grades 7-12), which combined education and awareness-building with youth perspectives on environmental change (see description in Section 3.1.1.1). Student-created images provided the basis for further discussion about the potential challenges and opportunities associated with different development trends as anticipated by young people in the community.

In the final project stages, a directed scenario-based adaptation workshop was held during the March 2007 trip, involving 11 leaders from different community organizations (APPENDIX D). Vulnerable sectors were identified, and adaptive strategies for each sector were discussed. The heterogeneity of the group brought differences of opinion to the table, but it also served to impress upon the participants that change impacts all groups, and that solutions require collaborative efforts.

3.2.5 Participant observation

In order to better understand how local people interact with and use environmental resources, it is important to observe these processes first hand and participate where feasible. Ethnographers deem participant observation an essential technique for understanding what is important and meaningful for members of the research community, and the types of constraints and pressures that they may be subject to (Emerson et al., 1995). The total of ten months I spent in the field provided me the opportunity to immerse myself in the activities and experiences of daily life in Fort Resolution during repeat visits in different seasons.

During this time I was fortunate to engage in an important aspect of community life: time on the land. Through various trips out on the land with local experts (Table 3.9), I was able to combine my own experiential learning process with on-site unstructured interviewing about environmental change. Verbal communication of environmental phenomena by informants was enhanced by visual representations, reducing potential cultural and linguistic barriers. A simple example involves the demonstration of how to trap muskrats in the push-ups that dot winter lake ice. Experiencing this first hand allowed me to better understand what it meant when land-users indicated that reductions in the number and size of push-ups reflected a similar change in number and size of muskrats. Another experience involved travelling by snowmobile on thin spring ice. The vulnerability I felt while having to 'gun' my machine over the 10 feet of open water along the shoreline to get onto the lake ice, and while

waiting for our guide to test the ice quality at the mouth of a delta channel to see if it was safe to cross made me further appreciate the types of challenges and stresses that local people are experiencing due to increasing variability of previously predictable environmental conditions.

Travelling with locals on the land led to storytelling about specific places and incidents that are difficult to comprehend in the abstract. For example, a visit to the abandoned hamlet of Rocher River stimulated discussion about pre-1960s livelihoods that were closely intertwined with the rhythms of the land, and the resulting strength of social bonds within this tight-knit community. A week-long camping trip for the annual cultural gathering at Reliance, located at the eastern tip of Great Slave Lake, led to discussions about how relationships between the Akaitcho First Nations have shifted over time. A two-day delay due to stormy conditions impressed upon me the uncertainty associated with unpredictable weather patterns at traditionally calm times of year, and the lack of control that individuals feel being 'windbound' when travelling by boat on the lake, uncertain of when they will be able to make it home.

Table 3.9: Trips on the land with local guides

Date	Trip type	Transport	Activity	Location	Guide(s)
June 2004	Single-day	Motorboat	Reconnaissance, muskrat and beaver hunting	Slave River Delta	Gaby Lafferty
July 2004	Single-day	Motorboat	Reconnaissance, water sampling	Slave River Delta	Gaby Lafferty
July 2005	Multi-day	Motorboat	Reconnaissance, fishing	Simpson Islands – Great Slave Lake	Ray & Dollie Simon, Paul & Annie Boucher, Irvin & Marlyn Norn, and families
August 2005	Multi-day	Motorboat	Annual cultural gathering	Reliance – Great Slave Lake southern and eastern shores	Ray & Dollie Simon, Paul & Annie Boucher, Irvin & Marlyn Norn, and families
December 2005	Single-day	Snowmobile	Trapping	Sandy Lake – Wood Buffalo National Park Boundary	Fred Mandeville, Jr.
December 2005	Multi-day	Snowmobile	Trapping	Rocher River – Taltson River – Great Slave Lake southern shore	Stanley Beck
December 2005	Single-day	Snowmobile	Reconnaissance	Rocher River	Kevin & James Boucher
February 2006	Single-day	Snowmobile	Ice fishing	Great Slave Lake southern shore – Across the Portage	Rocky & Scott Lafferty
March 2006	Single-day	Snowmobile	Trapping	Inland sloughs	Fred Mandeville, Jr.
March 2006	Single-day	Snowmobile	Trapping	Slave River Delta	Fred Mandeville, Jr.
April 2006	Single-day	Snowmobile and canoe	Duck hunting	Slave River Delta	Fred Mandeville, Jr., Philip Beaulieu, Faye Aviugana
April 2006	Single-day	Canoe	Reconnaissance	Great Slave Lake southern shore – Resolution Bay	Fred Mandeville, Jr.
May 2006	Single-day	Motorboat	Muskrat and beaver hunting	Slave River Delta	Fred Mandeville, Jr.
May 2006	Single-day	Motorboat	Goose hunting	Slave River Delta	Fred Mandeville, Jr.
May 2006	Single-day	Motorboat	Goose hunting	Great Slave Lake southern shore – Stoney Island	Fred Mandeville, Jr., Lawrence Fabian

Furthermore, through the process of participant observation, issues were brought to the fore that might have otherwise remained unidentified. For example, a winter trip by snowmobile to Taltson River in 2005 led to the discovery of an ice jam that has never before been seen on that river. This incident allowed me to experience first hand how locals respond to previously unknown conditions, something that they have become ever accustomed to doing under rapid environmental change. The discovery led us to first cautiously examine the new phenomenon and discuss speculative causes, and eventually to alter our travel route.

As part of the broader interdisciplinary research project, I was also able to participate in several reconnaissance and research trips on the land with natural science researchers (Table 3.10). Visual perspectives both from the air and at ground (water) level, combined with on-site discussions about a variety of environmental phenomena provided me with complementary perspectives on the physical layout and biophysical characteristics of the SRD, and how these have evolved over time. For example, travelling by boat through the delta during the aftermath of the spring 2005 ice jam and flooding provided visual recognition of the physical effects (e.g. a high water mark approximately two meters above normal in a slough connected to the Slave River, scars on the trunks of live trees lining the previously ice-jammed Nagle channel, and huge ice blocks deposited high up on the riverbanks still in the process of melting).

Other excursions to collect lake sediment samples, and subsequent discussions about the findings, further clarified the inherent environmental variability of the system,

and alerted me to likely correlations between physical and human livelihood parameters. For example, sediment cores indicated a large flood in 1974, which stimulated discussion with local participants about impacts they experienced at that time. Overall, these researcher-led experiences greatly enhanced my understanding of the relative magnitude of important events in the delta and allowed me to better conceptualize the resultant impacts on human activities and livelihoods described by local residents.

Table 3.10: Trips on the land with natural science researchers

Date	Trip type	Transport	Activity	Location	Researchers
March 2005	Single-day	Helicopter	Reconnaissance	SRD	Brent Wolfe, Derek Armitage
July 2005	Single-day	Motorboat	Aquatic vegetation sampling	SRD	Mike Stone, Leah Hagreen
July 2005	Single-day	Motorboat	Aquatic vegetation and tree ring sampling	SRD	Mike Stone, Leah Hagreen, William Buhay, Danny Blair, Dan Bailey, Marlin Rempel
May 2006	Single-day	Motorboat	Water and vegetation sampling	SRD	Mike Sokal, Bronwyn Brock, Brent Wolfe, Derek Armitage
March 2007	Multi-day	Helicopter	Lake sediment sampling	SRD	Brent Wolfe, John Johnston, Roland Hall, Bronwyn Brock, Paige Harms, Maggie Adam, Tracy Barkhouse; Community members Richard Simon, Rosy Bjornson and Paul Boucher also attended

3.3 Data Analysis

The large and diverse amount of data collected during my many months of fieldwork for this study has presented significant challenges for analysis. The different types of methods used and the qualitative nature of the data have greatly increased the complexity of analyzing the different subsets and drawing connections between them.

Major components of the analysis included the interpretation of land-user and resource manager interview transcripts, interpretation of focus group summaries, and statistical analysis of questionnaire results. These analyses were supplemented by understandings gleaned from field notes and textual components of the questionnaire, and were greatly enhanced by my understandings of culture and social dynamics gained from approximately ten months of fieldwork in the community. Systematically-employed data analysis procedures are detailed below.

3.3.1 Interviews and focus groups

All land-user and resource manager interviews were transcribed as word-for-word accounts either by myself or a research assistant. This was done by listening to the audio version at reduced speed while typing simultaneously. Subsequently, I listened to each audio file while reading the relevant transcript, and made modifications where appropriate to ensure transcript quality. The transcriptions were based on the English language portions of each interview, which, in the majority of cases entailed the entire interview. The Chipewyan sections that appeared in a minority of cases were not directly transcribed; in these cases the transcription is based on the English translation provided by the interpreter who was present at the interview. All transcripts were saved as word processing files.

During each of the five focus groups and the culminating adaptation workshop, notes relating to the discussion were written down on a flipchart that was visible to all participants. These notes were then transcribed into word processing files.

Once complete, interview transcripts and focus group summaries were imported into QSR NVivo® (version 7), a qualitative research software that provides a structured workspace for classifying, sorting and arranging information, and improved ease of information retrieval. Data reduction, organization, exploration and analysis is facilitated through various levels of coding (Cope, 2005), a task that I performed independently for each set of files. Within NVivo® I manually applied first order (umbrella) codes to phrases and sections of text according to relevant themes (Patton, 2002; Table 3.11) emerging from the background literature, research questions and inherent project categories (Cope, 2005). This initial coding process resulted in a manageable framework that formed the basis for more detailed description, explanations of relationships, development of conceptual models, and synthesis of findings.

Table 3.11: First order thematic codes for interviews and focus groups

Land-user interviews	Resource manager interviews	Focus groups
• Historical events • Livelihoods and knowledge • Changes and impacts • Adaptation to change	• Governance structures • Social and organizational relationships • Information and communication • Programs and policies • Traditional and scientific knowledge • Capacity-building	• Impacts • Causes of impacts • Adaptation strategies • Actor involvement in planning

Subsequent work involved the application of more detailed codes within each umbrella theme, which were then arranged in a relational hierarchical tree. The NVivo®

software allowed the assignment of multiple codes to individual sections of text, allowing the data to be analyzed from multiple perspectives and in different ways. Memos were also kept and linked to specific themes to record notes or relationships of interest. While the process of transcribing and coding interviews and focus group summaries was long and arduous, it was essential for maintaining the inherent detail of these in-depth texts, and allowing the exploration of nuances through easy retrieval and comparison of different sections of text. Relationships within each data set were explored and written up individually (land-user interviews in Chapter 4, focus group data in Chapter 6, and resource manager interviews in Chapters 6 and 7), while connections between them are synthesized in Chapter 7.

3.3.2 Questionnaire

The questionnaire data required a different tactic from the narrative information described above. The questionnaire was designed to generate information about participants' attributes, behaviour, attitudes and beliefs (McGuirk & O'Neill, 2005) to better understand trends, processes and interpretations related to social dynamics and environmental change. The bulk of the questionnaire data were category- or rank-based, allowing for numerical coding. To undertake analysis for patterns of response and relationships between variables of interest, the data were analyzed using a series of descriptive statistical procedures available in SPSS® (version 15.0) software. Frequency counts were run for each question, and details were noted where results showed strong trends. Each question was then cross-tabulated with personal data to determine if answers

differed within interviewee groupings. Where appropriate, Chi-square tests were used to determine the significance of results to a 95% confidence level, and categories were reclassified to ensure validity (McGrew & Monroe, 2000). The textual data emerging from questionnaire components that required description or contextual explanation were used to support interpretation.

3.3.3 Data verification and knowledge-sharing

A large part of the collaborative nature of the project involved ongoing dialogue with local community members. Several activities were used to improve communication and local engagement in the process. During and between trips to Fort Resolution, I maintained contact with two key individuals, the Environment Manager and the First Nation Band Manager. When possible, I made oral presentations on research progress to the FREWC, Deninu School students, and to the broader community. At various points I also disseminated pamphlets to participants and other interested stakeholders outlining project objectives and research progress (APPENDIX F). I also prepared trip summaries which were mailed back to community leaders and participants (APPENDIX G), and during later project stages provided research posters to the First Nations Band office and Deninu School outlining results to date. Discussions were held with interested residents and feedback was incorporated into final reports.

The effectiveness of collaborative indigenous community research relies in large part on knowledge-sharing from both partners. Specifically, however, researchers have a

responsibility for communicating knowledge to community-based audiences and other stakeholders (Howitt & Stevens, 2005). To complement knowledge-sharing and verification activities undertaken throughout my fieldwork, my paleoenvironmental colleagues and I organized a community open house in March 2007 to present and receive feedback on preliminary findings from the different components of the broader interdisciplinary study. A further knowledge-sharing session was undertaken during the fall of 2008 to report back final results through public presentations at the DKFN and Deninoo Community Council (DCC) office complex, at the Aurora College community campus, and at Deninu School. Summary reports and pamphlets were handed out to individuals and deposited in public locations for perusal. Results posters were also provided to DKFN and Deninu School for posting. Copies of the final dissertation will be mailed to local organizations, and audio interview files, transcripts, and focus group notes will be returned to DKFN and the Métis Local for their own use. Manuscripts developed throughout the course of the project are provided to community leaders for feedback before publication, and such publications will continue to be made available to community members.

3.3.4 Establishing rigour

Qualitative studies are often erroneously evaluated based on quantitative canons where "'rigour' has come to mean the satisfaction of the conventional criteria of validity, reliability and objectivity within quantitative research" (Baxter & Eyles, 1997: 506). While these canons remain important, they "require redefinition in order to fit the

realities of qualitative research and the complexities of social phenomena" (Corbin & Strauss, 1990: 4), and an incorporation of other related concepts such as academic responsibility and honesty, as well as the believability or trustworthiness of research findings (Baxter & Eyles, 1997).

Based on a study of 31 empirical papers, Baxter and Eyles (1997) outlined four common strategies used to ensure rigour in qualitative social geography, all of which are used in the current study. These include: rationale for the appropriateness of the methodology used, the employment of multiple methods, descriptive details on the process of respondent selection, and the inclusion of verbatim quotations in the text. The appropriateness of using a collaborative approach based on a qualitative methodology that is both participatory and integrative is demonstrated herein. Further, the analysis of data collected through multiple methods enables triangulation to confirm or corroborate results, helping to increase credibility. Mixing methods allows for extension in the breadth and range of inquiry, while counteracting the biases inherent in any one method (Greene et al., 1989; Creswell, 2003). In Fort Resolution, the use of different methods permitted access to a broad population segment, collection of complementary data, and development of a more holistic perspective on the social-ecological system than would otherwise have been feasible.

A further strategy involves the outlining of a rationale for sample selection, size and characteristics. This information is provided herein to make transparent whose voices are heard in relation to each of the different components of this study.

The use of quotations is important for revealing how participants create and express meaning; representative quotes have been used in this text to provide more detail and context related to interpreted claims. It is important to recognize which voices are being quoted, to reduce bias. In this case, while I attempted to select quotes from a range of individuals, I opted at times to include more descriptive and comprehensive quotes that address commonly expressed themes (resulting in the representation of multiple quotes throughout the text from several individuals with superior oral communication skills). Quotes are attributed to named interviewees only if consent was given.

In addition to the above strategies, this study employs several other methods commonly acknowledged to enhance rigour in qualitative research (Baxter & Eyles, 1997). Subsequent sections of this dissertation include details on how interviews were conducted and on how the data were analysed, as well as some of the issues and challenges encountered that may have influenced these processes (see Chapter 7). A further strategy involves immersion in the context of study. The lengthy time I spent in the field, and my residence with a local family allowed me to engage intimately with local people and culture, greatly improving my sensitivity to and understanding of subtleties of meaning in the data I collected. Additionally, at intervals throughout the project, I presented preliminary interpretations and results back to community leaders and members to ensure that I was accurately representing the meanings conveyed to me, and that my interpretations were plausible (see detail below).

All of the above strategies and practices contribute to different degrees in meeting the criteria for effective qualitative research, defined by Lincoln and Guba (1985, c.f. Baxter & Eyles, 1997) as credibility (authentic representations of experience), transferability (fit within contexts outside the study situation), dependability (minimization of idiosyncrasies in interpretation; variability tracked to identifiable sources), and confirmability (extent to which biases, motivations, interests or perspectives of the inquirer influence interpretations).

3.3.5 Ethics

All data collection procedures were undertaken with due respect for, and involvement of, local community members, following the main principles outlined in guideline documents regarding indigenous community-based research (Dene Cultural Institute, 1991; ACUNS, 1997; CIHR et al., 1998; CIHR, 2007), and the scientific research licensing process for the Northwest Territories (Aurora Research Institute, 2008). The research project was also reviewed and approved by the Wilfrid Laurier University Research Ethics Board. Participant involvement in all aspects of the project was voluntary and individual consent was granted through signed documents or, where appropriate, verbal agreement (APPENDIX H). A culturally-sensitive research protocol was discussed with FREWC members during my initial scoping visit, and all activities were designed to fit within this framework. All data were collected and analyzed in a manner that respected local culture, customs, confidentiality, and intellectual property insofar as possible.

3.4 Methodological Opportunities and Challenges

TK is often contrasted with scientific knowledge (SK), which includes both natural and social sciences. TK and SK are recognized as distinct knowledge systems, both of which contribute different aspects to the understanding of complex social-ecological systems. While the differences between knowledge systems cause challenges for knowledge integration, there is evidence that they may effectively complement each other in investigations of northern environmental change phenomena (Berkes et al., 2000; Berkes, 2002; Laidler, 2006). This project has incorporated complementary data and methods from both TK and social science sources, while also drawing on natural science data to better understand the holistic nature of the system of interest.

This section briefly explores how different types of information were used in this study, identifies relevant areas of overlap and complementarity between knowledge sources, and reflects on the importance of the community-based approach for obtaining quality data and achieving a more nuanced interpretation.

3.4.1 Incorporating interdisciplinary data for environmental management

As previously indicated, mixed project methods allowed the incorporation of multiple types of data and techniques at different project stages. TK and social science data were mutually informative throughout the project, jointly allowing an investigation of historical, current and projected events. Natural science data were included to help

analyze environmental change in the following ways: (a) through incorporation in the development of methodological tools, (b) as a complementary mechanism for informing and educating residents and stimulating discussion, and (c) as a complementary form of knowledge presented in the written analysis (see Chapter 4).

The concurrent paleolimnological study provided information on historical environmental change and the hydroecological characteristics of the SRD that proved complementary and beneficial in contributing to a more holistic understanding of the broader social-ecological system for both researchers and residents (Wolfe et al., 2007). Through reconstructions of past environmental conditions based on proxy data preserved in sediment profiles, paleolimnological data can be used to fill gaps in observational data and extend understandings of environmental change back in time beyond existing records and social memory. In this way, while I include some natural science data, its full integration or comparison with TK data is both beyond the scope of this study and not necessarily feasible or desirable. Its inclusion is not an attempt to validate observational data, but rather to portray different understandings of change and identify where they coincide to provide a more holistic picture of change. Further work to examine areas of complementarity and overlap in more detail will be undertaken in the future and published elsewhere (e.g. Brock et al., In review).

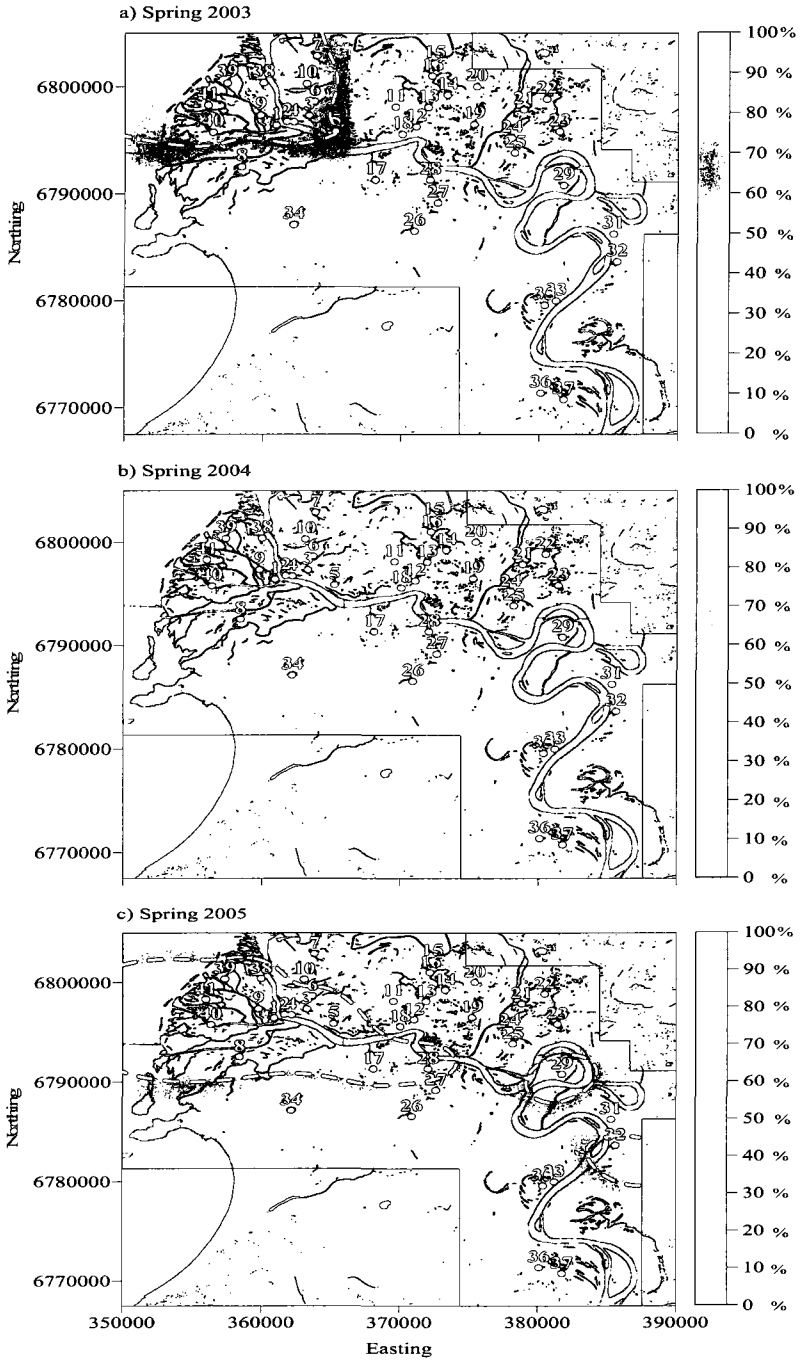
In the case described in this dissertation, the use of SK was important throughout the various project stages. First, scientific findings from the paleolimnological study contributed to the development of a useful tool for the current research. An analysis of

modern hydrological trends produced flood map images from spring 2003, 2004 and 2005 (Figure 3.3) that I used to stimulate discussion around flooding, variability and trends in the delta through informal interviews with local land users. Further, we were able to verify preliminary findings and interpretations from the hydrological studies with local participants (e.g. very high spring discharge in the Slave River in 1974 suggested a flood event, which was confirmed by locals). Resulting levels of congruency between natural and social science data reinforce the validity of interpretations based on both physical science and on land user observations elicited from semi-structured interviews.

Additionally, scientific data are often used to model the future environmental effects of climatic variability and change (Rouse et al., 1997), providing a foundation from which to build projections of community and livelihood vulnerability. In this study, natural science-based climate change projections were incorporated to determine baseline conditions for moderate and extreme climate change scenarios. The graphic scenarios used in this study effectively combined multiple types of knowledge to convey complex phenomena in terms of their influence on local livelihoods.

Figure 3.3: Spatial distribution of Slave River floodwaters in May 2003, 2004 and 2005

Flood distribution is defined by bright blue areas (marked by dashed line), interpolated from estimates of the percent dilution of lake water volume taken at numbered sample sites (Brock et al., 2008).



Second, scientific data offer an important tool for informing stakeholders through the provision of supplementary explanation about the causes of perceived environmental changes. In the current case, the Climate Days workshop, the community-researcher open house, and multiple presentations to local government and student groups provided excellent knowledge-sharing venues. Residents and scientists exchanged information and developed more holistic understandings of changing environmental phenomena in the region (e.g. water levels, forest fires, storms). One example where SK provided significant input was in relation to the SRD hydrological system. Where residents have long perceived the W.A.C. Bennett dam as the primary cause for modifying the system, scientific data and explanations were used to raise awareness and understanding about the important role played by climate variability and change (see Section 4.1).

Third, scientific data from the paleolimnological and other published studies have been incorporated to strengthen the analysis of environmental change in Chapter 4. For example, instrumentally recorded temperature and water discharge data are matched against local observations to identify congruencies and differences. Improved knowledge of broader trends (e.g. historical hydrological conditions over decades and centuries) can help place observational data and analyses into a longer temporal context (Smol & Douglas, 2007). As shown in earlier chapters, there is much overlap in the content of traditional and scientific knowledge (e.g. the identification of environmental changes such as water level fluctuations, river sedimentation, and flood frequency) as well as substantial complementarity (e.g. understandings of environmental phenomena such as

the drivers of hydrological change), providing a potential framework for mutual understanding.

While the importance of both scientific and traditional knowledge for understanding and managing social-ecological systems is recognized (Berkes et al., 1998; Berkes et al., 2003b), formal methods for effectively drawing on both while maintaining their integrity have yet to be devised, and may not realistically be feasible. Recent thinking questions the goal of data integration, suggesting that we must find new ways to effectively draw on each set of knowledge, while retaining the meaning of each within its own context (Nadasdy, 1999, 2003b). In the case of TK, this requires respect for elder and harvester knowledge, openness to non-science dimensions (e.g. spiritual values), and ensuring that the knowledge is not taken out of context. Together, SK and TK can provide a coherent, holistic understanding of impacts and adaptations related to change over time. Each type of knowledge has unique strengths, and thus plays specific roles.

Natural science and TK explanations of phenomena, such as the drivers of change and actual changes experienced within the system, often provide different pieces of information that can in some cases be combined to create a more holistic picture. For example, the extent of delta flooding in a particular year can be recorded from both perspectives, (a) through sediment sampling and analysis, and (b) through human observation. Results may provide complementary information, with natural science offering precise measurements regarding the relative timing and magnitude of individual

flood events (Wolfe et al., 2006; Brock et al., In review), while TK provides historical context and outlines human impacts and responses.

While human impacts of change (e.g. on the economy and the social system) are more commonly determined through social science and TK methodologies, there is scope for natural science to play a complementary role in some cases. For example, in Fort Resolution concerns about potential contaminants in traditional food sources have arisen as residents compile observations and information from a range of sources (e.g. observations of physical anomalies in harvested animals, perceived increase in local and regional cancer rates, and media and research reports outlining climate change impacts on northern wildlife and people). Natural science investigations can be used to determine contaminant levels and bioavailability in the environment, as well as food-health linkages.

While understandings of drivers and impacts of change may benefit from complementary sources of knowledge, studies of human adaptations lie more concretely in the realm of social science and TK. Scientific evidence can often help to explain the reasons for and provide details about specific changes; however, only the people who live the consequences are able to identify them in detail and assess their own livelihood impacts. An understanding of the social context improves the applicability and salience of physical science research and results by putting it into a practice-based context, and explicitly linking results to environmental management outcomes.

3.4.2 Treatment of the data

This dissertation treats issues that are difficult to define with fixed boundaries. While different themes are categorized herein for the sake of legibility and analysis, social and environmental aspects of the system overlap and influence each other in multiple ways, making it difficult to address individual components of the system. In reality, it is important to see the system as a complex web of interactions. There are many different variables which impinge on the perceptions of local residents, on the way that they communicated their perceptions, and on the manner in which they were interpreted by the author. Much of the data are qualitative and the interpretation is based on the experience and understanding of the author, who is not herself aboriginal. Ambiguities are inherent to this type of work, which raises often unanswerable questions. However, the complexity of the history and issues at hand would not be well treated through a more restrictive, quantitative approach.

My understanding of the data was greatly enhanced by my experience living and participating in community life for ten months over a period of two years. Furthermore, complementary experiences working with community-based ecotourism programs in South America and East Africa sensitized me to the type of social and political dynamics often present in small, localized indigenous communities. Awareness of this context allowed me to gain a feel for some of the motivations that drive behaviour, the historical events that shape current day realities, and the broader issues that concern local citizens. Throughout the thesis I draw on individual quotations from my interactions with them

relating to specific situations or themes. Although they are expressions of personal opinion, the sentiments expressed fall generally in line with the broader perceptions within the community.

Here, I have attempted to present local perspectives and traditional knowledge in a holistic manner, with due respect and acknowledgement for the people who were kind enough to share their views and knowledge with me. As an 'outsider', one is not privy to a full understanding of the multiple dimensions of such knowledge, and I can only hope that I have treated it with adequate care from the knowledge-holders' perspectives.

3.5 Summary

This chapter described the methodological approach used, outlined the various data collection activities, briefly summarized data analysis procedures, and outlined important methodological opportunities and challenges. This study was collaborative, field-based, and interdisciplinary within a process that is interactive, dynamic and adaptive. While the research focused primarily on TK and social science perspectives, natural science data were incorporated in multiple ways. The Fort Resolution case study is set within the context of a broader inter-disciplinary research initiative, and the importance of relationship-building is recognized as essential for ensuring that this type of work responds effectively to community interests.

Fieldwork was conducted during multiple field visits between June 2004 and November 2006. Data verification was undertaken in March 2007, and final results were presented to the community in November 2008. Each of the methods used in this study is discussed, as well as their interconnected nature. Methods included a two-day climate change workshop with two community member focus groups; semi-structured interviews with 33 land users and elders, and with 19 individuals involved in environmental governance; a social dimensions questionnaire of 104 households; five focus groups, three interviews and one workshop based on scenarios of future change; 15 field visits with local guides in different seasons; and participant observation throughout the ten months I spent in the field. The chapter describes the methods of analysis used in this study, including NVivo® software for interviews and focus groups and SPSS® software for numeric questionnaire data. Rigour and ethics were important considerations in this study, and data were periodically verified through presentation to community members throughout the project.

There were multiple issues and challenges related to the incorporation of different knowledge systems (TK, social science, natural science) within this study. This chapter explores how different types of information were used in this endeavour, and the relevant areas of overlap and complementarity between knowledge sources.

CHAPTER 4: ENVIRONMENTAL CHANGE, IMPACTS AND ADAPTATIONS

Things around the world are moving it. Not only fish, not only caribou – furs, everything moving around the world. It doesn't stay in one spot. Some years a lot there, some years gone. Rabbit – everything same thing. (King, 2005c, pers. comm.)

This chapter examines how environmental changes, with a specific focus on the SRD system, have impacted livelihoods in Fort Resolution and how residents have responded through different modes of adaptation. The changing relationship between residents and the 'land' (the surrounding environment) is central to this discussion.

The location and population studied provide an interesting combination of conditions for evaluating change and its effects. At the local scale, the people and environment around the SRD may not be experiencing climate change impacts as extreme as in Inuit communities in the high Arctic; regardless, the relative effects will be significantly higher than in southern Canada. Other environmental stressors are also affecting the traditional territory (e.g. river regulation and industrial development, both upstream and at the local scale). Furthermore, there are a number of socio-cultural stressors stemming from increased influence from the South which may affect the capacity of both individuals and the community to cope with change (see Chapter 5). While the combined influence of multiple stressors may be more striking in the Subarctic than in more remote and traditional Arctic communities, the case study in Fort Resolution reflects the complexity of influences and issues typical to other communities across the north.

This chapter focuses on the SRD as the central hydrological node and land use area in the DKFN traditional territory. Since environmental changes in this area have had the greatest impact on traditional land users, interviews on this topic targeted 33 informants who use the land consistently or have done so in the past. The chapter also draws on information from participant observation (guided field trips) and many informal interactions. Based on a discussion of the primary drivers of change, an examination of changes and impacts in the SRD focuses on key hydrological processes, drawing primarily on TK. This is supplemented by information stemming from the concurrent paleolimnological and hydrological research being undertaken by my colleagues. The inclusion of natural science data is neither an attempt to validate nor integrate the observational data with scientific data; rather I seek to portray different understandings of change and identify where they coincide to enable a more holistic understanding. The natural science data included here is by no means exhaustive, and focuses specifically on the hydrological system due both to its importance to Fort Resolution residents, and its position as a major component of the biophysical system that is experiencing multiple aspects of change. The chapter continues with a categorization of historically applied adaptation strategies, followed by the development of a framework of changes, impacts and adaptations to better understand their inter-relationships. Evaluating past responses to change aids in understanding current adaptive capacity and outlining some of the variables that influence it in this context.

4.1 Environmental change research in the Slave River Delta region

Recent detailed environmental history research in northern delta systems has focused in large part on the Peace-Athabasca Delta (PAD; e.g. Macmillan, 1996; Timoney et al., 1997; Wolfe et al., 2005; Timoney & Argus, 2006; Wolfe et al., 2006; Wolfe et al., 2008a; Wolfe et al., 2008b). Complementary studies are ongoing in the SRD to distinguish the effects of natural and anthropogenic drivers of change by reconstructing the delta's recent environmental history using high-resolution lake sediment records (Adam, 2007; Sokal, 2007; Wolfe et al., 2007; Brock et al., 2008; Mongeon, 2008). Natural science research suggests that the SRD has been experiencing an overall warming and drying trend since the 1950s, which became more pronounced as of the mid-1970s (Buhay et al., 2008), mirroring that of the PAD in northern Alberta (Prowse & Conly, 1996). This study's focus on community understandings of environmental change offers complementary perspectives about the nature of change, impacts on human livelihoods, and possible adaptations.

4.1.1 Drivers of change

Scientific and local observations of past changes in both the PAD and the SRD are most commonly attributed to three main drivers: natural deltaic evolution, climate change and regulation of the Peace River at Hudson's Hope (Bill et al., 1996; Prowse & Conly, 1996; Prowse et al., 2006; Brock et al., 2007; Wolfe et al., 2007; Wolfe et al., 2008a; Wolfe et al., 2008b). The upstream development of Alberta's Oil Sands is a more

recent stressor that influences both water quantity and quality (Campbell & Spitzer, 2007). Other localized sources of environmental concern in the DKFN traditional territory include the Pine Point lead and zinc mine (1964-1988), and hydroelectric regulation of the Taltson River since 1965 (Bill et al., 1996). Whether natural or anthropogenic, the implications of the above changes for water resources and hydrological regimes are particularly significant, with implications for land-based livelihood activities.

4.1.1.1 Natural deltaic evolution

Delta hydrology, controlled by the relationship between river discharge and basin water level, is important in shaping how the delta develops (Gardner et al., 2006). The active part of the SRD is located downstream from the point where the Slave River begins to bifurcate into several distributaries (Figure 1.1), while the upstream portion is considered relict (English et al., 1997). The active delta is divided into three distinct morphological zones (outer delta, mid delta and apex) based on flood frequency. The younger, outer delta is flat (levees at or within 0.1 m of Great Slave Lake low summer water levels) and dominated by emergent vegetation. The apex is the oldest portion, with high levees (2.3-3 m) and mature forest communities dominated by white spruce. The mid delta is the transition zone between outer and apex portions, with 0.5-2.5m levees and predominantly alder-willow vegetation (English et al., 1997). During spring break-up, river water can breach the levees and flood the many small delta lakes and sloughs. In

the mid and outer delta, river flooding provides the dominant water input to such lakes with the outer delta being particularly susceptible (Brock et al., 2007, 2008).

Spring floods also deposit sediment to form submerged levees at the mouths of active distributary channels. As these build up, driftwood becomes lodged in the sediment, followed by the invasion of emergent vegetation, creating cleavage bar islands. This continual process of stabilizing these landforms and enhancing sedimentation causes the delta to prograde into Great Slave Lake (English et al., 1997). While progradation is the predominant direction of delta development, simultaneous erosional processes are also present (Gardner et al., 2006). The erosional influences of Great Slave Lake (e.g. wave and ice action; Prowse et al., 2002) and wind-forced seiche events act to limit sediment accumulation. However, these become less effective once cleavage bar islands stabilize and are sufficiently established (English et al., 1997; Gardner et al., 2006).

The SRD has also experienced significant redistribution of flow among channels, a common natural phenomenon for an active delta (Prowse et al., 2002). English et al. (1996) estimate that both the flow and widths of East and Steamboat channels have decreased by 50% between 1946 and 1994, while the flow in ResDelta channel has doubled, making it the dominant outlet. At the same time, overall declines in cleavage bar island formation were observed, which is consistent with a noted reduction in rates of sediment-transporting flow (Prowse et al., 2002).

4.1.1.2 Climate change

During the past century the Mackenzie River Basin (MRB) has experienced average warming of 1.5°C, a trend that is projected to continue, and that may lead to an overall warming of 4°C or 5°C by mid-century (Cohen, 1997a; ACIA, 2004, 2005). This phenomenon, coupled with increased variability and more extreme climatic events, will continue to have a range of biophysical and related socio-economic impacts. Shifting and more variable climatic conditions compromise the integrity of hydrological regimes, ecosystems, economic development, infrastructure maintenance, and the viability of traditional aboriginal livelihoods (Cohen, 1997a; Malcolm, 2002). Community members in Fort Resolution have been observing these effects on the hydroecological system, which are important for culture, travel and food security.

Climate variability over the past several decades has affected hydrological systems in the region, with particular emphasis on the sensitive deltas. Periodic droughts and reductions in ice-jam induced flood events (e.g. due to reduced snowpack and changes in ice quality) affect water replenishment and retention rates of delta basins (Prowse et al., 2006). Furthermore, simulations of pre-regulated and naturalized conditions indicate that climate variability has the tendency to increase the amplitude of water-level fluctuations and both the timing and magnitude of peak water levels (Gibson et al., 2006b; Prowse et al., 2006).

The Peace River contributes approximately 66% of the annual flow to the Slave River (English et al., 1997). Reductions in flow peaks and the amplitude of water level variation (Prowse et al., 2006), shifts in seasonal flow patterns (Prowse et al., 2002) and changes in the sediment transport regime (English et al., 1996; English et al., 1997) have been noted in the Slave River since the mid-1900s. While the average annual sediment load has lessened, there is increased transport during ice-on flow and decreased transport during ice-off flow, with implications for delta progradation. These shifts, combined with changes in distributary channel morphology have negatively influenced the growth rate of cleavage bar islands on the outer delta. Studies also show a trend towards a drier, less productive environment in the outer delta (English et al., 1996; English et al., 1997). Although the effects of climate change on the Slave River Delta are not yet well understood, ongoing studies suggest that many of these changes are due to climate-related drivers rather than river regulation as previously believed (Brock et al., In review).

4.1.1.3 River regulation

Since the W.A.C. Bennett Dam was constructed in 1968 on the Peace River in northern British Columbia, concerns have arisen about its potential effect on downstream systems throughout the MRB, stimulating multiple assessments and influencing management strategies (Macmillan, 1996; Prowse & Conly, 1996; Prowse & Conly, 1998; Stuart Adams & Associates, 1998; Peters & Prowse, 2001; Mackenzie River Basin Board, 2003; Wolfe et al., 2005; Prowse et al., 2006; Wolfe et al., 2006; Wolfe et al.,

2008b). Aboriginal populations (e.g. those in Fort Chipewyan, Fort Smith and Fort Resolution) living in the upper MRB have observed changes in water quality and quantity, which they attribute in large part to operation of the dam and upstream industrial development (Bill et al., 1996; Stuart Adams & Associates, 1998). For example, residents in Fort Chipewyan indicate that "naturally occurring ice dams flooded the land regularly in the past, but in recent years this has not been observed and is believed to be linked to the control of the water regime on the Peace River by the Bennett Dam" (Bill et al., 1996: 190). The primary effects of environmental changes noted by Fort Chipewyan residents to have occurred in conjunction with dam development include impacts on wildlife and the subsistence economy, and a lingering sense of injustice, hurt and anger towards B.C. Hydro (Stuart Adams & Associates, 1998). Fort Resolution residents have made similar linkages between river regulation and their own livelihoods.

They built the Bennett Dam and held water back for three years to fill the reservoir. The prairies and sloughs used to be full of rats so they kept the willows down; they chewed on the shoots. ...The rat population will go down ...and after a flood it will rebound. ...Where they held the water back, the land dried out and willows started to grow. There weren't enough rats to keep them down, so ...the slough will never go back to being good rat habitat. (Beaulieu, 2005a, pers. comm.)

However, while noticeable long-term shifts in hydrological conditions are perceived by many locals in Fort Resolution to correlate with river regulation, recent research suggests that its role may be limited (Adam, 2007; Mongeon, 2008). In fact, research from the PAD that draws on environmental evidence from the last 1,000 years indicates that water levels were already in decline at the beginning of last century. The study concludes that climate, rather than river regulation, is the overwhelming driver of both hydrological and ecological change in the region (Wolfe et al., 2008a).

4.1.2 Community perspectives on changes and impacts

Environmental change is a common topic of conversation in Fort Resolution, where locals often discuss their many observations of change and related impacts. Residents are concerned about the impacts and generally interested in what they can do as individuals and as a community to mitigate negative outcomes. The changes most often recognized and discussed by local harvesters and elders are those directly related to their livelihoods, focusing in large part on components of the hydrological system, the foundation of their transportation network and essential habitat for traditional food and fur species. Changes in water levels, ice and snow, and river break-up and flooding were each noted by over two thirds of those interviewed (APPENDIX I). Knowledge about the functioning of these elements is important for travel and land use, and also to understand indirect impacts on other ecological parameters (e.g. wildlife and vegetation). Many changes and related impacts are more prominent during certain times of the year due to the seasonal nature of predominant weather and land use patterns.

The nature of most of the changes described was fairly consistent across interviews. Variability within the responses can be explained through differences in a number of factors (e.g. informant age group, boundaries of spatial knowledge, primary land use activities, intensity of land use over time, and the timing of recent climatic events).

Those who use the land or its resources directly are significantly affected by change, as are the many others who rely on the food and furs these users obtain. Primary environmental change impacts include increased difficulty in planning travel on the land, travel safety concerns, limited access to land-based activities, and decreased pelt values as fur does not reach prime in warmer conditions. A discussion of these changes and impacts follows, focusing on the primary role played by the hydrological system in both understanding change and in supporting local livelihoods.

4.1.2.1 Climatic variables

Fort Resolution and its surroundings are characterized by a climate that fluctuates seasonally, with long, cold winters and short, warm summers. Climate data from the nearby town of Hay River indicates a mean annual temperature of -2.9 °C, while mean temperatures for January and July are -23.1 °C and 15.9 °C, respectively. A total of 320 mm of precipitation falls annually, 200 mm of which falls as rain in the ice-free season between mid-April and mid-October (Environment Canada, 2002).

In Fort Resolution, many informants reported changes in climatic variables, including temperature, precipitation, winds and storms. Seasons are also included here as a category as they represent the temporal dimension of the relationship among the other climatic variables. More specifically, local seasonal observations are almost exclusively linked to temperature (Table 4.1). Although the initial stages of some of these environmental trends were observed in earlier years, the cumulative evidence from

interviews and informal discussions indicates a shift towards increasing rates of change in many variables since the 1960s.

Table 4.1: Summary of changes in climate variables observed by interviewees

Variable	Observed Climatic Changes	Livelihood Impacts (+/-)[8]
Temperature	• Warmer winters since the 1960s • Variable spring temperatures; cool weather lasts longer • Variable summer temperatures	• Various effects on animals and harvesting activities (see Section 4.1.2.3) (+/-)
Seasons	• Seasons more spread out; less abrupt seasonal changes • Longer spring • Longer fall – cold weather comes later • Shorter winter	• Travel safety concerns during transitional seasons (-) • Shortened trapping season (-) • Longer recreational boating season (+)
Precipitation and snow pack	• Variable; increasingly unpredictable • Winter rain occurred several times in recent years • Lower snow pack generally; more inter-annual variability	• Lack of snow can limit snowmobile travel (-)
Winds and storms	• More variable and unpredictable winds and storms • More extreme events • More prevalent and longer lasting summer winds during the past four to five years	• Reduced certainty for travel planning on the land (-) • Increased chance of being 'windbound' on the lake (-)

Most observations of significant change were fairly consistent across key informants. Observed changes and their relationship to human impacts are explored below.

[8] Impacts are designated as positive (+) and/or negative (-) based on their noted effect on local people and livelihoods.

4.1.2.1.1 Temperature

Shifts and variability in the climatic regime are causing concern as such trends become more frequent and more pronounced. Temperatures are generally more variable than in the past, leaving locals uncertain about what kind of weather to expect.

There is some changes. Like last year for instance ... the weather was really bad and cold until the end of May almost. And it's different again this year. ... It's always changing, it's never consistent. You never really see any consistency over a period ... it's never the same. (Lockhart, 2005, pers. comm.)

The most pronounced trend is the change in winter temperatures. Elders remember that winter temperatures commonly dropped to -50 degrees Celsius during their youth and early adulthood. Most noted a gradual change as of approximately the 1960s. Winters now tend to be warmer and shorter, generally with less snow. Furthermore, conditions are noticeably more variable, with temperatures fluctuating from one day to the next.

The winters aren't as severe as they used to be when I was a kid. Seems like now it's spread out more, you know like the fall is cooler. Like right now in the summer it's a bit cooler. [In winter] it seems we don't have the severe cold, cold weather for long periods of time. (Balsillie, 2005, pers. comm.)

When I was a kid, I remember out in the bush some guys they'd hole up and would live in the log house near the standing trees. ...The house would crack ...50 below when I was a kid and it's not like that now. It's a warmer climate now. The most cold it gets is maybe about 30 [below]. Not very often do we get 40 [below]. (Giroux, 2005, pers. comm.)

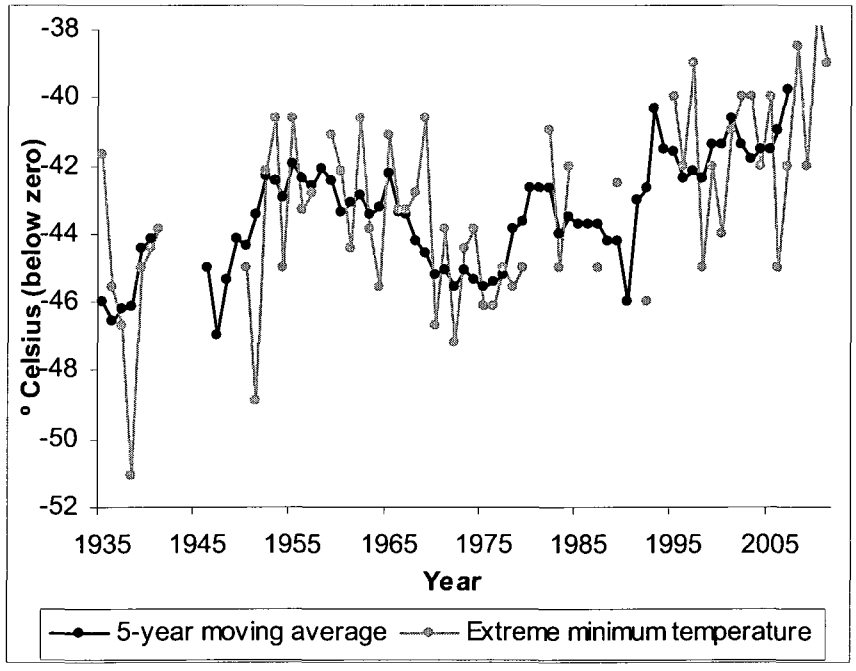
It doesn't freeze as much as it used to freeze, eh? I remember when I was a kid, you could walk across the snow, and you could hear people walking from a quarter mile away because it's so cold. The sound carries a long way, eh? (Fabian, 2005, pers. comm.)

Before, it used to be pretty cold too, sometimes it would be over 50 below. Colder summers and warmer winters now. ...Gradually went like that. (Smith, 2005, pers. comm.)

[In the 1950s] one old man told us, "Boys" he said, "the world is changing". How? Said you'll never see 60 below weather, you'll never see 50 below weather – it left a long time ago. And that's true...I started to watch the weather then. I never seen 50 below yet, I never seen 60 or 70 below yet. And the old days was ...really cold. Late [in the] year, just like dropping a bomb around the lake. The ice is cracking, the trees is cracking, everything is cracking. Too cold. And that one is gone; you never see that again. That's how we know the world is changing. You see the world is changing because we know the old days is not like today. (King, 2005c, pers. comm.)

These observations are consistent with instrumentally recorded temperature data from Fort Resolution that indicates a rising trend since the late 1960s in extreme minimum temperatures. Extreme minimums since the early 1990s show a consistently higher average than any other period on record (Figure 4.1).

Figure 4.1: Extreme minimum temperature in Fort Resolution, 1934-2006
(Environment Canada, 2008)



Summer temperatures are noted by locals to be more variable, with some summers being quite hot, and others (especially several in recent years) being cooler than usual. Instead of fluctuating day to day, informants indicate that a specific temperature trend commonly prevails over the entire season.

4.1.2.1.2 Seasons

The annual cycle of seasons is often described through its relationship to changing climatic variables. Elder Gabe Yelle described it as such. Spring begins in April when it warms up; summer begins in late May after ice break up and green-up, and is in full swing in August; fall begins in late September when the leaves turn colour; and winter begins when the snow comes in late October (Yelle, 2005a, pers. comm.).

Recently, residents have observed that the seasons tend to shift more gradually from one to the next, whereas they are used to more abrupt seasonal changes. They have also reported changes in seasonal timing. The arrival of spring conditions is more variable, and the season has recently been lasting longer. Fall conditions are extended, delaying the arrival of winter.

The weather pattern has shifted dramatically. March used to be nice but windy, and then spring would begin in April when the weather started to warm. Recently, we have had some long cold springs which did not used to happen. It used to get steadily nicer as of April and warmer after break up. (Yelle, 2005a, pers. comm.)

The springs were getting later now. Like it'll melt, but if we have a cold spring [like this year], only now [in the third week of June the water is] starting to run out now for the summer. (Anonymous 1, 2005, pers. comm.)

These shifts influence the proportional allocation of seasonal conditions throughout the year. Winter has long been the dominant season, lasting from November to March, and remains the primary trapping season. However, as winter conditions become warmer and the seasonal duration is reduced, this has substantial impact on winter travel and harvesting activities.

4.1.2.1.3 Precipitation

Residents in Fort Resolution have observed that precipitation events are generally becoming more variable in terms of onset, timing and duration, resulting in less predictable weather patterns. Travel on the land is highly impacted by inclement weather, and reduced predictability challenges land users' capacity to plan outings and travel safety.

Now it's not much snow as it was before. There's was lots of snow, not that much now, not much snow, not much rain now too sometimes. This summer was not much rain sometimes, sometimes lots of rain. Always changing. The weather is now changing fast. Not as cold as it used to be fore, sometimes it's really hot in the summer, too hot. (Sayine Jr., 2005, pers. comm.)

In fall time I remember it used to rain lots in the fall. Now we don't get that much rain in the fall. (McKay, 2005c, pers. comm.)

Winter precipitation is of particular interest. Several participants noted that it has rained several times during recent winters (Workshop Participants, 2005, pers. comm.), which interferes with travel and trapping. Rain can freeze traps, rendering them useless

until reset. It is also a danger on the roads for those travelling between Fort Resolution and Hay River, especially since locals are not used to this phenomenon.

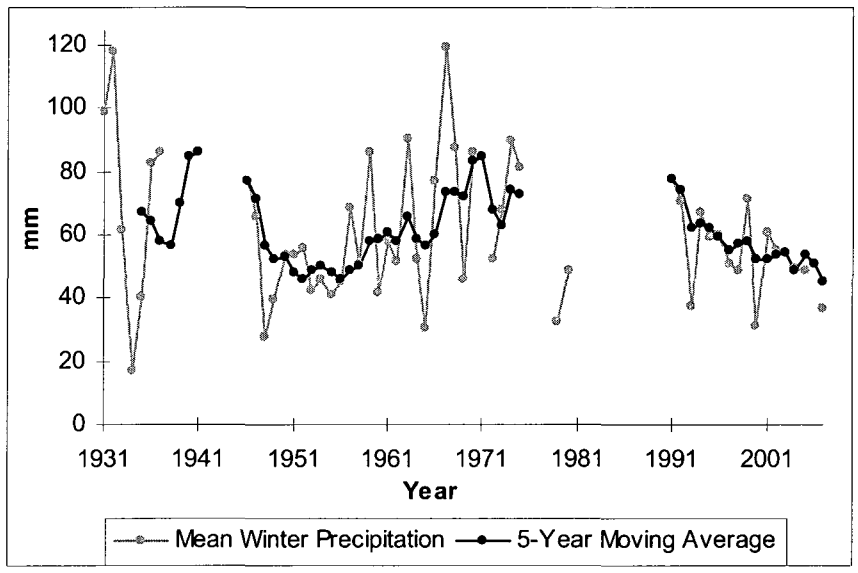
For about 15 years it was really warm out in the trapping. It rained twice one time. (Anonymous 1, 2005, pers. comm.)

Even in the winter we got rain a couple of times. (Mckay, 2005d, pers. comm.)

It never rained after it snowed. Now we're starting to get ice rain landing; the roads were slippery. (McKay, 2005b, pers. comm.)

As well, interviewees noted that the snow pack has been variable during the last few winters, with a trend towards reduced snowfall. This trend can be detected in the instrumental record, which shows a general, although variable decline in winter precipitation since the early 1990s (Figure 4.2). However, these records also indicate that the low levels of winter precipitation are not unprecedented.

Figure 4.2: Mean winter precipitation (December-March) in Fort Resolution, 1931-2007
(Environment Canada, 2008)



To me, everything started changing from 1960 – even the weather, even the snow. I used to go and get snow about this time now ... and there was usually snow so deep those days! ... I used to fill up two barrels for the next day to wash the kids' clothes. And they ... walk around in the snow in their little running shoes now. ... There used to be big snow banks, there's nothing any more. The best country [where] we'd go for rabbit snares now has hardly any snow. I remember anybody who had to go in the bush had to use snowshoes in those old days. ... Now there's no snow. (McKay, 2005a, pers. comm.)

I know before we used to get lots of snow. Every year we used to get lots of snow but I see now that changes. ... Eight or nine years ago it wasn't the same. ...We got a little more snow [this winter], but not so much as before. ...We used to get at least two feet in the bush, but by the lakeshore [it was higher] from the drift. (Beaulieu, 2005c, pers. comm.)

Well I've noticed in the last 20 years that we don't get as much snow as we used to I don't think. I remember when I was younger, a lot younger we used to get a lot more snow. ...We used to have huge piles of snow outside of our place, and we used to tunnel through it. Now it we just don't have the same amount it seems. (Balsillie, 2005, pers. comm.)

We used to get a lot of snow before, and now we're hardly getting any snow. Like [now] when you'd be commercial fishing, most of the time you have to chisel ice to get ice to put on top of your fish [because] there's no snow. If you've got snow, then you could use the snow on top of your fish. ... It should be up to at least eight feet of snow every year, like in the olden days, when everything was cold, too. (Lafferty, 2005a, pers. comm.)

Interviewees also notice that the snow is freezing differently than in the past due to the warmer temperatures. As the snow pack builds up throughout the season, or in the weeks after a snowfall, the snow is deep and difficult to travel on. In colder temperatures a crust forms on top of the snow, allowing snowmobiles to travel on top. Conversely, recently land users are reporting higher incidences of 'dropping' their machines into the deep snow or burning out the motors due to a lack of crust.

On the lakeshore you [can easily] drop the Skidoo. ... There's no crust on the snow anymore. ... On the rivers, too, it's hard traveling. Even last winter, it was really deep. ... To get wood you're going to have to [make] a road to get out there. Couldn't [travel] pulling a toboggan [because it is too weighted] down. (Fabian, 2005, pers. comm.)

The deeper it is the better, because you've got softer snow and better for traveling. Say you have three feet of snow in one night, then it's hard traveling. But ... another two or three weeks of it and the snow settles while you're gone, it packs a little bit. But I've traveled in three foot of snow and burned all my Skidoos out, you know, trying to go through them – seized all the motors, got too warm for them. But if it's cold ... the snow will go down, and then you stay on top of the snow. If it's warm, it's slushy. ... [and] you're always doing this pushing and stalling. Everything gets stuck in the Skidoos. Dogs don't even like traveling in the thick snow, but after it's cold the dogs just love running. (Lafferty, 2005a, pers. comm.)

4.1.2.1.4 Winds and storms

Several interviewees noted that winds are now occurring at atypical times of the summer, and often last longer than in the past. One local recounted the predictions made by four elders – two from Fort Resolution and two from Lutsel K'e – several years ago. They indicated that big winds would be coming to the Akaitcho Territory region due to changing climatic conditions.

There are more winds than before. The wind now is noticeable, more wind. Before there was hardly any. Now all of a sudden the wind will come up, it will be big waves. It just comes up all of a sudden. ... It was always just warm and nice in June and July, but not now. It's windy and cool, it's not like before. (King, 2005b, pers. comm.)

Last two years I think there was straight northwest winds steady, and northeast. Mostly what it is — odd year — last year in the springtime, when we were leaving [Rocher River], there was only one bit of south wind, so that's all we got out of it. That north wind didn't really go out. That is mostly northwest, northeast winds steady now for a little while. (Smith, 2005, pers. comm.)

I've never seen so much wind on Great Slave Lake as this year. It was so noticeable. Over the last 10 years, more wind, but this year is like no other. ...When I got out to my camp on April the 27th it blew for 31 days straight. North and northeast wind blowing constantly. And that is what kept the birds basically grounded, you know, waiting for a southern breeze or a break in the wind so they can have a better flight in to [the] barren lands where they nest. So wind is a big noticeable factor. (Balsillie, 2005, pers. comm.)

Furthermore, in summer the winds do not calm consistently in the late evening and overnight. Many people choose this time to travel by boat on the lake. However, unpredictable winds make it more difficult to plan a return trip, and land users are more likely to be stuck or 'wind bound' and unable to travel for one or more days as a result.

Interviewees reported that storms or extreme events are occurring in unpredictable patterns. Henry Yelle (2005b, pers. comm.) noted that storms used to occur in June and July, and it was strange to recently experience thunder, lightening and rain in September.

It's getting extremes. You still have short little patterns on the extreme ends, like when you get a storm like a couple of years ago [when we got] a real extreme summer storm [with very] high winds. ... In the winter you get the real high blizzard or something like that, a whiteout. Those changes I've noticed. (Lockhart, 2005, pers. comm.)

Winter storms often shut down the town and transportation routes for one or more days, and are also a hazard for land users if not expected. Summer storms can equally strand boaters out on the islands or shoreline of Great Slave Lake, preventing them from travelling.

Changes in the above climatic variables lead generally to a more variable and unpredictable climate, making it more difficult for locals to 'read' and anticipate the weather. These variables play out in conjunction with other elements within the environment, especially elements of the hydrological system and the ecological system. These interactions and impacts for human livelihoods are further explored below.

4.1.2.2 Hydrological system

The dominant hydrological feature in the DKFN traditional territory is the SRD, which lies just 10km from the town of Fort Resolution. While the Taltson River to the east and Little Buffalo River to the west are also noted as important travel and harvesting areas, this analysis focuses in large part on the SRD system. This focus facilitates comparison with ongoing, complementary paleoenvironmental work in the delta (Wolfe et al., 2007).

Major hydrological events in the SRD include the spring freshet (thaw-induced flow increase) and periodic flooding, both of which influence physical, chemical and biotic attributes of the aquatic system (Brock et al., 2007, 2008; Sokal et al., 2008). Informants describe flooding as a "washing of the land" whereafter everything seems brighter and cleaner (Bill et al., 1996: 223). Parallels can be drawn between some of the patterns observed and communicated by local elders and land users with evidence from the scientific community to better understand the types of hydrological change taking place. Observed changes and related human impacts are outlined in Table 4.2.

TK perspectives regarding the impacts of climate variability and river regulation on the SRD hydrological system focus on the predominance of certain types of change. Primary trends include increased variability in flow timing, lower water levels, more rapid and less frequent dynamic river break up, later freeze up, and more unstable ice.

Table 4.2: Observed hydrological changes in the Slave River and Delta

Theme	Observed hydrological changes	Livelihood Impact (+/-)[9]
River discharge	• Increased flow variability since late 1960s, especially in winter; winter release causes water to overflow on the ice • River current is not as strong • Flow fluctuations increase bank and bottom erosion • Redistribution of delta flow due to sandbar and vegetation build-up	• High beaver mortality with winter flooding; reduced hunting and trapping return (-) • Overflow reduces snowmobile safety and access (-) • Sediment build-up reduces boat access on river, delta and lake shoreline (-)
Water levels	• Lower water in river, sloughs and Great Slave Lake since the 1970s	• Reduced boat access to hunting areas for moose, muskrat, beavers, geese and ducks (-)
Freeze up	• Later freeze up • Longer period of ice instability • Increased snowfall before freeze up • Increased variability in timing and ice quality	• Snowmobile travel delayed (-) • Reduced travel safety on ice (-)
Ice thickness and quality	• Thinner ice in rivers and Great Slave Lake • More air pockets in river and lake ice • More unstable ice • Ice not as strong or clear as it used to be • Dirtier ice on river (more sediment in water) • Variable freezing and melting; more frequent overflow	• Travel on ice is limited, especially during fall and spring (-) • Reduced travel safety on ice (-)
Break up and flooding	• Earlier ice break up • Increased variability in break up timing • More rapid and less dramatic break up • Fewer ice jams since regulation • Fewer and less significant floods since regulation	• Drier sloughs and ponds – reduced habitat for beavers, rats, moose, bison (-) • Only main channels accessible by boat (-) • Shorter spring trapping season (-) • Decreased travel safety for spring ice travel on Great Slave Lake (-) • Earlier boat travel with fast break-up (+) • Rocher River land users (who stay there during spring) can access town earlier (+)
Water quality	• More contaminants in river and lake water • More sediment in river and lake water	• Concerns regarding water consumption (-) • Possible secondary effects on animals (-)

[9] Impacts are designated as positive (+) and/or negative (-) based on their noted effect on local people and livelihoods.

4.1.2.2.1 River discharge

Local observations indicate increased variability in flow in the Slave River since the late 1960s. Interviewees described overall lower flows and slower current in spring and summer, coupled with increased sediment build-up and turbidity in the channels. In 2005, for example, excess sediment made it difficult for boats to exit Nagle channel into the main river channel. Locals also described increased flow variability during the winter. Although locals cannot directly observe water levels during the ice-on season, a water release from the dam can cause water to 'overflow', seeping through cracks and fissures onto the ice. This occurs near the mouths of both the Slave and Taltson rivers, both of which are influenced by river regulation upstream. The cracks and resultant slush and water are safety hazards and can limit access to certain areas. Winter water releases also cause significant beaver mortality.

When they first put in that Taltson River [dam] there, the water got so low. And then they let it go in the winter because the ice was building up on the river. So if you're crossing to say set your traps, sometimes you're in the water in the winter time. (Lafferty, 2005a, pers. comm.)

They had more overflow [on the Slave River] because of the hinging of the river. ...You've got ice under and then you've got four feet of overflow sitting on the edge that freezes, right? And then the natural overflow freezes again and pretty soon you get eight feet of ice that's holding that hinge together. ...That makes for a late spring now because of all that freezing along the riverbanks. Because that hinge drops way down and then the water flows in again ...it just fills up with water. And then sometimes you have to go 10 miles down the river before you can get ashore because you have 200 feet of overflow that flows for two feet. ...That is the kind of impact brought on by something like the Bennett dam. ...That's been occurring more notably since the '60s when they built that dam. And the same thing is occurring on the Taltson River with the little Taltson dam. (Unka, 2005b, pers. comm.)

4.1.2.2.2 Water levels

Interviewees reported a trend toward lower water levels in the SRD channels, inland sloughs and Great Slave Lake since the 1970s. Correspondingly, hydrological modelling results show a net reduction in annual water level variability and annual maximum levels in Great Slave Lake (Gibson et al., 2006b), with the lowest levels observed during noted dry periods (1980, 1981, 1995) and during the period of reservoir-filling behind the Bennett Dam (Prowse et al., 2006).

Pretty well any place you go ... I went to Rocher River a few times, and even there according to my elders older than I, they'd say "oh yeah, we used to go in here, fly in here and boat in here". Now it's a bunch of willows. So, all that water just dropped. It's unreal, and it's too bad. Now the muskrats; I remember I used to go back in Jean River [into the] prairies. Now when I go back in there's nothing, no water. [It's like that] all over the place. I'd just go back in there, we went all over with traps, and you can't do that now. Everything's changing. (Mandeville, 2005, pers. comm.)

During the ice-free season, low water levels and sediment accumulation in the Slave River and delta inhibit hunter access to habitat for traditional species such as moose, muskrat, beavers, geese and ducks. Instead of being able to travel along the lakeshore or across the delta through the smaller channels, boaters are forced to travel up and down the major channels, often increasing the distance, time and gasoline required.

The channels are drying out, the water's going lower and lower. ... The sand that's coming down the river is closing off the channels. ... If you don't know where you are going, you could be high and dry and stuck there; these boats are heavy. (McKay, 2005c, pers. comm.)

During the summer, it's different again because the water is so low. Sometimes you can't go through the channel now, closing up. (King, 2005c, pers. comm.)

If the water is high then you can pretty much go in any channel. ... When the water's low you've got to take the long way all the way up the river. It takes a lot more time. (Lafferty, 2005b, pers. comm.)

The whole country, the whole land, the whole environment is changing because of low water level. I can see the changes in the trees, in the ways plants are growing. Some of the food is drying out, some traditional pathways are overgrown because of lack of water. (Yelle, 2005a, pers. comm.)

Some interviewees noted a similar drop in water levels on the Little Buffalo River and on the Taltson River during the past several decades.

The last time I went up [Little Buffalo River] was in 1982. ... [Still] lots of water. Now there's hardly any. Even the break-up in the springtime, they come in and say "there's hardly any water, we had a rough time coming down that big rapid!" (Mandeville, 2005, pers. comm.)

Because of the hydro dam on the Taltson River the whole system has changed drastically and never really recovered. (Lockhart, 2005, pers. comm.)

When they first put the dam on the Taltson River you could see the high water mark on the rock, on the shield rock. That's how much the difference has been. So all the routes are changed, because all the rocks are exposed now. (King, 2005d, pers. comm.)

It could be the dam ... on the Taltson holding all the water back. ... I remember ... when I was a kid, before they put that dam in that water used to be higher. After they put the dam in the water became lower. (Giroux, 2005, pers. comm.)

[On the Taltson River there] used to be a lot of [water] falls, now it's just dripping. Before you couldn't walk across, you had to meet the boat. Now you can walk across. ... The water went down. (King, 2005b, pers. comm.)

I used to go hunting ... in Gaudet Bay [at the mouth of the Taltson]. There're moose tracks in there. Now from here to there, you can't hardly paddle in summertime now; it's too shallow. (Yelle, 2005b, pers. comm.)

4.1.2.2.3 Fall freeze-up

Freeze-up occurs on the Slave River between late October and mid-November. Frazil slush particles float down the river, agglomerating into ice pans (Beltaos, 2000) which cluster together in the delta near the mouth of the main channel. Once the temperature lowers to near zero, the slush starts to crystallize, eventually forming a solid platform on which to travel (Lockhart, 2005, pers. comm.). Some land users notice that it now takes longer for this process to occur than in the past, and this variability in freeze up timing has an effect on trappers who are eager to get out on the land. During freeze-up, the river is impossible to cross, greatly limiting travel. The trapping season officially (legally) opens on November first (Government of the Northwest Territories, 1992), and those who trap full time in the winter are unable to maximize their efforts due to the warming trend that results in later ice freeze-up. Furthermore, safety concerns for land users are heightened, especially early in the winter season, due to instability of the ice relative to colder winters in the past.

When the fall in the olden days gets cold, it gets cold right now [instantaneously], everything freezes. But now, you'd be one month before it would even get cold enough to get out on a Skidoo. For a month, two months, you know...it's really bad now. Yeah, it's really changed now. I've been trapping [in the olden] days in the first of November. You know, I was out with my dog team or my Skidoo. Now it'll be the end of the month before I can go anywhere. It's getting worse and worse every year, like two or three days later. (Lafferty, 2005a, pers. comm.)

That's sort of a concern; it takes longer to freeze in the fall because it's warmer. (McKay, 2005b, pers. comm.)

That's different too, that freeze-up. ...Usually frozen by November – you know, first week of November, it's frozen good. Now first week of November ...the river's still open.

Sometimes you gotta wait until just about before Christmas to go out because the river's still open, not frozen hard enough. ... Well the animals, too, are a month off. Geese are coming late this year. ... To me it sort of seems late. ... To give you an example there, [we were] hunting geese last year with a Skidoo and we're normally there with a boat. I think it was May. (Delorme, 2005, pers. comm.)

Like with creeks and the flood river channels they're on, it wasn't freezing as quick. There was lots of water. (Anonymous 1, 2005, pers. comm.)

Yeah, it freezes a little later now; I guess it's not as cold as before. It makes it harder in the fall because it takes longer to get to a place, so it's a little harder. (Giroux, 2005, pers. comm.)

4.1.2.2.4 Ice thickness and quality

Interviewees report that ice thickness and quality are changing. In the early to mid-1900s the lake ice was commonly about eight feet thick (Lafferty, 2005a, pers. comm.), a level that is also consistent with that measured in the early 1800s (Smith, 1822). Interviewees remember digging holes in the ice that were taller than they are to put nets out for fishing. Now the ice only becomes solid enough to travel on much later in the season, and may only attain two or three feet of thickness.

Since I was a kid ...it's starting to get warmer. 'Cause it used to get cold before. I remember setting nets with my dad in the winter and the ice was thicker than us. (Lafferty, 2005b, pers. comm.)

The ice used to be thicker in the rivers and lake. I used to set a net behind Moose Deer Island in the 50s to 70s and the ice was over six feet deep. Now a fisherman's lucky if he finds two feet of ice. (Beaulieu, 2005a, pers. comm.)

Wherever you go out on the lake there, it would be eight foot of ice. Now it's through the whole winter you'd be lucky if you get three feet of ice. So it's hard to go out fishing now

in the winter. ... You've got to [wait] really late to get in there – way after Christmas before you can travel with all the [heavy] gear and way out [away from shore]. (Lafferty, 2005a, pers. comm.)

I remember this guy was chiseling and he was about five feet in, and he was standing in the hole chiseling away. And you can pretty well hear that thing going underneath making the noise, "boom, boom". ... We said "oh, don't go through now!" He just kept going. But now, the thinness of the ice is now as thick as about three feet. And it used to be about seven or eight feet. ... It just keeps getting thinner. (Mandeville, 2005, pers. comm.)

In addition to reduced thickness, the quality of the ice has also changed in some locations. Several interviewees noted that it is essential for those who travel on Great Slave Lake during the winter to know the ice, and be able to pinpoint where the dangerous locations are. Thin ice, and sometimes open water, can often be found in the narrows between islands or between the lake's shoreline and an island. However, seasoned travelers have noted that the ice in other traditionally safe areas is less predictably safe.

In the old days you can walk any place [on the ice]. Today you can't do that. (King, 2005c, pers. comm.)

Thin ice poses an additional travel safety issue with the conversion from dog team to snowmobile. Mushers put a lot of trust in their dogs to choose a safe route. Now with fast-moving machines, and in some cases less knowledge of the area (especially the youth), locals have expressed concern about the safety of winter travel.

Before, with dog teams, you could tell where the ice is white – it would be more solid. Even around break up time, you could tell where the light ice was and where it was safe to cross. The dogs would know instinctively and follow safe ice. Darker ice is dangerous. Nobody used to use lifejackets, and they'd use small hunting canoes to cross the river. My grandfather told me what to watch for. (Beaulieu, 2005a, pers. comm.)

A related issue noted about the river ice is the appearance of air pockets. Undetectable until they have 'dropped', these are areas on the ice where a pocket of air holds the snow up. This causes concern with snowmobile riders regarding their own safety and that of their equipment.

One thing I noticed ...I once saw this in Rocher River, too – there's air pockets popping up later. They never did come before. ...If the snow out there has dropped, you see the ice. ...One big chunk [of snow] goes down ... they call that air pockets. ... You could be up here [on top of the snow] and then it drops and it stays there. ... Not the whole thing drops, it's [maybe] 25 feet around like that. (McKay, 2005b, pers. comm.)

4.1.2.2.5 Spring break-up and flooding

While the spring break-up of river ice is a brief process, it has important socioeconomic and ecological impacts, especially during periods where ice jams cause substantial flooding. Ice-jam events are denoted as 'mechanical' break ups, where some or all of the ice cover strength is retained until it starts to move. By contrast, 'thermal' break ups have no jamming potential, as warm weather reduces ice thickness and strength to the point of disintegration (Beltaos, 2000). Local residents in Fort Resolution note the trend towards shorter break-up periods with fewer ice jams.

River ice used to flow for about five days during breakup. Sometimes it'd start moving, then stop for a day or two. From the time it was frozen until it flowed out would take about five days. Now it's about two days – the ice is thinner, so it breaks up faster. (Beaulieu, 2005a, pers. comm.)

The seasonal cycle of spring flooding in the delta is influenced by other climatic and hydrological factors discussed above. Floods are most commonly caused when decaying ice builds up and jams in major river bends or junctures, or at the contact zone

between river channels and Great Slave Lake. Water rises behind the blockage and spills over the river banks, inundating the flat delta terrain. This process is important for ecosystem sustainability: it replenishes delta sloughs and ponds, clears brush and small vegetation from riverbanks, scours out sediment build-ups, and distributes nutrient-rich sediment, contributing to delta growth and ecological productivity (Mackenzie River Basin Board, 2003). Periodic flooding is important for maintaining habitat, especially for muskrats, and also for beavers, moose, bison and other traditionally-used species. It is also important for replenishing delta lakes (Brock et al., 2008) and improving boat access through delta channels.

Informants generally agreed that it was common to experience significant spring floods in the SRD every two to three years before the late 1960s, but the frequency and intensity of such floods has declined. They note that more recently big floods have been occurring approximately every ten years, often with a small one in between, although none are perceived to be as substantial as the pre-dam floods.

Before, maybe, I'll say about 15, 20 years ago. ...The ice was thicker and then when the ice starts coming down the Slave River [it] dams up at the mouth of the Slave River and it keeps damming up, damming up and finally it plugs up the whole channel on the river and the whole delta will flood. ... But I noticed in the last couple of years the Slave River is not like that anymore, the ice is not as thick and the break ups are different now. You don't hear that big banging the ice make. Just like it melts and slowly flows out now. But there was a real flood this year [2005] but not that much, not as much as it used to be 20 years ago. (Anonymous 1, 2005, pers. comm.)

This year [2005] the river opened ... [and there was] high water, lots of snow from the winter. I never seen Slave that high in quite a while. Well, it wasn't really high, but it was high water. Swift. Been quite a few years since I've seen high water in the delta, and I'm there every spring. ... It's high but not high like before. (Delorme, 2005, pers. comm.)

While flooding intensity and extent differ by year depending on a combination of factors, hydrological studies suggest that the generation of upstream flow plays a key role in the SRD (Brock et al., 2008). As such, records of peak spring discharge in the Slave River may be a good indicator of flooding (Brock et al., 2008). The above observations from Fort Resolution residents correspond to hydrological evidence based on a 46-year (1960-2005) record of peak Slave River discharge measured 280 km upstream at Fort Fitzgerald (Figure 4.3). The frequency of high-magnitude discharge events was lower in the post-1980 period than during the previous 20 years (Brock et al., 2008), findings that are consistent with evidence of drier delta conditions over the past few decades (English et al., 1997).

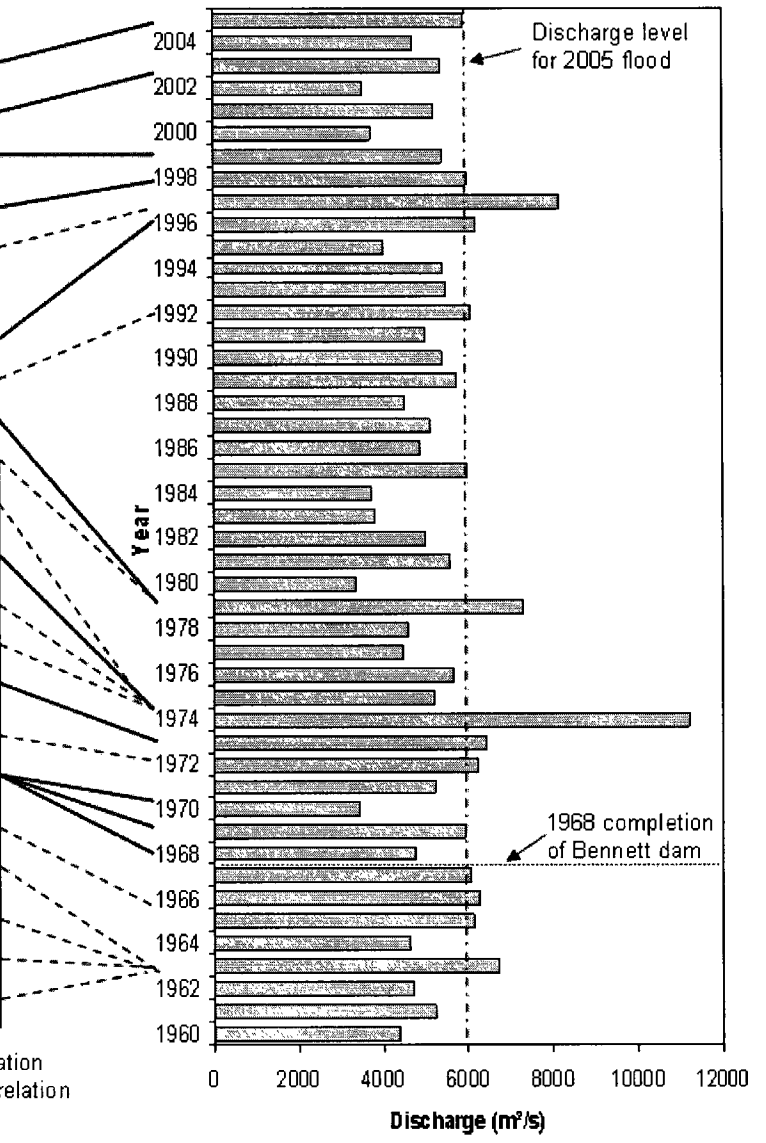
As noted in the above quotations, the 2005 flood was deemed substantial by informants, although not as significant as many pre-Bennett Dam floods. Regardless, both this and hydrological evidence suggest that 2005 was an above-average year for discharge and possibly flood magnitude during recent decades, suggesting that 2005 discharge levels can be used as an effective marker to speculate about past flood frequency and intensity in the SRD (Brock et al., 2008). For example, the 14 years on record since 1960 where discharge was equal to or greater than that in 2005 may correlate with delta flooding. The discharge level that correlates to the 2005 flood is indicated in Figure 4.3 to facilitate relative comparability.

When interviewees were asked to recall years where the delta had flooded, many were able to suggest general periods of time when an event occurred, but were not always

able to pinpoint the specific year. In cases where they did mention a specific year, it is possible that they may be off by a year or two, as it appears that interviewees often tend to remember events in relation to other events (e.g. a substantial flood before the Bennett Dam was completed). Taking into account these likely inaccuracies, the list of floods based on TK correlates fairly well to the years where high spring discharge levels were recorded at Fort Fitzgerald (Figure 4.3). This provides support for the suggestion that flooding in the delta is concretely linked to river discharge levels (Brock et al., 2008).

Figure 4.3: Observed water levels and flood events correlate with Slave River peak spring discharge
(following page)
Peak discharge is obtained from Fort Fitzgerald, Alberta (Water Survey of Canada, 2006) during the 14 days before and three days after the disappearance of solid and floating ice on the Slave River (as compiled by Brock et al., 2008). Sources: (Mackenzie River Basin Committee, 1981; Woo & Thorne, 2003; Anonymous 2, 2005, pers. comm.; Balsillie, 2005, pers. comm.; Beaulieu, 2005a, pers. comm.; Lafferty, 2005a, pers. comm.; Lafferty, 2005b, pers. comm.; Lockhart, 2005, pers. comm.; Mandeville, 2005, pers. comm.; Mandeville Jr., 2005, pers. comm.; McKay, 2005b, pers. comm.; Mckay, 2005d, pers. comm.; Sayine, 2005, pers. comm.; Smith, 2005, pers. comm.; Gibson et al., 2006b; Open House Participants, 2007, pers. comm.; Brock et al., 2008; Boucher, 2009, pers. comm.)

# Sources	Year(s)	Water level/flood
2*	2005	Ice jammed on Slave River (near Little Fishery); flood in Middle and Nagle Channels
1*	2003	Flood on Slave River (less extensive than 2005)
2	1999	Flood on Slave River
1	1998	Flood on Slave River near Ring Lake
2	1990s (late)	Big flood on Slave River (Little Fishery) and Nagle Channel; last big flood in delta
2	1997	Flood due to dam release (through summer)
2*	1996	Flood across the delta
1	1991	High water in Slave River; possible flooding
1*	1979	Flood on Slave River
1	1978	Flood on Slave River
1	1975	Big flood near Nagle and Steamboat Channels
3	1974	Big flood on Slave River; flushed out Nagle Bay; landing road flooded to Cheez Creek; high snow pack
1	1970s (?)	Flood on Slave River
1	1970s (early)	Flood on Slave River
1	1973	Flood on Slave River
1	1971 (?)	Flood on Slave River
5*	1968-1970	Low water due to filling of Williston Reservoir
1	1960s (early/mid)	Flood in delta (before 1967)
1	1964 (?)	Big flood on Slave River (Little Fishery), possible flooding on Jean River
1	1960s (?)	Flood on Slave River
1	1960s (early)	Flood on Nagle Channel near buffalo ranch
2	1962	Big flood on Jean River; Flood in Jackfish Bay area



* Includes literature sources when flood years were recorded
(?) Indicates interviewee uncertainty about exact event timing

—— Direct correlation
- - - Possible correlation

Two of the anomalous high and low water events recorded on the Slave River (and visible in the discharge plot) can be attributed to activities relating to the Bennett Dam. After the 1968 completion of the dam, Peace River water was held back for three years to fill the reservoir, reducing flow rates downstream (Woo & Thorne, 2003; Gibson et al., 2006b). Many local residents remember this period as the beginning of the drying era. Three decades later there was a sustained water release between June 24 and August 17, 1996 to allow for dam repairs (Leconte et al., 2001). Recorded as the highest artificial flow release on record, it caused sustained summer flow in the Slave River and record high water levels in Great Slave Lake in 1997 and 1998 (Woo & Thorne, 2003). Several interviewees noted the occurrence of (previously unknown) summer floods during this period.

Other anomalous events are not as directly explainable. Of particular note is the level of peak discharge in 1974, the highest on record since 1960. This event provides an interesting point of comparison among different data sources. The event was not only recorded instrumentally in the discharge record, but also in the sediment record of a lake in the SRD adjacent to the Slave River (Brock et al., 2008; Mongeon, 2008), in the observations of TK holders (Open House Participants, 2007, pers. comm.; Boucher, 2009, pers. comm.), and in a marked ecological response in muskrat populations (Lafferty, 2005a, pers. comm.).

Sediment records were analyzed for SD2, a flood-dominated pond (where Slave River floodwaters control the water balance), and SD20, an evaporation-dominated pond

(with limited water inputs from the river system) next to the Jean River, a tributary of the Slave River and a known ice jam site (Mongeon, 2008). The paleolimnological records from SD2 show high levels of correlation with discharge data (Brock et al., 2008). Records from this pond strongly indicate the presence of a 1974 flood and those from SD20 also suggest otherwise anomalous river water input for that time period (Mongeon, 2008). Water levels in 1974 are also documented as a historical high upstream in the PAD (Peters & Prowse, 2006; Peters et al., 2006a; Peters et al., 2006b).

Several Fort Resolution residents noted a major flood in the delta around the 1974 time period (Figure 4.3). Paul Boucher (2009, pers. comm.) remembered that the water flooded Nagle Channel (the southernmost channel where residents launch their boats to access the delta) and inundated Nagle Road as far as Cheez Creek (several kilometres). He noted that the 1974 flood was the last event that scoured out Nagle Bay and made the southern part of the delta accessible by boat from Great Slave Lake. Boats floated away from their moorings in the delta and drifting ashore at the Portage, located in the bay at the mouth of the southern delta distributaries. The flood impacted local harvesters by delaying spring travel on the delta, which was treacherous until it cleared of debris and ice. As well, two residents who had been living in Fort Smith at the time remembered the 1974 flood and its impacts upstream. They recounted significant infrastructural damage from inundation of the Salt River First Nation settlement (Open House Participants, 2007, pers. comm.).

A further strand of evidence involves the ecological record. Results indicate an overlap between this major flood in 1974 and a very high muskrat year (Lafferty, 2005a, pers. comm.), two variables that are known to be correlated (Timoney et al., 1997; see Section 4.1.2.3.3).

The two decades between 1974 and 1996 indicate low flood frequency, mirroring that of the PAD (Wolfe et al., 2006), and this extended dry period is likely to be perceived as a long-term drying trend by local land users. This is especially true since high flows between 1996 and 1998 may be perceived as attributable to Bennett Dam water releases, and the influence of sustained high water levels in Great Slave Lake throughout this period. The only other anomalies from the perceived dry period are the moderate 2003 flood and the more extensive 2005 flood (Brock et al., 2007; Wolfe et al., 2007; Brock et al., 2008), the latter of which occurred in the months before interviews were undertaken for this study. While this overall drying trend is also documented in the scientific literature (English et al., 1997), it is important to note that multi-decadal dry intervals have naturally occurred in the past, and that currently observed conditions are not outside the range of natural variability experienced over the past three centuries (Adam, 2007; Mongeon, 2008). Similar trends have been documented in the PAD (Wolfe et al., 2005; Wolfe et al., 2006).

4.1.2.2.6 Water quality

An additional hydrological variable of concern to local people is water quality. Several people noted an increase in turbidity in the Slave River, which has a browner colour than in the past, and forms weaker ice (Anonymous 2, 2005, pers. comm.). Others noted that the concentration of sediment varies from year to year (Workshop Participants, 2005, pers. comm.).

The water's been getting dirtier. The lake used to be – it wasn't that dirty as it is now. Now it's dirty. (Mckay, 2005d, pers. comm.)

Yeah, [the Slave River water is] dirtier. The ice is dirtier than the olden days for me. ... It never used to be like that. (McKay, 2005b, pers. comm.)

Some years the ice is different, the water temperatures are different ...and I know it has to do with turbidity. ...The river is really unstable now – it's not like the old days when the river acted like a river should. Because it's changed from the [Bennett] dam. ...It has an impact up here, it loads a lot of sediment. ...The water levels are fluctuating and they're eroding a lot of the sand along the river banks and the river bottom. ...The turbidity in the water is very high. Sometimes in the fall the amount of water that has been released impacts the freeze-up. The freeze-up is later. You get a lot of the brown water. ... There's still soft spots in the ice...and you know you don't want to go in that area because [of] the thin ice. ...So that has a significant change on the river I've noticed over the last 20 years, there's more turbidity. ...And it also influences the spring break-up because there's less ice, so sometimes the ice will go faster. And of course the way the ice is anchored to the river banks has changed also. (Unka, 2005b; pers. comm.)

There is also concern about contaminant levels in the river and lake water. A large number of households have switched to buying bottled water because they are uncertain of the quality of the publicly delivered water, although it is chemically treated at the local water plant. Perceived increases in fish and wildlife deformities (see Section 4.1.2.3.11)

add to these concerns, especially because such trends are not directly observable, and cannot be discerned without consistent water quality monitoring.

Grab a cup, take some water. ... That's the difference now, you can't even drink water out of the lake unless you boil it, eh? It's not safe the water any more. ... That's changed. (McKay, 2005b, pers. comm.)

I remember we used to haul water right from the lake for our house. Mom used to boil it. ... In the summertime she used to boil our water, but in the winter I don't remember them boiling water. Dad used to haul ice. (Mckay, 2005d, pers. comm.)

The water quality is not as good as it used to be. The water quality is affected by mines, by development [and has led to high] cancer rates. ... So much mining industry has affected our daily life. (Yelle, 2005a, pers. comm.)

In Taltson River, before it used to be just clear blue, now it's turned yellowish like. It's not as clear as before ... since they built that dam, Taltson Dam. The water was always clear before. ... [Now] there's always something in the water now. It never used to be. Sometimes it's some kind of weed, grass or something floating. It used to be clear before, it used to be just beautiful, the water. (Smith, 2005, pers. comm.)

4.1.2.3 Wildlife

The animals that provide the basis for traditional land use for Fort Resolution residents are impacted by environmental change in various ways, the most prevalent of which are outlined in Table 4.3. Hunting and fishing provide locals with traditional foods, while trapping is undertaken to sell pelts, with the meat of specific animals (e.g. muskrat and beaver) also being used as a food source. Although red meat is preferred, fish from the river systems and Great Slave Lake have always formed an indispensable foundation for local diets (Bodden, 1981), and are used as a fallback when other foods are

unavailable. Moose and migratory birds are now the most commonly hunted species, the former being highly prized and available year-round. Caribou are also desired, although their distance from town requires hunters to plan ahead and possess substantial equipment for multi-day trips (usually limited to one trip per winter).

4.1.2.3.1 Birds

Locals indicated that migratory birds have long been relied upon for their consistent annual appearance. More recently, migration patterns and bird behaviour appear to be changing, resulting in an overall reduction in availability in the delta and along the south shore of Great Slave Lake. Some species are not travelling through the area anymore, and others may arrive up to two weeks later than expected. By contrast, due to the long, cool springs more birds are remaining in the area to nest instead of flying further north. It is questionable as to whether this trend will increase local availability of some species.

You don't see as much migratory birds coming through the delta. ... But what I have noticed is the birds that do come through ... they are coming a bit later because of the weather conditions. They are staying a little bit longer ... to the point where there's a lot more – especially the greater Canada [geese] – are starting to nest on the river system and within the Simpson Islands. You will see in the last five years more birds nesting in these areas than ever before. Yeah, so they come up late and they have to lay their eggs, right? And they are held back by the weather, so they stay and they nest there. And of course once they nest there, then the younger birds have a tendency to regard that as home, I guess, and they come back. (Balsillie, 2005, pers. comm.)

Table 4.3: Commonly observed wildlife population and health trends, and impacts

Animal	Observed wildlife changes	Livelihood impact (+/-)[10]
Fish	• Changing migration pattern – lake fish move out farther to colder water • Variable spawning season timing • Inconnu, suckers, whitefish and other commercial species declined since 1945; some recent increases • Trout coming back to Resolution Bay • Softer texture, darker meat (many species) • Increased frequency of poor health indicators: skeletal deformities, external sores, internal cysts, intestines with puss or stuck together	• More gasoline and time for travel (-) • Some increase in diversity of fish for consumption (since 1950s) (+) • Concern over safety of fish for consumption (-)
Migratory birds	• Lower numbers in SRD and Taltson since river regulation (mid-late 1960s) • Delayed timing of annual migration • Change in behaviour; some birds stay and breed in East Arm • Duck and goose health has declined	• Reduced yield for hunting effort (-) • Uncertain timing of hunt (-) • Increased frequency of poor health indicators: white puss in flesh, darker meat, different taste, skinny birds (-) • Some meat wastage of unhealthy animals (-)
Ptarmigan	• Lower numbers during past decade	• Reduced yield for hunting effort (-)
Muskrats	• Lower numbers since river regulation	• Reduced yield for hunting and trapping effort (-) • Reduced economic return for pelts (-)
Beavers	• Population rebounding since mid-1900s • Lower numbers after periodic winter flooding drowns them out	• Periodically reduced yield for hunting and trapping effort (-)
Fur species	• Pelts are not as thick with warm weather	• Pelts sell for less money at the fur auction; reduced return (-)
Caribou	• Migration to Great Slave Lake moved progressively east since late 1950s • Caribou health has declined • Taste of animals has changed	• Reduced hunter access to caribou (-) • More gasoline and time for travel (-) • Increased frequency of poor health indicators: organs have puss, are stuck together, or are pale in colour; more skinny animals (-)
Moose	• More variable timing of rut • Rutting season usually lasts longer	• More difficult to plan hunting travel (-) • Longer harvest season during rut (+)
Bison	• Lower numbers in SRD area since late 1960s • Health has declined since 1960s: TB, brucellosis and anthrax cause worry	• Reduced hunter access to bison (-) • More gasoline and time for travel (-) • Increased frequency of poor health indicators: organs have puss, are stuck together, or are pale in colour; sores between knees; swollen joints; visible cysts (-)
Black bears	• Increased numbers • Behaviour change since late 1960s – more aggressive, not shy, eating more garbage	• Nuisance to humans (-) • Gun required when travelling (-) • Reduced desire to hunt and eat bears (-)

[10] Impacts are designated as positive (+) and/or negative (-) based on their noted effect on local people and livelihoods.

Several interviewees also mentioned a decline in ptarmigan numbers over the last 20 years (e.g. Yelle, 2005b, pers. comm.). As they only migrate locally, these birds have always been a readily available and easily accessible source of food. However, hunters are now realizing lower returns for their efforts. This trend may be of particular concern to lower income households, as it signifies a decline in a food source that is accessible to those without machines and equipment to travel out on the land. Ptarmigan are hunted on foot, and can often be found in areas very close to town (e.g. Mission Island) or along the highway.

Now we didn't have ptarmigans the last four or five years now Ptarmigans used to go through here. There used to be millions of them went through here. ...Some years you never see one. Last year I see a few. This year a few of them came back. But not as in the old days though. I don't know, maybe they find different route someplace. (King, 2005c, pers. comm.)

4.1.2.3.2 Fish

Fish numbers are perceived by many to have declined in the area during the mid-20th century, where trout and inconnu dropped to particularly low levels. Since the middle of the century, a dramatic reduction in commercial fishing (due to low stock numbers) has likely contributed to population rebound and stability for some species.

And there are not much fish here anymore. I've hardly caught any this year. (McKay, 2005b, pers. comm.)

Not that much fish now, not like before. Used to be lot of fish everywhere. (King, 2005d, pers. comm.)

About 40 years ago ... there'd be lots of trout right out here [in Resolution Bay]. ...Now they're starting to come back ... people are starting to catch trout during the last couple of years. Not much, like one or two, so maybe that's a good sign that they're coming back. ...Forty years ago, like the elders were telling me that there was trout all over this bay here. (Anonymous 1, 2005, pers. comm.)

As an example the coney [inconnu] stocks. ...The commercial fishery has declined, the stocks are coming back up. (Balsillie, 2005, pers. comm.)

Yeah there's a lot of commercial activity in the mouth of rivers up to about 10 years ago ... [when] they changed the zonation. They extended from about the domestic fish area out further away from the mouth of the rivers. ... So that kind of took the pressure off the spawning activity on the ... conies. ... Some of the areas like Simpson Island are totally closed now to commercial fishing because it's been targeted for trout and certain species were targeted, and really decreased the quota in the lake. ... And they're only starting to come back now, very, very, very slowly. (Unka, 2005c, pers. comm.)

It is difficult to maintain an accurate idea of population size due to each species' annual migration (Lockhart, 2005, pers. comm.). Nonetheless, fish numbers are deemed generally sufficient for current local use, the intensity of which has dropped dramatically with the change-over from travel by dog team (which were mostly fed on fish) to snowmobiles.

The last number of years that I've been out there fishing each year [the fish have] started to make some changes in their habits of travel – because of the temperature of water, because [of] the late spring. So everything is evolving. (Balsillie, 2005, pers. comm.)

4.1.2.3.3 Muskrats

One of the most noted declines in wildlife is that of muskrat populations. Having been the trappers' economic mainstay in the area, muskrat numbers have declined substantially over the past decades with disappearing habitat due to low water levels and

encroaching vegetation. Once the willows take hold in newly drying areas, they shift from being sloughs to prairies, and travel through these areas becomes more difficult. Studies in the PAD indicate a parallel drying trend, which correlates with increasing willow cover (Timoney & Argus, 2006) and decreasing muskrat availability (Stuart Adams & Associates, 1998).

I've seen quite a change in the last 30 years. There aren't as many muskrat as there used to be. Their habitat is starting to get choked out. (Balsillie, 2005, pers. comm.)

When [the muskrats are] gone, the inland lakes are all dead, like no water – it's so shallow you can't even paddle on them. And when they're back, you can paddle on them – they're nice and deep. So I don't know – the water table goes up, or down, or...(Lafferty, 2005a, pers. comm.)

There's no water there now. ... The whole North Prairie used to be full of water, they'd say in the olden days. People used to go from Rocher River to paddle up there; they used to paddle in the prairies before, years ago. There was all kinds of [musk]rats then, that's why they call it Rat Lake. (Smith, 2005, pers. comm.)

Several land users associated delta flooding with muskrat numbers, which tend to rise and fall in seven to ten year cycles. Interviewees noted that the year after a flood usually brings an increase in muskrat numbers (see quote by Beaulieu, 2005, Section 4.1.1.3). One harvester remembered 1975 as the last particularly good muskrat year on the SRD, which coincides with the highest peak discharge (1974) since 1960 (Figure 4.3).

The year Gail Beaulieu moved up here from south (1975) ...that's when there was a lot of muskrats, the last time. Because I remember, she moved here and had a yellow and brown car, and I bought it off her with muskrat money. That's how I remember when the last muskrats were here. (Lafferty, 2005a, pers. comm.)

4.1.2.3.4 Beavers

As noted previously, winter water releases by the Taltson Dam have been noted to wipe out hibernating beaver for that year, and also have some effect on muskrat populations.

When they opened the [Taltson] dam in the wintertime, it killed all the beavers and rats. (King, 2005a, pers. comm.)

When they release water in winter it fills up the beaver lodges. Sometimes you see them trying to chew out, but then they freeze. So they either drown or freeze because all their holes, their sleeping and feeding areas, are above water. It's bad for the rats, too. (Beaulieu, 2005a, pers. comm.)

There's a beaver house on the Taltson, and they let go this water [from the Taltson dam] in the winter, and the beaver's got no place to go because the ice is so thick. They die off, they just drown. And they say how come there's no fur from the beaver, but it's because they kill it all when they turn on the water! (Lafferty, 2005a, pers. comm.)

They let water out of the Taltson River. ... They did it a couple of times in the winter and they killed all the beaver on the Taltson. ... They let the water out and it went over the beaver lodges, and it kills them. They drown in their house. (McKay, 2005c, pers. comm.)

Overall, however, it was noted by several interviewees that the beaver populations have been rebounding during the past several decades after having been very low due to over-trapping in the early to mid-1900s. Quotas were initially instated and enforced, but have more recently been rescinded due to population increases. At the same time, it takes substantial effort to prepare a beaver pelt, and declining fur prices have reduced incentive for some local trappers. Individuals tend to specialize in harvesting from a specific area

within the broader traditional territory, and it appears that beaver numbers may be geographically differentiated.

You go for beaver this year, there's not much, you know, they're not wiped out but they're hunted hard 'cause there's no jobs and people gotta make a living. ... Yeah, last year they went for beavers. They did good, but not too good. Not like in the past where every time someone goes down the river they bring home a hundred beaver, eh. That number has dropped down sixty, seventy, sixty, fifty. ...Ten years ago a hundred beavers. ... The only river I'm talking about is Little Buffalo, you could notice it. Other areas it is not noticeable because it is so big. (Delorme, 2005, pers. comm.)

Beavers – in the olden days there wasn't that many when I was young. You were only allowed to kill five, and then it went to 15, and that's all you were allowed to kill. ...But then it just opened up and you could kill as much as you want, as long as you had your license – as long as you paid you could kill. But [the population is] not slowing down – it's getting too much out there. And the prices are going down too, so people don't want to hunt and there's getting too many and the land's flooding out with it out in the inland. ...You go across country from there to my cabin, it was dry and clean. Now there's water in there because there's so much beavers. (Lafferty, 2005a, pers. comm.)

The above quote indicates that the land away from the main water courses has become wet in parts due to beaver activity. It is possible that such activity may work to counteract some of the noted drying in the area, and provide habitat for other wildlife.

4.1.2.3.5 Fur Species

Populations of fur species (e.g. lynx, marten, fox, beaver, muskrat) have always varied over time due to influences such as climate, predator-prey relationships and trapping intensity. There were some differences of opinion among interviewees regarding changes in animal populations over time. Concrete long-term trends are often difficult to gauge since most animals migrate seasonally, and many populations (especially the 'fur'

– the species of interest to trappers) are perceived by local trappers to fluctuate in seven to ten year cycles.

Yeah it goes in a cycle. Some years there's lots of rats, some years there's nothing. Rabbits are like that too, in a cycle. (Sayine Jr., 2005, pers. comm.)

Yeah, fur goes through cycles. Some years there's lots, some years there's nothing. Now we're starting to get our lynx back, because one year I think I caught one. ... Now we got no more martins, but we're catching lynx again. I got 25 last winter and my dad got about 50. So now the lynx are coming back, and the martins are off. Some years there's minks, you turn the corner, and there's minks running around. Some years there's nothing. (Lafferty, 2005b, pers. comm.)

Nonetheless, while they recognize that populations fluctuate in cycles, many experienced trappers are concerned about declines in overall animal abundance, which they attribute to the various facets of environmental change. It may also relate to the high intensity trapping within a certain radius of the town site, where traps are easily accessible during a short day-trip.

An important impact of warming winters that was noted by informants is the lower-quality fur in many species. The fur does not reach 'prime' (reaching optimal thickness, or in some cases changing colour) with warmer winter temperatures, reducing the monetary return per pelt for trappers. Additionally, fur prices are already much lower than in the past due to declines in the market. Both reduced wildlife abundance and financial return are disincentives for continuing this activity.

If you do get anything in this warm weather, just, you know the fur is not as good as the colder weather. When it's the colder weather fur you get a higher price fur. That's with the longer hair. But now with the fur – it's been a bit warm for the last few years, so fur's not that good anymore. (Lafferty, 2005a, pers. comm.)

On the other hand, trapping in warmer weather is more pleasant, encouraging locals to spend time out on the land.

We like warm weather and nice days. Good for traveling and stuff like that. (McKay, 2005c, pers. comm.)

4.1.2.3.6 Caribou

Another commonly noted trend involves caribou. Caribou numbers are thought to be declining, and the migration route has shifted eastward since the mid-1900s, requiring residents to travel much farther to hunt. Until the 1950s the winter migration route of the caribou brought them from the east, through the East Arm and along the south shore of Great Slave Lake. Oftentimes they could be found as far west as Fort Resolution.

In the past ...well, long time ago I heard stories of the old-timers saying caribou used to be right out here in the bay here, Resolution Bay here. And I remember the elders telling me that ... because the husbands were out trapping in the bush, even the wives would hook up a couple of dogs, about three, four dogs and go for caribous themselves. Get one or two, whatever you need. (Anonymous 1, 2005, pers. comm.)

Caribou, it run away. ... [It used to come] in town too, around Jean River. But people who do hunt find them too far. ... Around 1950 they run away, so there's hardly any around here. You have to go to Snowdrift [Lutsel K'e] now. (McKay, 2005a, pers. comm.)

Interviewees have different beliefs as to why this is occurring. Some believe that these impacts are caused by a combination of mining development, loss of food sources (e.g. lichen) due to fires, and possibly other climate change effects, while others note the

more traditional belief that caribou will move to a different area if someone 'hits them with a stick'.

Back in the old days, in the winter they had a lot of caribou that was migrating through the area ... then it dwindled to the point where there are none today. ...Not only the population is down ... the forest fires have depleted all the lichen that the caribou had depended on to winter in this area. (Yelle, 2005a, pers. comm.)

What I am hearing from other communities, people have used the caribou since the opening of the diamond mines on the caribou migration routes. ... People have noticed that the animals are less healthy by having less fat and some are [scared] by activities [like the blasting of] mine rocks. So there is a noticeable change in some of the migratory animals such as the caribou. (Yelle, 2005a, pers. comm.)

The traditional belief is that you're not supposed to hit caribou with a stick, and they say that ...if you do that to caribou, they'll move away from you. And it changed, coincidentally, it happened. But you must also remember that the forest fire burnt a lot of their feed, the lichens which the caribou are depending on, you have to consider that also. So compound it, caribou have moved away from us. (Unka, 2005c, pers. comm.)

The old timers said that if they got hit ... by people, that animals would never come back down, and that's what happened to the caribou. They were always going to Rocher River and someone must have beat it up with a stick or something, and that caribou never went back there again after that. (King, 2005b, pers. comm.)

Similar changes in migratory and population trends of the same caribou herd are noted by elders from Lutsel K'e Dene First Nation, several hundred kilometers east of Fort Resolution, in the East Arm of Great Slave Lake (Kendrick et al., 2005). Elders believe that caribou numbers and distribution have been affected by fire frequency and intensity, as well as mining development. They indicated specifically that disturbance around traditional migration corridors and water crossings, and to herd leaders ('vanguard' animals) may affect migration and overwintering patterns. Lutsel K'e elders noted that a lack of respect for the animals may lead to a different choice of migration

routes and lack of availability to hunters for a period of time. They cited the example of not harming the caribou with a stick, as well as several other forms of respect, including:

> using as much of the animal as possible, removing the tip from the caribou heart, sharing meat with community members, not chasing caribou down with snow machines and running them to exhaustion, women not being involved in the hunting process while menstruating, women not stepping over the caribou's blood or the hunters' equipment, treating the meat and animal products with respect once they are inside the home, and not leaving animal remains lying around outside (Kendrick et al., 2005: 185).

4.1.2.3.7 Moose

While moose are generally perceived to be sufficiently abundant, hunters often have to travel farther to access them. Access is impeded by low water levels in the delta that limit travel to some areas (see Section 4.1.2.2.2), and due to lower numbers in the delta and area immediately surrounding Fort Resolution where hunting effort is high.

It almost seems like the moose population fluctuates drastically within a given year, because during summer months they're traveling all over the place – they're near water and people see them all the time. But during the freeze-up times and the spring break-up time, moose are generally scared of ice. So they're more confined to an area, so they are hardly ever seen. So it almost seems like the moose population is down during these months when they're more or less confined to an area because of the freeze-up or break-up of ice. But generally the population is the same. Some years it seems like there's more – the way people say there is a lot of moose is when, how much is landing in your deep freeze. (Lockhart, 2005, pers. comm.)

The moose might be not as much anymore, might be. You got to cover more ground now to get the moose. ...I don't know if it's not as much or if it's that there's more hunters out there now. ...Sometimes though I'll run into them during the summer like when we're traveling or out on the land fishing. Springtime we run into moose. (Anonymous 1, 2005, pers. comm.)

[There are fewer moose] in the delta. ... Basically they were hunted. ... They just got outboard motors so you can just go out and fly all over the place, eh? The population in the delta is not that great. The numbers are [higher] further inland. ... I don't think it has anything to do with the water level or anything – it's just access to hunting [has been made] easier. (Mandeville Jr., 2005, pers. comm.)

Moose are commonly hunted along the highway during the fall rut. This is an especially fruitful season as hunters are able to 'call' the moose by imitating the sounds made by those of the opposite sex. One hunter noted that the extended fall season lengthens the period of rut, providing more opportunity for hunters during this season (Anonymous 3, 2005, pers. comm.).

Even the moose they move around at different times, sometimes its two weeks off the normal mid-September movement. (Delorme, 2005, pers. comm.)

4.1.2.3.8 Bison

In addition to the moose, the wood bison (*Bison bison athabascae*) population – locally referred to as 'buffalo' – was often hunted in the past, but less so recently. The bison population has declined in the Slave River Lowlands during the past three decades due to diminishing habitat induced by a drying trend, hunting and predation, and the impacts of disease[11] (Reynolds & Hawley, 1987; Government of the Northwest Territories, 2007b). Some hunters note that bison are still numerous in the broader region;

[11] These herds have a long history of disease, including bovine tuberculosis (*Mycobacterium bovis*), brucellosis (*Brucella abortus*) and anthrax (*Bacillus anthracis*) (van Camp, 1989; Ferguson & Laviolette, 1992; Government of the Northwest Territories, 2008b). Bovine tuberculosis and brucellosis are recorded to have caused declines in wood bison numbers due to poor calf recruitment and high mortality (Government of the Northwest Territories, 2007b).

however, many are not healthy. Bison can now be found in the southern reaches of the traditional territory, but require extended travel for hunters.

The buffalos are also dwindling. ... There aren't much people hunting them. (Yelle, 2005a, pers. comm.)

Yeah I remember when I was a kid...there used to be buffalos right through going everywhere [around Hook Lake area]. Now there's not as much as before. (Giroux, 2005, pers. comm.)

There used to be lots before ... a few years back now. ... They stay up that side mostly now. We can't get up there too – it costs too much to get up there by Skidoo and all that. Hard to get around too now – too much willows. ... Before that, that north prairie there, you could see right clear across. Now I can't see across – there's willows and poplars, most of them over that size now [10cm diameter]. (Smith, 2005, pers. comm.)

4.1.2.3.9 Black bears

The behaviour of some animals is also changing. A commonly cited example is the black bear, which used to be hunted frequently for meat, grease and pelt. Bear harvest began declining in the 1970s when bears were increasingly seen to be spending time scavenging garbage at the dump (e.g. at Pine Point town site). Consequently, residents now view bear meat as contaminated, and several interviewees noted that bear numbers are increasing because people don't hunt them anymore. Perhaps as a consequence of larger populations and human encroachment on their territory, bears are perceived to have shifted to more aggressive behaviour.

Oh, too much bears now because they don't kill it. ... Before, you know, they used to hunt them. They worked hard to get bears ... because they hardly see any. You don't see them close to your cabin before ... [Now] they attack people, they kill people. I remember 1967

when we worked at Pine Point, we used to go to the dumpster. There was sometimes eight bears, eating all the garbage. People seen that and stopped eating red meat. ... It used to be good meat, a long time ago, of course they wouldn't come around to town. They stayed out in the bush all summer. Whenever you'd go hunting, you'd hardly see any. (McKay, 2005a, pers. comm.)

Black bears have really changed, become habituated, starting to kill people. ... Back in the old days people shot black bears and ate them. ...Currently nobody is using black bears and the population is not as exploited. (Yelle, 2005a, pers. comm.)

Bears, before they'd see people they used to take off. Now they see people, they come to people. Even that's a change. (King, 2005b, pers. comm.)

My Gran used to tell me [about the future]. ... They used to eat bear too, to get the grease out of that. Later on, [she said that] everything's going to change. ... It'd be too scary to stay in the bush. It's true now that bears get after people. ... Maybe that's what she meant. (Pierrot, 2005, pers. comm.)

The interviews noted above took place in the wake of a fatal black bear attack on June 17, 2005 at Nonacho lake, just south of Lutsel K'e (CBC News, 2005). Several interviewees noted this incident as an example of increasingly common aggressive behaviour of these animals.

4.1.2.3.10 New species

Locals have also noted the recent appearance of new species such as magpies and cougar, and deer are now more frequently sighted. They believe that industrial development in northern Alberta is pushing deer, cougars and bears northward; the latter two cause concern for human safety. Some new birds are also being seen during spring migration. Skunks are perceived to be declining over the past few decades. As well,

recent declines in frogs and songbirds are noted as a potential environmental alarm bell by some interviewees.

There's the cougars ... that are coming up here, they're fairly new. And that ... magpie, they've only come up here in the last 10 years. Maybe it's because of the warming trend up here and the outside pressure. ...Lots of habitat change. (King, 2005d, pers. comm.)

It's a big change from years before. Now some of the birds are gone, no more frogs. Before, in the spring, I used to listen to frogs all over the land. Now there's hardly any. Black birds with ... a little red on their wings ... there used to be lots, now there's hardly any of that too. (King, 2005b, pers. comm.)

The little song birds used to wake [me] up – used to be a lot of robins. [Now] there are very little song birds. (Yelle, 2005a, pers. comm.)

4.1.2.3.11 Wildlife health

Some locals expressed concerns over the health of commonly consumed wildlife and fish species, and consequences for human health. Hunters look for abnormalities first in the organs, as well as in the meat, as indicators of ill-health. While some interviewees indicated that they are finding such indicators more frequently, others noted that there have always been a small proportion of animals with compromised health, an amount that is not necessarily increasing.

When you kill an animal you start to butcher it and you know, you go to the organs first because the organs are going to tell you whether the animal is healthy or not. ... You'll see puss ... that kind of scarring. You know any kind of abnormal colours other than what you'd see in a healthy animal, you know. So there's certain things that are going to tell you, that are indicators that the animals are not healthy. (Unka, 2005a, pers. comm.)

Everything has got its own little parasites. ... If the lungs are bad then you know you don't use the meat. ... The ones that use... animals in the field all know how to look for

parasites and know anything different, out of the ordinary. But it's always what happens, never big changes. You just discard the meat that are bad like that; you don't eat it. (Lockhart, 2005, pers. comm.)

When I fix something I always look at the liver of the meat, because the fish sometimes is really good [and] fat. We cook it [and] sometimes in between the meat, [there's] just like a little puss inside. ... Now, even duck, even rabbit ... I fix it and open it up and look at the liver. ... Sometimes it looks like white stuff on it. Anything that's no good on the liver, that means that the flesh is no good. I throw it away. (McKay, 2005a, pers. comm.)

As of the 1970s and 1980s, locals have expressed concern over the health of fish species due to potential contamination through the hydrological system from the nearby Pine Point mine, the crash of COSMOS 954[12] (Workshop Participants, 2005, pers. comm.) and increased industrial activity upstream (Sanderson et al., 1997). Of particular concern are the possible human health implications from consumption (Bill et al., 1996). A number of interviewees indicated an increase in the frequency of finding physical abnormalities and decreased flesh quality in fish.

There was changes ...in that [15 year] warm spell we had, where it was getting warmer in the winter. There was changes then. I noticed there was some spots you seen on fish – you'd see little sores on them ...just like blisters. ... It was on all different kinds of fish, it wasn't just on one kind. It was on jacks [northern pike], walleye, suckers, losh [burbot], trout – it was on all these. (Anonymous 1, 2005, pers. comm.)

Well, [the fish] have these scars on them. And they have kind of worms in them. ...I don't know about that stuff before, I didn't notice that much like I did these last few years. (Mckay, 2005d, pers. comm.)

And the fish – you see the deformities in fish, you can tell from the fish texture that ... there is some kind of contaminant that is getting into their body, or how are they getting sick? (Unka, 2005a, pers. comm.)

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[12] COSMOS 954, a Soviet nuclear-powered surveillance satellite, crashed on Great Slave Lake on January 24, 1978. Radioactivity was scattered from Great Slave Lake into northern Alberta and Saskatchewan, and only a minute fraction of the radioactive debris was recovered (Health Canada, 2008).

Some locals also indicated that the texture of the meat of various fish species is changing. They noted that fish flesh used to be more firm and the meat was whiter (Workshop Participants, 2005, pers. comm.). The very soft fish are not edible, which contributes to wastage.

There used to be hard fish before, they used to be firm. But now they're getting soft, and really soft. They're not like before. Some, not all of them. (King, 2005b, pers. comm.)

The fish meat is different for me. ... Sometimes the [flesh is] just soft, so that's different. A long time ago the meat was just nice. (McKay, 2005a, pers. comm.)

I'm finding the meat is not [as good] – like fish, too. If it's kind of soft, I just throw it away. I don't eat it. (Pierrot, 2005, pers. comm.)

While abnormalities of this nature are visible, their perceived increase coupled with concerns over pollutants fuels concerns over the potential presence of contaminants which are undetectable to lay-fishermen. Ongoing and planned increases in Alberta Oil Sands activity, with regards to the cumulative effects of increased water extraction and potential contamination, are intensifying such concerns for downstream communities (Workshop Participants, 2005, pers. comm.).

> The Deninu Ku'e First Nation of Fort Resolution, NWT, located 120 kilometres northwest of Fort Smith where the Slave flows into Great Slave Lake, made the rare move last year of intervening in the regulatory review of Imperial Oil's Kearl Tar Sands mining and bitumen-processing project. The DKFN was concerned that water quality assessments in Imperial's project application wouldn't capture the cumulative impacts from the development on the Athabasca and Slave. (Campbell & Spitzer, 2007)

While it is understood that dioxins, furans and some organic contaminants are present in the hydrological system due to anthropogenic and natural causes, targeted

research in the 1990s indicated that levels of contamination were generally low across the Peace-Athabasca-Slave Basin, and should not cause a human health hazard (Sanderson et al., 1997; Cash et al., 2000; Mackenzie River Basin Board, 2003). Furthermore, the presence of physiological abnormalities among the different species of fish in the basin was found to be less than one percent. The presence of both contaminants and abnormalities were higher near industrial areas (Cash et al., 2000), indicating that ongoing monitoring is important as such activity increases upstream from important fishing areas for aboriginal residents.

4.1.2.4 Vegetation

Residents have noted that climatic and hydrological changes have impacted vegetation around the SRD. The general drying trend has encouraged willow encroachment in many areas that previously supported aquatic species. Once the willows grow too thick for muskrats to chew, they begin a new cycle of succession, building up biomass in delta channels, sloughs and ponds. This results in habitat loss for traditional species, especially muskrat and bison, and reduces hunter access (see Sections 4.1.2.3.3 and 4.1.2.3.8).

Many interviewees also indicated that berry quantity, quality and taste have declined during the past several decades.

You may be able to find in a bush two good berries; the rest are hit with some type of deformity. ... Don't ask me why they're deformed, whether it's too much rain, not enough rain... When I really look at the plants, it almost looks like they're dehydrated. ... Even

the berries taste different. ... Anything kind of out and exposed to the environment, they either get dwarfed or they don't seem to grow to the fullest. They get stunted in a way, or they get some sort of fuzz on it that starts to ... kill the berries. (Unka, 2005a, pers. comm.)

This deterioration seems to apply to the range of berries collected around the SRD. Since this is one of the activities that does not require special technology and that can be undertaken on the outskirts of town, it is accessible to most people. Berries can provide a substantial source of vitamins and nutrients for local people well into the winter, as they are easily preserved. A reduced harvest may have health impacts for a range of households, which are generally not accustomed to buying fruit in the store. Also, it reduces the incentive for individuals – especially elders, women, and youth, who tend to be less mobile – to spend time actively using the land.

4.1.2.5 Fire

Fire is another environmental factor affected by climate change. This phenomenon is seen to be cyclical and variable, although the effects are muted by GNWT fire suppression crews. The ecological benefits of fire were noted by some.

The boreal forest is dependent on forest fires. It renews the ground. Now it's just lush again. (Lockhart, 2005, pers. comm.)

When [the fire] burned, a couple years or a year later [there were] a lot of marten. A lot of mice, animals, fresh vegetation. Lots of moose. ... Rabbits, all the smaller animals you see increase in a couple years after it's burned. ...[Better] bison habitat. [GNWT] used to burn the prairies; all the buffalo just go through that spring. (Mandeville Jr., 2005, pers. comm.)

The bush is nicer to walk in, all the plants come back. It's the same as when it burns. You know, the country burns, a couple of years later it's better trapping in there. More animals go into a country like that, I think, after it burns. You go on your same trap line every year and there's an area that's burned out – a couple of years down the road there's a lot of martens on there. (Lafferty, 2005a, pers. comm.)

Concern was noted by workshop participants who perceive that fires burn more easily and quickly than in the past due to the drier landscape (Workshop Participants, 2005, pers. comm.). During the last decade, several large fires have been left to burn out, with various effects on animal populations. Moose and other large, highly mobile animals move into adjacent vegetated areas, and return to burned areas once they regenerate. According to interviewees, a recent fire in the Taltson River area increased moose density in the SRD, which has been a boon for hunters.

They had lots of fire on the other side, so all the moose they took off when the fires were around. They took off [from] Rocher River, Taltson Bay and people were seeing moose steady coming away from the fire. They saw [lots of] moose the last couple of years. (Giroux, 2005, pers. comm.)

Oh yeah, so all the moose came down because there was a big fire down by [Rocher River]. Yeah, big fire, so moose came this way. (Cree, 2005, pers. comm.)

On the other hand, fires destroy trap lines and cabins, forcing trappers to relocate. Smaller animals often suffer higher mortality, and habitat for specific species may experience longer-term damage. For example, lynx do not return to a burn area until the trees grow back (Delorme, 2005, pers. comm.; Lafferty, 2005a, pers. comm.). A recent fire in the Simpson Islands area (including the shoreline of Great Slave Lake) burned the lichen that caribou depend on for winter feed. Since lichen take 50-75 years to reproduce to a size where caribou can digest them (Workshop Participants, 2005, pers. comm.), this

recent habitat degradation is deemed as a factor that is likely limiting their migration to this area and causing them to search elsewhere for food.

4.1.3 Variability in informant responses

While the nature of most of the environmental changes described was fairly consistent across interviews, there was some variability, as noted above. While differences in awareness, perception and location and timing of travel are likely the main reasons for this variability, several other factors may also play a role.

The age group to which each informant belonged affects the temporal duration of their knowledge. For example, some of the younger land users did not note as much of a difference in temperature and snow pack as the elders, due to their lack of longer-term experience. As well, because of the difference in conditions under which they were raised, younger land users often have a different perspective on the role of the land in the broader context of their livelihoods. While they may perceive it mostly as a means of generating income and for recreation, elders who grew up on the land may perceive it as a more fundamental element in everyday life. Furthermore, life on the land was a formative part of most elders' early experience, whereas many younger adults and youth have had significantly less exposure. This may affect the types of impacts that these different groups perceive in relation to specific elements of change. On the other hand, it also heightens the urgency to conduct a study such as the current one before elder memory is lost.

The boundaries of the spatial knowledge and the primary land use activities of each individual also influence the types of perceived changes occurring in different locations. Since the knowledge of each land user is based on personal experience, those familiar with different areas and phenomena (e.g. specific species) may equally have different views regarding trends they are observing on the land. For example, trends in the populations of some animals may be different, even opposite, in different areas of the traditional territory (e.g. between SRD, Taltson River and Little Buffalo River). As well, someone who doesn't hunt buffalo may not travel as much in buffalo habitat, thus may have only peripheral or second-hand knowledge about populations and behaviour of that animal. Different individuals necessarily have different (geographical and thematic) areas of expertise.

The intensity of an individual's land use over time also affects their knowledge. Some elders have not travelled consistently on the land in recent years, and other land users may have limited their activities during certain periods or seasons for a number of reasons (e.g. employment away from town, full time employment in town, lack of access to equipment, shifting family priorities, etc.). These gaps in knowledge may affect how individuals perceive (or don't) trends over time.

A further factor influencing variability in responses was the weather in the year immediately preceding my fieldwork in 2005. The climate throughout late 2004 and through 2005 was deemed anomalous by a number of people. The immediacy of these climatic events may have influenced their perception of and communication about long-

term trends. On the other hand, events like the 2005 flood may equally have heightened the memory of local residents about similar past events.

Interviewees noted that heavy snowfall occurred before ice freeze-up in the fall of 2004, causing a delay in the formation of solid ice. A layer of melt water under the snow limited travel on the river for several weeks. The 2004-05 winter brought heavy snowfall, which was comparable to those of several decades ago, but anomalous in the context of more recent climatic trends.

There's a lot more snow last year then there was [during recent years]. There was a lot more rain – I never had that much rain! Like last winter we had that snow and had a lot of rain the same year. Everything changed in the environment, like just this year and last summer, too. (Fabian, 2005, pers. comm.)

Spring brought cool weather that lasted for a long time. Hunters were disappointed by an anomalous year where the migratory birds flew right over the delta without stopping. Several interviewees noted that it had been decades since that had occurred.

The birds flew over this spring. For the first time in 22 years there were no birds to hunt. There was lots of south-southeast wind, so the birds flew to the farthest place with open water. (Balsillie, 2005, pers. comm.)

A cool, rainy and windy summer followed, which was especially difficult for the elders. It also made travel on the lake difficult.

But this summer again is an oddball. It has been pretty miserably cool all summer. ...We didn't have really any consistent warm; maybe just in June we had about a week or so [where] it was nice. July was a write-off. August, we had two warm days in August. September we might get some. (Mandeville Jr., 2005, pers. comm.)

This summer, it's cold. About three or four days we had the warm weather and that's it. ...No, no [I haven't seen that before], not yet. Since maybe 10 years old not that way, you know. ... They've never seen this kind of cold summer. ... That's what old people they were saying. ... I never took my winter jacket [off] all summer! (Sayine, 2005, pers. comm.)

And now, this summer ...I never walk around with short sleeve or blouse this summer. It was jacket all the time. ...This summer it's not warm too, not like before. It used to be so warm. (Pierrot, 2005, pers. comm.)

This summer? Bad! Really bad. The weather was so bad. We never had summer. You know I've never seen July with rain, and this summer in July we had nothing but rain. In July we [usually have] no wind, [so] that you have to be in the water swimming because it's so hot around here. Every year in July is really nice; you can go any place with a boat, paddle if you wanted to. This year, though, there was wind and wind and wind. You know, it would wreck every boat [I have if I took them out on the lake]. (Lafferty, 2005a, pers. comm.)

Since the interviews I am drawing on took place during the summer and early winter of 2005, the temporal proximity of the occurrence of these conditions may have influenced the manner in which climatic changes were communicated to me. For example, many people noted a trend towards warming winters and earlier ice break-up until recently; however, the cool springs and later break-up of the past few years do not fit this trend. This may have led individuals to either mention one or other of these trends, or attribute the occurrence of both to increased variability. In this case all are valid observations, although it may be difficult to discern these nuances when dealing with other individualized variables (e.g. summer temperatures).

The differences in experience and knowledge described above are fully expected within the broader TK system, where areas of both overlap and complementarity exist

among knowledge holders. Here I have focused largely on events and trends described by multiple people.

4.2 Past and Current Human Adaptation to Change

Environmental change is one of several key factors that have encouraged a shift away from traditional livelihoods (see Chapter 5 for a discussion of other social-ecological changes and impacts). Several main strategies have been important in allowing residents to adapt to past environmental changes, which have most concretely impacted traditional land users. Adaptations include: altering land use patterns, drawing on TK, implementing new technologies, diversifying economic activities, drawing on social relationships, and accessing institutional resources. The application of these strategies in the Fort Resolution context is explored below.

4.2.1 Altering land use patterns

The ways that people use the land have shifted over time due in large part to the increased expense of accessing resources, declining fur value, and alternative options in the wage economy. For local land users, trapping was always a secondary activity, having been introduced by the fur traders, whereas hunting has always been undertaken whenever possible (Bodden, 1981).

While trapping activity has generally declined since the 1950s with waning fur markets, hunting remains a culturally important activity, providing significant contributions to the local informal economy (Bodden, 1981). Opportunistic hunting has declined with people spending less time on the land, and residents now concentrate their hunting efforts during specific seasonal periods when returns are likely to be high. Hunting participation is at its peak during the spring waterfowl migration (especially geese and ducks) and the fall moose rut, where many locals spend available time and resources out on the land. In addition to the obvious benefits for food security, these activities also serve to renew social bonds, since it is common for hunters to travel with friends or family members. A further positive adaptation is the recent resurgence in land use for recreational purposes, made possible for those with time and resources. This provides a mechanism through which to strengthen cultural ties and identity through reconnection with the land.

With changing environmental conditions, travel access has been severely reduced or seasonally delayed in some locations. Boaters often have to portage boats through shallow spots with a guide line, and sometimes haul along a small hunting canoe to access shallow channels and shoreline bays. Land users indicated that they must regularly delay activities or alter their travel routes, often having to travel farther and spend more time and gasoline than in the past to access hunting and trapping areas.

What we do is we carry a little hunting canoe. Whatever we can't get at by kicker, might be a little short portage, eh? We just pull that little canoe and then paddle in there. ... That's the way we work. (Mandeville, 2005, pers. comm.)

Locals further adapt to variable conditions by using different methods and machinery for accessing the land. During milder fall weather, trappers will set traps along the shoreline by boat until the ice thickens. With the advent of snowmobiles, access to the land has become faster and easier (albeit more expensive). This encourages land users to go out on single-day rather than multi-day trips, while being able to sleep in their own beds at night. This has resulted in a substantial decline in animals in the area close to town.

About 25 [to] 50 miles is pretty well trapped out. ...Not many guys go [for more than a day at a time]. You hit a wall with how far you can go and how far back you have to come home. (Mandeville Jr., 2005, pers. comm.)

Furthermore, since the highway reached Fort Resolution in the late 1960s, residents have been using it to increase their access to the land. For example, the water melts early and forms ponds along the highway in spring, so locals drive out to harvest their first ducks and muskrats of the season. Some residents shift hunting efforts to a different caribou population, preferring to travel more than seven hours by truck to hunt near Yellowknife rather than spending a similar amount of time snowmobiling to the East Arm of Great Slave Lake. This travel route provides hunting and trapping access to some individuals who don't have machinery like snowmobiles and boats to get out on the land (but who have access to a truck and the gas to use it), either because they cannot afford it or because they only hunt infrequently as a supplementary activity. Other residents continue to remain mobile on the land, accessing different species, depending on availability.

I've been all over. ...In the winter months I usually go, like, sometimes when the caribou herds are closer just out in the East Arm ...then we go up Slave River for moose hunt out in the prairies there. If we don't get a moose, we usually get a buffalo in winter months. And then [for] caribou sometimes we'll go out towards that Gordon Lake, towards Yellowknife and those places. (Anonymous 1, 2005, pers. comm.)

We're homeless; [home is] wherever you are on the land. You don't have a specific place when you are out there. Home is wherever you are. [It] all depends on what you do; if you are hunting, trapping, fishing. It is all different areas for all kinds of sustenance. If you need moose we go to a place where it's good for water. If you need water you go to a place that there is drinking water. (Delorme, 2005, pers. comm.)

Travel planning has also become more difficult due to unpredictable weather. Winds occurring at the 'wrong' time of year or day affect boat travel on Great Slave Lake, while less predictable ice conditions create travel barriers during river break-up and freeze-up. Land users must remain flexible, planning travel times based on information gleaned from the local forecast, other land users, and satellite imagery. Boaters also commonly haul extra food and supplies in case they get 'wind bound' on the lake due to inclement weather.

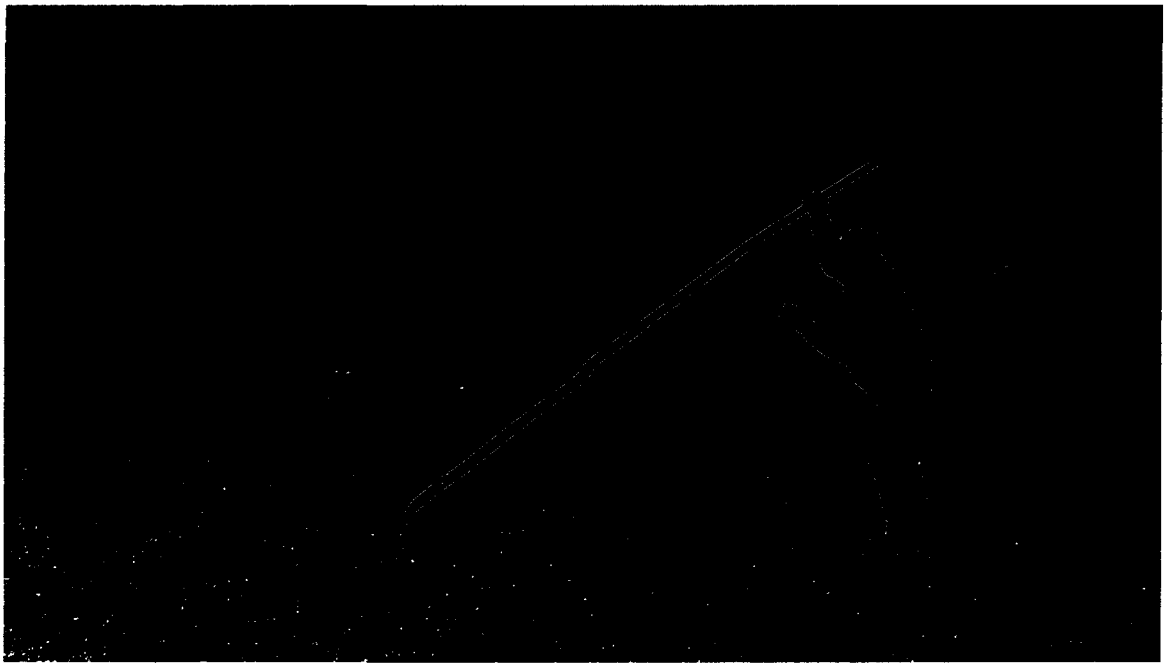
Changing environmental conditions also have a major impact on travel safety. Locals have implemented specific strategies to reduce risk. Several people described carrying a long pole (Figure 4.4), dragging a buoyant skimmer sled, or tying oneself to a companion while testing the quality of thin ice

Yeah, [the ice has to be] not less than a half inch [thick]. I think that's about the only thing that will hold you up. It will probably crack up behind you. But when I cross I usually have a sled, a sled that's like a skimmer, you know, you just go across. I wouldn't go across without anything. A pole is good, a big long pole. You can pack that along. ... Yeah, so if you have a pole, the ice will hold. You've got to hold this and the little freeze will hold you up. And a sled is really good, because it's a skimmer. If you go through you could get in your boat; it's like a boat, the skimmer. But if you just go say with a floater, I

wouldn't even take a chance to go across with a floater. I'd rather use a pole. The floater you could just go straight down and the current will take you once you fall through. But if you've got a pole, it'll hold you up on each end. (Lafferty, 2005a, pers. comm.)

It's not often that [the ice] gets that rough on the Taltson. It's smooth sometimes. So, we just go straight across over a slick. ... We usually cross with a stick or a rope. One guy behind with a rope tied on you, in case you go down. (Smith, 2005, pers. comm.)

Figure 4.4: Fred Mandeville, Jr. testing spring ice quality



River water overflow, often due to winter releases from upstream dams, causes obstacles and dangerous ice conditions for snowmobile travellers. People adapt by taking alternate routes or travelling in pairs to improve safety during overflow periods. Experienced land users tend to be risk adverse, taking more precautions than in the past, especially during seasonal transition periods.

Nowadays they're more cautious. Olden days people go out by themselves; [you could be] gone two to three months out ... in a tent and trapping and you come back [to town]

for Christmas. ... Now they go a few days, maybe a week at a time. (Giroux, 2005, pers. comm.)

Yeah, you pretty well have to be careful. You have to know your way around. A guy can't just take off like that if you don't know this country. You'll never come back. (Mandeville, 2005, pers. comm.)

4.2.2 Drawing on traditional knowledge

In response to variable conditions, land users draw heavily on their knowledge of the land. They generally pay more attention and take added safety precautions when traveling, especially during freeze-up and break-up periods on the rivers and Great Slave Lake. This highlights the need for learning, using and allowing TK to evolve so that it remains current as conditions change.

Yeah, really [we have to be more careful]. For a month later, too, than the olden days. In the olden days, sometimes I don't even touch the ice. If it's cold for two nights, then I'm going across. But now you can't, you've got to watch. A month later before you can cross anything now. (Lafferty, 2005b, pers. comm.)

Gleaning knowledge from friends and family who use the land is also common. When travelling only intermittently or to an area outside of one's regular zone, individuals seek out specific people who have knowledge about the area in question.

It's all where we grew up, eh? Like, I grew up on the Slave River. I know what the Slave River does in the winter time; I can travel safely on it. Whereas out here in the rock country, Simpson Islands, I can't because I don't know the country. I don't know how to move about it. But he knows - he goes everywhere![13] (Unka, 2005c, pers. comm.)

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[13] The speaker is referring to his friend who has more knowledge about another part of the traditional territory.

Since youth are not receiving a traditional upbringing, culture camps are one method that locals use to transfer TK. These camps, often run in conjunction with the school, involve experiential education on the land with knowledgeable elders. Current land users stress the importance of knowing the land that one is travelling on, and of having sufficient foundational skills to survive should a problem arise.

Land use is changing. There's a few people trying to get back into using the land and stuff. [Some have] never been on the land before, maybe, but their parents had. Some of it is being lost. It could be taught to them, re-taught to them or saved. (Delorme, 2005, pers. comm.)

4.2.3 Using new technologies

Technologies like the snowmobile and high speed power boats have greatly increased land user flexibility, although the high costs of owning and running them are prohibitive to many.

The mode of traveling changed drastically since the snowmobile came along. ... Gas is very expensive. There's only so many people that have snowmobiles to go out. When they go out, with the escalating price of gas, they are limited to how far. They don't go as far as they used to go with dogs. Back in the old days they would travel extensively throughout the whole region. (Yelle, 2005a, pers. comm.)

Snowmobiles and powerboats with larger motors allow people to go farther in a shorter timeframe, and to go out for shorter periods of time. However, some informants noted that the essence of traditional land use is marred by this type of travel.

Now land use is almost spontaneous. ... We can go out and do things within a certain weather frame. ... You wake up and it's this beautiful day and you're going to go just all

the way across to Simpson Island and you can be back before that evening storm comes in. That's so untraditional. (Unka, 2005a, pers. comm.)

Some informants also noted adverse effects on their well-being. Lifestyles have become more sedentary, physical work is less common, and eating habits have changed. Combined with continued increases in conditions such as asthma and various forms of cancer, which both interviewees and a range of northern researchers connect to environmental change (Berner et al., 2004), concerns for human health are on the rise.

Improvements of technology has made things easier, but has weakened our bodies because the work is easier. (Workshop Participants, 2005, pers. comm.)

New technology has also supplanted some of the need for applied TK. Elders were known to be able to predict the weather; however, much of this knowledge has been lost, while rapid change and increased variability reduce its applicability. Land users now rely on radio or television weather broadcasts to determine when best to travel.

You're at the mercy of nature. ... So today with some three-day, four-day forecasts from the weather bureau gives you a good heads up in terms of what's to be expected. And you know what the conditions are on the ground so you have an idea of what is to be expected in the next week or so ... with the ice conditions anyway on certain river systems. (Balsillie, 2005, pers. comm.)

They [used to] watch all of that and know what the weather's going to be like the next day, tomorrow. But nowadays there's all the computers; tells when the wind will blow. If you're going into the bush you know what day to travel. ... The young guys, they don't read the skies and that. ... Now with the weather you know ahead of time. ...Easier to plan. (Giroux, 2005, pers. comm.)

During the spring, residents phone in to the local GNWT Environment and Natural Resources office for satellite updates on ice conditions to help determine when

and how to travel. To increase travel safety, many people carry Global Positioning System (GPS) units and satellite phones, or inform others of their travel plans.

If you're traveling the big lake ... you can go through a whiteout with a GPS, as opposed to before you might get lost. (Balsillie, 2005, pers. comm.)

4.2.4 Economic diversification

Opportunities in the wage economy combined with dropping fur prices and government settlement policies have drawn trappers progressively away from the land during the past half century. Individuals, especially men, have become versatile in a range of labour activities, and adapted their mobility to take advantage of available opportunities within the Great Slave Lake region. Seasonal or short contract jobs remain common in the wage sector, and many working individuals continue to trap during the off-season, especially when fur prices are high.

When I get a chance I'll go on the land, but when I'm working I work, so it's fifty-fifty. (Giroux, 2005, pers. comm.)

When I got the money, I'll go [out on the land to hunt]. As long I've got about 30 gallons of gas, I'll go anywhere. (McKay, 2005c, pers. comm.)

People would try to do their living every way they can, eh? (McKay, 2005a, pers. comm.)

In Fort Resolution there has been some resurgence in trapping participation since the closing of Pine Point mine and the local sawmill during the 1980s (see Section 5.1.2).

There's more people out there now. They don't live there, but there's more use of the country. A lot of young guys here are trapping now. They never used to. There was a time when there was maybe ten of us trapping here in town. (Lafferty, 2005a, pers. comm.)

Participation is also encouraged and supported by a combination of specialized GNWT programs developed since 1994 to reinvigorate the fur industry, and attract trappers by reminding them that their "bank is in the bush" (Rossouw, 2004, pers. comm.; see Section 7.1.3.1 for more information on trapping-related programs). Individuals trap for different reasons. Some trap in order to survive, rather than working in the wage economy, or because they can't find work. However, substantial dedication, time, energy, and resources are required to make the endeavour economically worthwhile. Others trap for recreation. Regardless of whether individuals trap for financial or recreational purposes, most individuals do so because they enjoy it, it is part of who they are, and it contributes to the type of lifestyle they know best (Boucher, 2006b, pers. comm.).

The fur sales...they cut it down for a few years...and now it's starting to come back up again. ...[But] I don't think it'll ever be back to where it was. (Anonymous 1, 2005, pers. comm.)

There isn't much employment and we trap hard in the winter, eh. It affects ...our wildlife. Everybody is trapping hard, trying to catch a marten or a lynx. (Delorme, 2005, pers. comm.)

Alternately, those who are keen and able may access available funding for various training programs, often provided away from town, to improve knowledge and skills for wage employment (e.g. heavy equipment operation, truck driving, welding, carpentry). Others have developed local businesses, both formal (e.g. local convenience store, tourist operations) and informal (e.g. local catering, baked goods made to order), to generate

income. These adaptations have improved living conditions for many, providing more expendable income and leisure time. Over the past decade unemployment and income support beneficiary rates have dropped, while personal and household income have increased substantially (Northwest Territories Bureau of Statistics, 2006). Regardless, these adaptations have also contributed to social stratification and lack of access (often due to increased regulations and requirements for waged positions) has marginalized some groups. For example, in 2004 18.5% of the participating labour force remained unemployed (Northwest Territories Bureau of Statistics, 2006).

4.2.5 Drawing on social relationships

Strong social ties have been extremely important in dealing with environmental change, especially in the pre-settlement era when families moved seasonally between camps on the land. Watching out for others, whether or not they are members of one's immediate group, was part of the cultural tradition. Household doors were always (physically and metaphorically) open and it was unthinkable that someone in need might be turned away. Furthermore, land users are prone to helping each other out on the land to improve travel safety.

When it freezes and then snows the water comes out and overflows ... trappers are going to get stuck in there. So, it's not bad if you travel in pairs, someone to give you a hand. In the fall they used to travel in pairs if [the overflow was] big enough. (Giroux, 2005, pers. comm.)

These relationships continue to be especially important in times of crisis. Should an individual be in distress or need help on the land, other residents will be there to

provide help. In the winter of 2006 when two males who attempted to snowmobile across Great Slave Lake did not arrive in Yellowknife as planned, the news of their possible distress travelled quickly. A group of individuals with snowmobiles was quickly assembled, travelling late into the night in an attempt to find the men. The relief at their safe return was palpable throughout the community, showing that despite interpersonal tensions, strong ties bind people in Fort Resolution together.

These relationships are shifting, however. With fewer hunters on the land, the availability of traditional food in the community is limited during most seasons. Traditionally, hunters would pass out meat to family members and those in need, especially those who were unable to hunt for themselves. Since the 1970s, social norms have been changing. Hunters have reduced their sharing circle to smaller groups consisting mostly of close family members as well as specific friends and elders.

[When] I kill a moose I'll bring some to the elders, eh? Give them something to eat, the people that don't have anybody to [provide for] them. (Mandeville Jr., 2005, pers. comm.)

In order to cover equipment costs, it has become more common for hunters to collect money from people beyond this circle in exchange for meat (Boucher, 2006b, pers. comm.).

If you look at it, it's just not consistent hunting anymore; [it's] all commercialized. In the spring there's maybe 80 or 90 geese. [Locals are] selling them; they're allowed to sell them amongst themselves. They can't sell to [outsiders], but they can sell to anybody that's a GHL [general hunting license] holder, or native. ... There's only one that has a commercial tag – that's the caribou. (Mandeville Jr., 2005, pers. comm.)

To substitute for decreased amounts of traditional foods, most households rely heavily on either the local grocery store, or the larger one in Hay River. (See Chapter 5 for an in-depth discussion of the social dimensions of environmental change and adaptation.)

4.2.6 Accessing government resources

One of the major effects of government services introduced in the 1960s has been the creation of a formal social safety net. In combination with opportunities in the wage sector, the ability to access family allowance, pensions and social assistance has shifted the mode of land use away from its former survival-based nature. Individuals and households have adapted by coming to rely on these services as a full or partial source of income, either giving up land-based activities altogether, or supplementing social service income with subsistence resources. This (albeit low level) financial security reduces the risk associated with reduced returns on hunting or trapping activities. Several pensioners use the available time and money to subsidize land use, which they pursue more for enjoyment than as an economic activity.

Increased access to government resources through social assistance, family allowance, pensions and housing subsidies is seen as a mixed blessing. On one hand, it ensures that those in need no longer have to struggle for mere survival; however, subsidy structures often fail to provide adequate incentives to encourage training and employment

for a large segment of the population. Increases in income have also led people to become more dependent on store-bought food and other goods.

On another front, the GNWT has implemented a complement of programs to support continuity within the territory's traditional economy. The Genuine Mackenzie Valley Fur Program has a targeted marketing strategy to promote high quality authentic NWT-harvested fur, while sub-programs (Guaranteed Advances, the Prime Fur Bonus Program and the Grubsteak Program) have been established to reduce individual risks to trappers. They provide financial support to encourage the harvest of high quality pelts, and help to stabilize fur market fluctuations through guaranteed minimum pelt prices. Subsidies for equipment purchase are also periodically available through local organizations. Funds from the GNWT Community Harvester Assistance Program are distributed to defray capital and operating costs for harvesting activities, and DKFN also periodically provides hunting shells to its members. Another complementary suite of GNWT programs – Take a Kid Trapping, Trapper Recognition and Trapper Workshops – aim to promote and recognize trapper and general bush skills, and counteract the degradation of traditional skills in the NWT (Rossouw, 2004, pers. comm.; Government of the Northwest Territories, 2008a). Culture camps at the community level also help to reinforce these skills. In combination, these resources help to support the viability of hunting and trapping activities for individual residents.

4.3 Linking Change, Impacts and Adaptations

It is important to see how the changes, impacts and adaptations discussed above are inter-related. The following section expands on the relationships among variables and indicates some outcomes for vulnerable groups in the community.

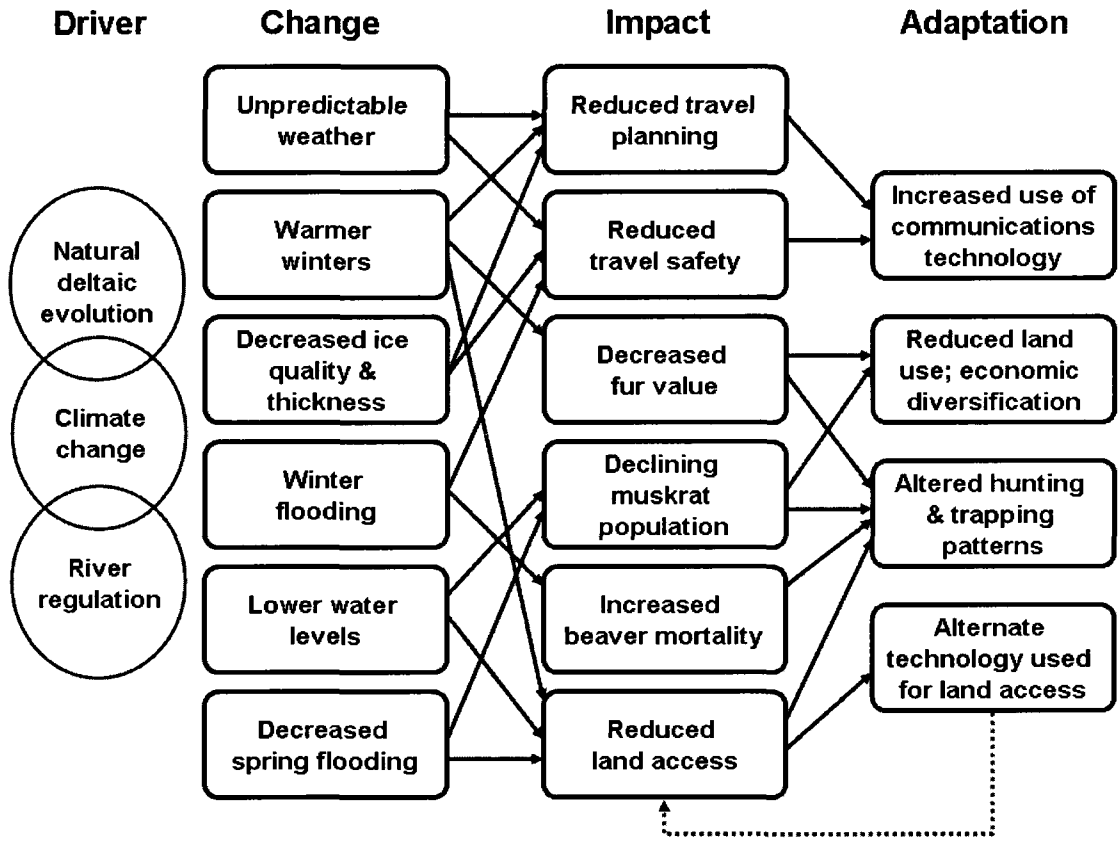
4.3.1 Relationships

Complex inter-relationships among a number of social-ecological variables are often better expressed via a pictorial diagram than in textual form (Checkland, 1999). Drawing on the comments of elders and harvesters, Figure 4.5 provides a summary of the various pathways in which key components of the Fort Resolution social-ecological system interact and are influenced, using selected examples of environmental change.

Experience in DKFN territory shows that relationships among factors of change, impacts and adaptations are complex and non-linear. Figure 4.6 illustrates a conceptual framework for understanding and analysing such relationships, with embedded examples from the case study. Livelihood impacts often result from cumulative environmental pressures. Various factors or 'variables' are mutually reinforcing and may precipitate secondary and tertiary effects. For example, key informants noted the following impacts during the past three decades: sediment build-up and diversion of water flow in the delta reduces accessibility for boat travel; a drying trend in inland marshes and ponds encourages willow encroachment, reducing habitat for muskrats and bison; and debris

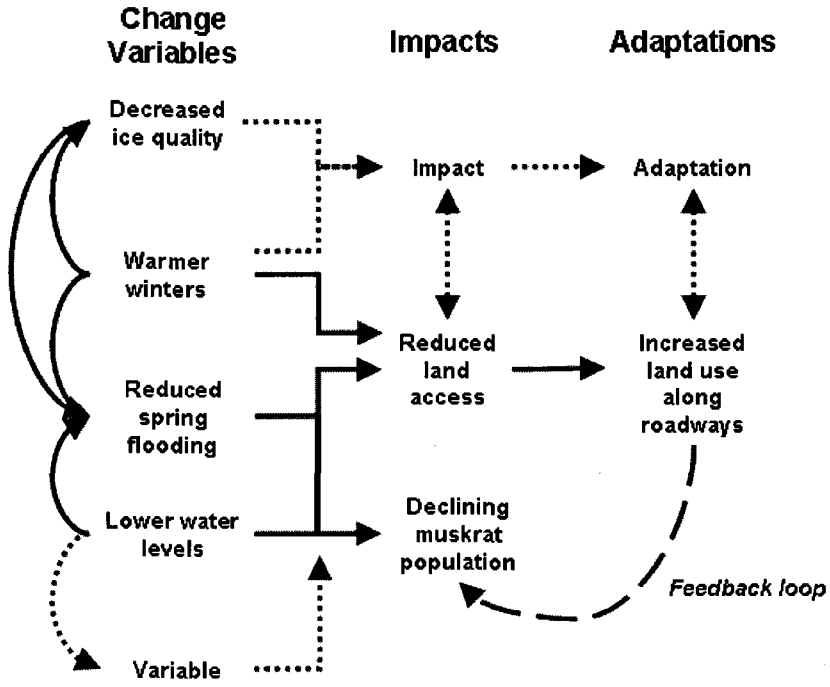
build-up along the riverbanks limits moose access to the water. Both individually and in combination, all of these trends result in reduced hunting opportunities.

Figure 4.5: Conceptual model of selected relationships among environmental changes and related human impacts and adaptations



Individual impacts can also be reinforced by non-linear, synergistic change and feedback. For example, reduced land access (impact) encourages hunting and trapping along well-travelled corridors near town (adaptation) causing further faunal depletion (impact). Individuals may select one of a number of strategies to cope with such changes, depending on their unique livelihood context. Specific adaptive strategies are often useful in addressing multiple impacts, and are also often used in combination.

Figure 4.6: Conceptual diagram of synergistically reinforced environmental change variables and multiple, linked impacts, with case study examples



Although largely presented in a positive light, the outcomes or consequences of the adaptations noted here are not necessarily positive in all respects. Several adaptation strategies implemented to deal with past changes may undermine the overall ability of harvesters to adapt to future change. For example, economic diversification leads to reductions in individual land use and the continued evolution and relevance of TK in their lives. This limits the chance that this knowledge will be transferred to their children. The use of new technologies can also act as an obstacle to truly connecting with the land.

Back in the old days you travelled slower, you saw more, and you travelled by dogs. You'd come a lot closer to the land than you are now, travelling by jet boat. At one hundred kilometres an hour, or whatever, you don't see much. (Unka, 2005b, pers. comm.)

New technologies like power boats and GPS have also supplanted some practical application of TK. For example, GPS use suppresses the development of individual spatial skills, and powerful boats reduce the need for detailed knowledge about river currents. Such adaptations can be helpful in the short term, allowing a broader range of people to access the land despite limited knowledge. However, loss of TK at individual and community levels may be particularly detrimental in the long term, with no recourse for regaining it. Other adaptations, such as a reduction in the frequency of land use, may be perceived as stimulating a negative result: a loss of TK and culture. Since such maladaptive responses may be perceived as doing more harm than good, Adger (2003a) cautions that it may be as important to avoid maladaptation as implementing positive adaptation strategies.

4.3.2 Societal disparities and vulnerable groups

The relationships discussed above can be used to determine the types of vulnerabilities that are specific to individuals and groups within the community of Fort Resolution. As a broad category, land users are most affected by changing environmental conditions. However, the above framework points to adaptation barriers resulting in increased vulnerability for a sub-group of individuals and households. The types of adaptation responses in Figure 4.5 are often differentiated based on financial well-being (e.g. increased gasoline use, and accessing new technologies). The combination of changing environmental and socio-economic circumstances amplifies economic disparities within the community.

Gas prices went up [and that] limits people. ... The only people that you see cruising around or trapping or giving 'er lots are those that could afford it. The people that can't afford it some of them don't even go anymore ... 'cause they can't afford the gas and they don't have dog teams like before. 'Cause before, when you had dog teams ... it was all fed through fish and whatever you killed. ... It was off the land too, so you didn't have to buy food for dogs then. So you had more people [on the land] back then than you have now with Skidoos. Now you only get to see people who could afford it now. ... Lots of us are so used to that lifestyle, that's why we do it. ... Lots of guys that trap now probably don't make any money at it, probably just break even. (Anonymous 1, 2005, pers. comm.)

It is common that the people who would benefit most from subsistence harvesting experience increased limitations on their land use. For example, some previously active land users are now limited to berry picking and hunting along the roadways because their financial status prohibits access to necessary equipment for land travel (e.g. boat, trailer, snowmobile, gasoline). In contrast, those who have alternate income sources and use the land for recreation or for economically profitable activities (e.g. tourism), have access to technologies such as fish depth meters, global positioning systems, and satellite phones that facilitate and improve resource exploitation and safety.

4.4 Summary

This analysis of changing environmental conditions, related impacts on human livelihoods, and past and current adaptation strategies clarifies the relationship between local aboriginal residents and the land, highlighting its importance for culture and identity. Local participants in Fort Resolution have observed changes in environmental conditions in the following areas: climate, hydrological system, wildlife, vegetation, and fire regime. Many of these areas have also been documented through natural science

investigation. Through diagrammatic and textual methods, the chapter explored some of the ways where TK and SK can complement each other to improve system knowledge.

The chapter outlined historical and current human vulnerabilities and described strategies that have already been used in the community to adapt to environmental change. Adaptations include: altering land use patterns, drawing on TK, implementing new technologies, diversifying economic activities, drawing on social relationships, and accessing government resources. The chapter illuminated some of the primary relationships among change, impacts and adaptations, noting that the impact on livelihoods often results from multiple or cumulative pressures that are mutually reinforcing. At the same time it is recognized that while many past adaptations have been successful, it is clear that the scale and nature of current environmental change brings "a very different sense of uncertainty and presents different kinds of risks and threats to the livelihoods of indigenous peoples" (Nuttall, 2005).

The next chapter (5) focuses on issues relating to individual and group vulnerability, and the important role played by social relationships in shaping adaptation in response to changing conditions. It discusses the multiple and cumulative pressures facing residents in Fort Resolution, and highlights the social assets that play a role in current adaptation, which provide a focus for capacity-building for the future.

CHAPTER 5: THE SOCIAL DIMENSIONS OF ADAPTIVE CAPACITY

Back in those days you had to depend on your peers or your immediate relatives or your friends or the community as a unit. You handled it that way, because there's no outside help. (Unka, 2005b, pers. comm.)

Biophysical environmental change is only one of several recent phenomena to cause major upheaval to northern peoples. Government settlement policy, changes in services and infrastructure, and resource development at various scales have stimulated significant social and cultural shifts in aboriginal communities (Alden Smith & McCarter, 1997). Thus, although climate change is now receiving considerable scientific, political and media attention, its impacts must be viewed within the larger context of a complex web of cumulative pressures.

Like many other northern societies, Fort Resolution has undergone rapid change on social, cultural and economic fronts. Changing relationships and livelihoods at the local level are occurring within the broader context of evolving regional-national political agreements for both the Dene and the Métis (see Section 5.1.3). From its previously strategic location and *raison d'être* as a fur trade centre, the settlement first experienced an evolution from modest beginnings to commercial hub, then fell more recently back into relative obscurity. The current population has lived through much of this rapid change, and has struggled to emerge from a particularly difficult period of social challenge in the 1970s and 1980s.

Insight into community social structure and dynamics is key to better understanding the local capacity of people to work collectively to adapt to current and future change (Adger, 2003b; Pretty, 2003; Pelling & High, 2005; Armitage et al., 2007; Wakefield et al., 2007). Accordingly, this chapter focuses on how the socio-cultural system in and around Fort Resolution has changed over time, how these changes have impacted local social dynamics, and how the latter affects the ability of individuals and groups in the community to respond effectively. This chapter begins with a synthesis of the historical context of the settlement and region, providing a basis from which to understand how social dynamics have evolved through time, and how historical events and relationships still play an important role in the social and political fabric and function in Fort Resolution. Subsequent sections draw largely on 104 household questionnaires completed in Fort Resolution, consisting primarily of numerical rankings (APPENDIX C, APPENDIX J). These quantifiable results are supplemented by descriptive data derived from the questionnaire responses, interviews and focus groups.

5.1 Historical context

Historical background provides a framework for understanding how external and internal forces, whether through rapid or gradual shifts, have affected the current state of social relationships and dynamics. Such considerations are especially relevant in small aboriginal communities where outside forces have greatly impacted the internal sense of

cultural affiliation and identity[14]. A brief historical sketch of the community and its residents follows, consisting of three parts: socio-economic history, recent social change, and governance. These sections highlight many of the major events and trends that have helped shape the current society.

5.1.1 Socio-economic history

The earliest fur trade activity in the Northwest Territories began on the south shore of Great Slave Lake with the North West Company (NWC) trading post in 1786. The Hudson Bay Company (HBC) returned in 1815 after an aborted attempt to set up a competing post in 1803, and both posts co-existed on Moose Deer Island (2 km east of town) for several years. HBC gained a monopoly when it absorbed the NWC in 1821 and moved to the current Fort Resolution town site. From then until the mid-1800s all of the fur in the Great Slave Lake region was traded into Fort Resolution, and the HBC maintained a monopoly over the area until the latter part of the century (Smith, 1982).

The fur trade brought an influx of Métis to the southern Mackenzie District, most of them Red River Métis of French-Cree heritage[15]. Of the several aboriginal groups who traded in Fort Resolution, including Yellowknives, Dogribs, Slaveys and Chipewyans,

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[14] Identity can be understood as "the ways in which individuals and groups perceive and act upon the social and cultural traditions they inhabit" (AHDR, 2004). I distinguish between this and 'legal identity' which refers to a government-assigned legal category.

[15] The term 'Métis' was more recently extended to include others of mixed Native-European heritage, in this case primarily those with Athapaskan (Dene) and Scotch/English or French ancestry (Helm, 2000).

the latter were prevalent and their brethren make up most of the current population (Smith, 1981; Fumoleau, 2004).

During the 19th century, the Chipewyans trading into Fort Resolution lived in nomadic bands that varied seasonally in size depending on hunting, fishing and trapping opportunities. During the early fur trade era, the territories of these subsistence-based bands were centred on the mouths of major rivers flowing into Great Slave Lake. Each of the Snowdrift, Taltson, Slave, Little Buffalo, Buffalo and Hay Rivers had an associated local band, the members of which congregated annually in fall and/or spring during fish spawning season (Smith, 1982). Individual and family ties to these 'locations of origin' are discussed later in the chapter.

Anthropologist David Smith described the Chipewyans of Great Slave Lake as having a fairly simple social structure, where three types of traditional leaders were recognized, although their abilities and roles were not necessarily mutually exclusive. The bek'abąθdeli (hereafter spelled 'bekabanthdeli'), translated as 'the one who is at the centre while the others serve him', held authority over both his own co-resident band and over a larger group, the size of which depended on his reputation. Major roles included directing group movements, hunting and economic activities, and acting as a war leader, when necessary. From pre-contact times to approximately the 1930s, a second type of leader – the dene gą kalǫ̀ərae (hereafter spelled 'dene gan kaltherae') played the role of 'foreman for the people', whose role it was to coordinate subsistence activities for a small co-residence group. These leaders were selected by casual consensus based on their

superior abilities and knowledge regarding hunting and traveling on the land, and they typically had some supernatural adeptness which aided in these endeavours. Until recently there also existed the 'shadow people', or i^{n}ka^{n}zẽ dẽnẽ. These were men, and a few women, with magico-medical adeptness whose services were sought as required (Smith, 1982).

The bekabanthdeli became obsolete in the early to mid-1800s as inter-group hostilities declined and the early fur traders instituted 'trading chiefs' who assumed their other roles. These 'trading chiefs' were likely dene gan kaltherae, chosen to mediate and facilitate Indian-trader relationships. By the late 1800s the institution of this role seems to have disappeared along with the HBC's monopoly, as trappers became more inclined to individually seek out the best price for their furs among competing operations (Smith, 1981, 1982).

Religious conversion began when early Catholic missionaries visited Fort Resolution in 1852 and established a Mission six years later, proceeding to convert locals to Catholicism with relative ease (Fumoleau, 2004). Missionary influence continued with the 1903 establishment of an orphanage (which largely housed children that were unwanted, orphaned or diseased) and convent, and a hospital in 1939. In 1909, the orphanage was converted to a residential school run by the Grey Nuns and supported by federal government funds. The students received instruction in multiple subjects, including religion, and all instruction was in the English language until the senior grades when French was also offered. In 1920, the Fort Resolution Residence, known as St.

Joseph's, was one of seven schools (five boarding and two day schools) in the Mackenzie District, serving 72 children (Smith, 1981; Fumoleau, 2004; Abel, 2005). Students, patients and others from around the territories came to Fort Resolution for these services, and some of them stayed and raised families in town, adding to the cultural diversity.

Well, you know some families had lots of children. ... It was hard bringing [kids] up at that time. ...Not every year's the same ... for fur or for [finding other means of providing for the family]. ... [And] they want for the kids to be all Catholics, learn their prayers, learn schooling, so they take them to the Mission and that's where they stayed. And [they] live in there, too. (Sayine, 2005, pers. comm.)

I went to [the residential] school when I was just a little guy ... here in Fort Resolution. ... The school was pretty tough and ... we started to be taught in English. ... And it's hard. You didn't understand, you didn't know what [they] were talking about. (King, 2005c, pers. comm.)

Although never an outstanding fur post, Fort Resolution was successful due to its critical location at the mouth of the Slave River, and its role as a fish provider for northern traders. Around the turn of the 20th century, transportation improvements such as the rail link as far north as Edmonton and the commencement of steamboat operation on the Slave River encouraged the movement of freight and passengers (Fumoleau, 2004), and the growth in the fur trade industry on Great Slave Lake. During the early 20th century, Fort Resolution experienced a boom as the central node in the northern trading system. By 1902, six competing trading interests were operational (Smith, 1982). White trappers moved in from the south in successive waves with a targeted purpose, often using more efficient and sometimes more destructive methods (e.g. dynamite, airplanes for accessing remote areas) than the more subsistence-based aboriginals. Many white trappers were itinerants, moving from place to place, seeking out the best fur. These activities, combined with the sometimes unscrupulous practices of the inbound 'free

traders'[16] (HBC competitors) put the aboriginals at a disadvantage due to an "inaptitude for competition and inexperience in cash transactions" (Fumoleau, 2004: 317).

As the fur trade continued to develop, aboriginals transitioned into semi-nomadism with the establishment of log-cabin hamlets, each populated by several family units and located on a major watercourse with abundant fish (Smith, 1982). 'White' diseases wreaked periodic havoc on aboriginal society, and the years from 1920-1940 saw many deaths from influenza and tuberculosis (Abel, 2005). Particularly tragic for the Great Slave Lake bands was the influenza epidemic of 1928 that wiped out up to a quarter of the aboriginal population (Fumoleau, 2004). The elderly were especially hard hit; many small bands lost influential elders as well as some chiefs and headmen in a short time span. In addition to the aftermath of dealing with the many personal tragedies, important ties to cultural history and traditions, and vital environmental knowledge were lost (Abel, 2005), causing social discord and a break in social memory.

[Famines were] compounded by the different diseases that were coming in from the Europeans, that we had no way of fighting because our immune system wasn't developed to fight off ... whatever was coming in, like the typhoid fever and the flu epidemics and all this stuff. ... Our immune system didn't know how to deal with it, and it killed us. ... It changed a lot of the social structures, a lot of the traditional [leaders] died. (Unka, 2005b, pers. comm.)

I'm thinking about the flu epidemic in 1928. ... There was only a handful of people that were still capable of burying people. And that's all they did was bury people and make coffins. They had to break boats up to get the boards and make coffins out of them. They buried people in old canoes. They just cut the ends off and folded over because they had no caskets. ...There were just five or six people getting buried everyday. (Unka, 2005b, pers. comm.)

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[16] Between 1920 and 1927 the number of trading stores in the Northwest Territories doubled to 220 (Fumoleau, 2004).

In the following years, the unregulated activities of the white trappers resulted in a hunting and trapping crisis[17]. While a series of restrictions were imposed with the supposed intent of protecting wildlife and eventually benefiting aboriginal harvesters, these seriously threatened the entire structure and manner in which the aboriginal way of life was carried out. Between 1928 and 1939, closed seasons on fur and game were imposed, beaver harvesting permits were instated, and discussions about the designation of a game preserve were ongoing. Aboriginals were fined or even arrested for non-adherence (Godsell, 1935 cf. Smith, 1982), and found such limitations on harvesting activity devastating (Fumoleau, 2004).

Way back in those days there was no fresh meat in the stores, only canned meat. On the land we didn't waste any food. If you only had rats, you'd eat the same thing over and over. When the ducks came over, the game warden would set up a tent across from our cabin and come [over] to check the ashes. He would gather duck bones from the fall before, put them in an envelope and try to charge my uncle for killing ducks during the wrong season. He'd take the shotguns away until September second when the new season opened. So we'd have to go into the inland sloughs to kill a duck with a 22 and hide the bones in the bush. What gets me is that we weren't wasting anything and we were being stopped from getting fresh meat just because it was out of hunting season. You can't keep moose or caribou meat for very long so it is made into dry meat, but it is nice to have fresh meat [like] duck. But you had to hide. ... [The warden would] search your bag and everything if he met you along the river. Those regulations are across Canada, but it shouldn't be enforced in the bush near small communities where people use the meat for subsistence. This was in the 1950s and 60s. The way the locals were treated was unfair; in the south ducks are used for target shooting, whereas people in the north are struggling to make a living. (Beaulieu, 2005a, pers. comm.)

Economic depression and a declining fur market in the 1930s led in part to a decisive shift in the northern economy towards extractive, non-renewable industries (Abel, 2005; Bone, 2009). As the fur trade declined and road (1948), air (1955) and rail

[17] To give an idea of the relative presence of white trappers in the Northwest Territories, Hudson's Bay Company records indicate the issuance of 551 licenses to non-Indians in 1932 (Fumoleau, 2004).

(1964) linkages were developed from the south to Hay River, traffic and commerce shifted away from the river system, bypassing Fort Resolution (Bodden, 1981). The subsequent decades saw federal government provision of family allowance, old age pensions, and other social security programs. The government also took responsibility for education and health care, instituting a federal day school and a nursing station in Fort Resolution in the late 1950s (Smith, 1981, 1982).

By mid-century, continued low fur prices made it difficult to live solely from the land. Furthermore, in the satellite community of Rocher River, the school burned down in 1958, followed by the closing of the HBC trading post in 1963 (Pearson, 1969; Usher, 1971; Mandeville, 2001). The cumulative pressures of these events, combined with the interest in collecting family allowance and the movement of caribou (a primary food source) away from the settlement prompted its abandonment (Smith, 1982).

Nineteen fifty-eight, winter when the school burned. There was a store [trading post]; they had all the services they required. But the school was the main one because it kept the people there because their kids could go to school. But when it burned, the kids were taken out of there ... and of course the parents aren't going to hang around with their kids out of there, so they moved to where they can feed their kids which was here [to Fort Resolution]. (Unka, 2005b, pers. comm.)

I was born in Rocher River in 1956. Yeah, I stayed there until I was about 10 years old. ... The school burned down, there was nothing [left] there ... so I ended up here [in Fort Resolution]. (Giroux, 2005, pers. comm.)

The school burned down so we had no choice, we had to come over here to live in Fort Res[olution] so the children could go to school. ... They told us that our kids had to go to school and if they didn't they'll take our family allowance away. ... That's why we all moved over here, because the kids had to go to school. ... [In Rocher River] there was about six stores there, the mill and the café. ... There were four other stores around that area, so there was a lot of people there. Everyone just trapped. Nobody worked, they just

trapped, working in the bush and doing the ... traditional stuff. (King, 2005b, pers. comm.)

Access to health care, education and social assistance prompted many aboriginals to resettle permanently in Fort Resolution, and others in Fort Smith, Lutsel K'e or Yellowknife (Pearson, 1969; Smith, 1981). Some residents were able to find employment in the Great Slave Lake commercial fishery and local sawmill. This transition to settlement life brought with it many changes to aboriginal social structures and their way of life.

When I was a kid growing up you didn't see welfare. ... Everybody was out there hunting, trapping, fishing and living the traditional way. ... There was very little booze – at home booze is [only consumed] at Christmas, you know – a specialty [treat]. ...A lot of people didn't drink – they just didn't have time. ...They had just a full time job just to keep the family fed. Certainly [my] dad has twelve kids, you know. He was gone all the time hunting, fishing, trapping. [If] he didn't put food on the table, well nobody was going to put it on the table for us. I mean, us kids growing up, we [had] our [chores] to do. I was the oldest boy so I did all the chores like cutting the wood and hauling water with dogs and hauling wood and all that stuff. (Mandeville Jr., 2005, pers. comm.)

5.1.2 Recent socio-economic change

The 1960s brought marked improvements in housing and amenities, including television, which coincided with a population influx. Many adults who had spent their lives on the land were made to live permanently in settlements due in large part to the outcomes of federal assimilation policy, with few skills to take advantage of wage employment and suffering a feeling of loss of their identity and way of life. Alcohol (and later other drugs) became a coping mechanism, and its use expanded rapidly in the 1970s

after a new road was completed, linking Fort Resolution to the towns of Pine Point (a company town attached to a new lead-zinc mine) and Hay River.

[Since] they opened up the road ... they're bringing in the booze, too. Like before I remember they used to bring in booze but just for a special occasion like Christmas. Just for old people there who would want to drink to celebrate instead of making homemade brew. ... And now [in] three hours you're back here with ten cases if you want. (Mandeville, 2005, pers. comm.)

The social consequences of the bush-settlement transition, increased access to drugs and alcohol, and increased material wealth for part of the population who worked at Pine Point were exposed through a period of social unrest from the 1970s to the early 1990s. During this time the community suffered several tragic suicides and a range of other intra-community violence. Since that time, a growing number of residents have turned to sobriety and the process of re-building healthier and more prosperous lives. The unrest of previous decades has mostly subsided, although continuing drug use has shifted in part towards harder drugs, and bootlegging (local sales) of alcohol and drugs by a handful of residents is widely perceived as a blight on the town.

The rise and fall of employment opportunities has been challenging for many residents. Since the fishery decline in the early 1970s (Mackenzie River Basin Board, 2003) and sawmill and mine closures in the 1980s, most of the remaining local wage work is in government offices. Local informants indicated that people became used to obtaining contract work on a fairly regular basis, but more recently with the decline in industries the remaining jobs are not well distributed. Some individuals have more than one part-time job, whereas others are not able to break into the market (Workshop

Participants, 2005, pers. comm.). Some residents have also taken advantage of opportunities in the burgeoning diamond mine industry in other regions of the NWT, although a lack of professional qualifications and clean criminal records limit participation. Many families have had to draw on a combination of occasional or seasonal employment, trapping income, and welfare to meet basic needs.

5.1.3 Governance

During the 1800s, the aboriginals that traded into specific settlements were deemed by the traders and the government (and later by the people themselves) to belong to that post. The group of Dene (predominantly the Chipewyan formerly known as Montagnais, and some Yellowknives) that traded into Fort Resolution became known as Dene Nu Kwen (now Deninu Kue), or 'Moose Deer Island House People' (Smith, 1982). Thus the trading post, rather than the territorial range, became the focus of their identity. These groupings were referred to as individual 'bands', supplanting traditional structures of social organization. These trading post bands were then imbued with formal membership with the 'taking of treaty' (Helm, 2000).

The Treaty of 1900, made in Fort Resolution, has always been regarded by the Dene as a treaty of peace and friendship negotiated between two sovereign powers. The treaty, as understood by the Dene, allowed British subjects access to territorial lands in order to coexist with the Dene First Nations (DFNs). The intention was to show goodwill in sharing their territory, "to help each other 'like brothers in the same family'" (Akaitcho

Territory Government, 1995: 6), without ceding land or other rights deemed fundamental to Dene existence. In the aftermath, reduced aboriginal control over their land, the issuance of Métis scrip[18], and more recently the *Act to Amend the Indian Act* (commonly referred to as Bill C-31)[19] have led to differential treatment for Dene and Métis (Fumoleau, 2004). Despite this, relations between these groups have generally been good until relatively recently.

When the Treaty of 1900 was made, the government implemented the institution of chiefs and headmen (or councillors) to act as aboriginal representatives in any subsequent negotiations. While the chosen men were respected individuals from the various hamlets, they were seen by their own people as little more than spokesmen for Indian-government relations, whereas the government accorded them more authority. The government expected chiefs and headmen to represent the interests of a group of local bands; however, traditional leadership could not be so broadly accorded, and in reality it was difficult for them to speak for more than the members of their own hamlet. By the 1930s, residents were disenchanted with these 'leaders' because they were not deemed to be gaining adequate concessions from the government, and it became common practice for locals to deal individually with the Indian Agent. Only after the initiation of the collective indigenous movement and establishment of the Indian Brotherhood in the

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[18] Between 1870 and 1921 the government instated a scrip system to 'compensate' Métis for extinguishment of title to the land. Individual Métis were issued a certificate that entitled the bearer a predefined amount of land or money (Fumoleau, 2004).

[19] In 1985, the *Act to Amend the Indian Act* brought key amendments to federal legislation, including changes to Indian status registration policies and to First Nations Band policies and powers. This allowed many non-status Indians (including Métis) to (re-)gain status and access associated benefits (e.g. education funding and free health care).

Northwest Territories in 1969 did these offices regain some importance as mechanisms for improving local control over their own affairs (Smith, 1982). The Dene recognized the opportunity to use existing governance structures to draw attention to their rights and issues.

During the past half century, the legal distinction between treaty and non-treaty status has played a more prominent role in the allocation of benefits (e.g. housing and health care) and in structuring relations among groups in Fort Resolution. The differential provision of government services and perceived multi-level discrimination by the Métis (e.g. being labelled as 'white' when the government didn't want to spend money on them, and 'native' when competing with 'whites' for jobs) has caused disharmony between Dene and Métis that works against group unity and solidarity (Smith, 1982). A simple example was the allocation of beaver harvesting permits. During the mid-1900s, individuals were allowed to harvest five beavers per season. Métis had to pay five dollars for the permit, whereas treaty Indians got it free of charge (Beaulieu, 2005a, pers. comm.). This has since changed, but it serves as a reminder of divisive government policy.

Politically, Fort Resolution shifted from a one-council to a three-council system in 1990, creating three governance bodies: Deninu Kue First Nation (DKFN), Fort Resolution Métis Nation Local #53 (governed by the Northwest Territory Métis Nation (NWTMN), formerly the South Slave Métis Tribal Council), and the Deninoo Community Council (DCC). A diversity of views exists about whether or not this change

was positive and/or necessary. While it has resulted in the ability of Dene and Métis to pursue their own agendas in a more focused way, it has also created divisions between leadership groups that trickle down to the general population.

We had it like that before. We worked as a group, like the one council system we tried that years ago and it really never panned out because ... core groups are entitled to different [things]. Everybody is working on their different legislation, different treaties. ... Some [felt] "Well I have a treaty, I have more power". ... It just didn't work as a unit ... because you can't start something when you are not doing it at home. (Unka, 2005b, pers. comm.)

They should have just kept [the Dene and Métis] together, it would have been better. Maybe we could have something going, holding together anyways. But they don't do that now. (Smith, 2005, pers. comm.)

Further divisions were created at the regional level after the 1990 breakdown of the Dene-Métis comprehensive claim (Fumoleau, 2004), causing fragmentation among governance bodies and prompting the Akaitcho Dene First Nations (DFN) and the NWTMN to enter into separate negotiations with the Canadian government to determine lands, resources and self-government rights (Table 5.1). This, in conjunction with the aftermath of the *Act to Amend the Indian Act* has stimulated some ill feelings among residents, and conflicts over overlapping interests.

The changes described in the above historical sketch have had a range of impacts on factors like livelihood activities, social relationships, local politics, culture and values, and health and well-being. The predominant dynamics and trends are explored below, followed by a discussion of implications for adaptation.

Table 5.1: Outline of Akaitcho Dene and Northwest Territory Métis claims
(Indian and Northern Affairs Canada, 2004a, 2004b, 2007a, 2007c)

	Akaitcho Dene First Nations	Northwest Territory Métis Nation
Population	2,500 Dene in four communities: Deninu Kue (Fort Resolution), Lutsel K'e (formerly Snowdrift), Ndilo and Dettah	2,200 Métis in three communities: Fort Resolution, Fort Smith and Hay River
Land area	230,500 km^2	N/A
Joint claim	• Joint Dene/Métis Comprehensive Land Claim negotiations initiated – 1981 • Joint Dene/Métis Comprehensive Land Claim rejected by the aboriginal parties – 1990	
Current Agreement milestones	• Treaty Land Entitlement discussions initiated – November 1996 • Framework Agreement signed – July 25, 2000 • Interim Measures Agreement signed – June 28, 2001 • Akaitcho/Tlicho overlap/boundary agreement signed – November 27, 2002 • Interim Land Withdrawal Protocol signed – November 21, 2005	• Unique process negotiations initiated – March 18, 1994 • NWTMN Process initiated with signing of Framework Agreement – August 28, 1996 • Interim Measures Agreement signed – June 22, 2002
Ongoing objectives	• Akaitcho Agreement in Principle • Akaitcho Final Agreement • Implementation Plan	• Métis Agreement in Principle • Métis Final Agreement • Implementation Plan

5.2 Social System in Fort Resolution

The above sketch alluded to some of the complex issues at play and their influence on the structure and dynamics of social relationships in Fort Resolution. Here, I expand on the current social structure to provide a backdrop for the subsequent discussion regarding social relationships and networks (often referred to as social capital), and how these relate to adaptive capacity.

In Fort Resolution, over 90% of the current population is aboriginal (Table 5.2). The population is made up of families that lived in satellite hamlets or that seasonally used the land along one of the three river systems within the traditional territory

(geographically defined in Chapter 1): Little Buffalo River, the Slave River and Delta (including Fort Resolution), and Taltson River (where the main settlement was Rocher River).

As aboriginals increasingly settled in town during the mid- to late 1900s, and shifts in legislation allowed many aboriginals to claim status, the demographic character shifted from being Métis-dominated to Dene-dominated (Mckay, 2005d, pers. comm.). Locals estimate that the Métis make up approximately 35 to 40 percent of the current population in Fort Resolution.

Fort Resolution is made up of interconnected groups of residents (both Dene and Métis), most of whom share a joint cultural history. Kinship networks based on family origins represent the dominant dimension of the social structure, although the strength of these ties has to some degree been eroded by change. Additional dimensions, such as legal cultural designations (e.g. Dene, Métis, Other), socio-economic status, and extra-familial friendships add complexity to community relationships. Several residents indicated that the Dene and Métis were more integrated and treated similarly before the 1970s. One Métis member recounted that her father was invited to take rations with the Dene, and that it was common for existing resources to be spread around (Mckay, 2005d, pers. comm.).

Table 5.2: Population composition in Fort Resolution from 1910 to present

Year	1823	1863	1910	1920	1930	1940	1950	1971	1976	1981[20]	1986	1991	1996	2001	2006
Treaty Indians[21]	564	577	580	624	439	305	338	210	187	ND	310(+90)=400[22]	ND	485	475	450
Métis	10	25	82	111	219	277	254	331	264						
Non-aboriginal	5	15	44	65	85	83	67	65	47	ND	45	ND	44	45	35
Total[23]	569	617	706	800	743	665	659	606	498	480	447	515	536	525	484

Sources: (Bodden, 1981 [1910-1976]; Smith, 1982 [1823-1971]; Statistics Canada, 1991, 1997, 2002, 2007a)
From 1823-1976, Métis and Treaty Indian numbers include those trading into or residing in Fort Resolution
ND = No data available

[20] After 1976, Métis and Dene numbers are combined to make up an 'aboriginal' category, following the terminology employed in the Constitution Act, 1982 where S.35(2) identifies the 'Aboriginal peoples of Canada' to include the Indian (First Nations), Inuit and Métis. Post-1981, the Métis and Dene categories are merged into a single 'aboriginal' category, which includes residents who reported identifying with an aboriginal group (as above), who reported themselves as treaty Indian or registered Indian, and/or who reported being a member of an Indian Band or First Nation (Statistics Canada, 2007b).

[21] Treaty Indians maintain unique rights such as the collection of an annual annuity, and certain territorial benefits. Métis are those of mixed aboriginal and 'other' heritage who do not have treaty rights (or 'status') due to intermarriage with other than treaty Indians or voluntary rescindment. Prior to 1951, Canada's aboriginal people were defined through matrilineal descent, whereas between 1951 and 1971 this changed to patrilineal descent. Since 1981 aboriginal ancestry has been (re-)defined by descent from both the mother's and the father's side (leading to Bill C-31; see footnote 4). Prior to 1981 the steady decline in numbers of treaty Indians in Fort Resolution and parallel increase in numbers of Métis can be attributed to intermarriages among groups.

[22] Census data from 1996 lists 310 individuals as single-origin aboriginal and 90 individuals under an undefined multiple-origin category. Based on historical trends, it is likely that this category includes primarily Métis and perhaps also some of mixed aboriginal ancestry (Statistics Canada, 1991).

[23] Individual population values are randomly rounded either up or down to a multiple of 5 or 10 to ensure confidentiality. Since sub-total values are rounded independently, their sum may not match the total population count, the only value not subjected to rounding (Statistics Canada, 2002).

Everybody was under one roof before, so there's a sense of togetherness. ... There were family units, too; not just the sibling bonding and family bonding – outside of that there was communal bonding. That's a unit there, which is gone now. ... The whole community was like one unit because there [were] no outside influences. (Unka, 2005b, pers. comm.)

[We] all live in same place. Métis married to Dene, Dene married to Métis woman, [they have a] Métis boy, now all like that. (King, 2005c, pers. comm.)

The federal government's the one that split it I guess. ... [There are] some services and programs that the Métis aren't allowed to get, you know, because we don't have a treaty. But we're aboriginal too, as much as them. Just because we don't have a treaty doesn't mean we're not aboriginal. We come from them, too. My mom is treaty, I'm Métis, my dad is Métis, his brothers are all treaty. You know, that's the way the government is splitting up the people. Just not right. ... The way it is now they got the community split right down the middle, fighting each other because of [being] Métis and Dene. That's the way it is. (Delorme, 2005, pers. comm.)

Kinship is strongly linked to place of origin, which determines many people's knowledge of the land and connection to place. Whereas residents from most of the smaller hamlets were closer to and had frequent dealings with Fort Resolution, those from Rocher River were more cohesive as a group in their own right and tend to feel more like a separate community of people displaced within their own territory. They came from a mostly self-sufficient settlement (with trading posts, stores and a school) with its own identity and a strong sense of social cohesion. Collectively, Rocher River was only vacated during the late 1950s and early 1960s, in large part due to the loss of their school. Residents were one of the last hamlet groups to settle in Fort Resolution (and elsewhere), where they were perceived as the newcomers from the bush, and were often limited by language and formal education in competing for wage jobs (Smith, 1982).

The Rocher River people are kind of segregated because ... they're not well planted here, they're not rooted, and they don't have access to some [things] ... like education, computers, all that stuff. ... People essentially came out of the traditional lifestyle living on the land, living really good with hunting, fishing, stuff like that. And then they come into this welfare society. You know, they came here and now they're on welfare because they can't go hunting, they can't trap, because their land's over there [and] they don't know the area over here that well. So that kind of division has happened and it's still there now. (King, 2005d, pers. comm.)

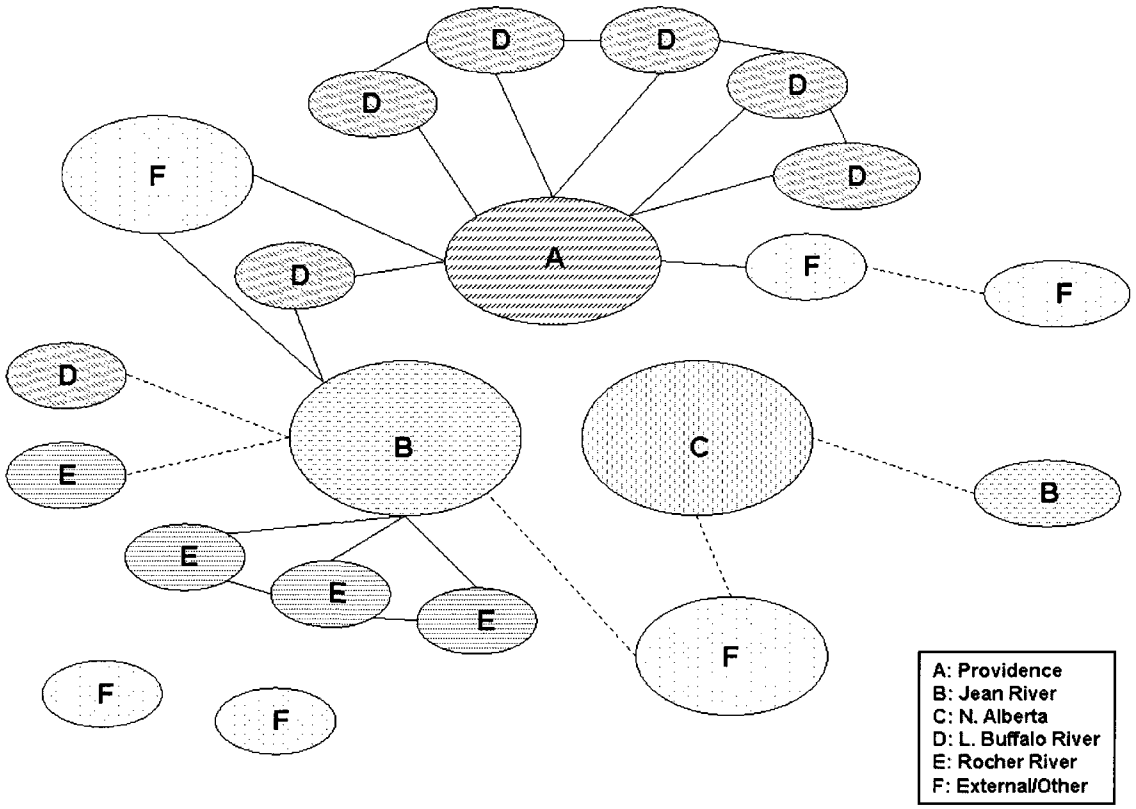
The people from Rocher River, they're actually displaced people ... in their home land. ... There's a big loneliness there with these people. There's a big social void that no one really addressed properly. (Unka, 2005b, pers. comm.)

While many of the residents from the hamlets and their children have integrated into local society, relationships and allegiances between same-origin families still remain fairly strong, acting as the framework for the local social structure (Figure 5.1). Three main families form the social axis in Fort Resolution (A, B, C), and other smaller families tend to align both socially and politically with one of them. There is a strong tendency for families originating from the same satellite community to ally with one another and with the same major family group (e.g. families from Rocher River (E) generally align themselves with family B from Providence). One focus group participant referred to Fort Resolution as an 'all in the family town'.

These ingrained allegiances affect everyday operation of the community in multiple ways. Personal relationships affect the political landscape, where power swings back and forth between two dominant family *power bases* (B and C), each of which has a similar-sized support base. They influence political and economic decision-making at the local level, and they also play out in the school yard where children from different families fight because they know they are not 'supposed' to get along. In this way the

personal becomes political, and vice versa. With the current political structure and electoral procedure supporting the maintenance of *power bases*, individuals from smaller families have limited influence over community direction.

Figure 5.1: Localized bonding ties linking family groups
This network image is based on qualitative interviews and joint diagram development with two community members. It was subsequently shown to several other residents and alterations were made until a consensus was reached. As family relationships and allegiances in Fort Resolution are dynamic, this diagram represents a generalized snapshot of evolving relationships as society has shifted away from its traditional roots into the current day. The oval sizes in the diagram give an approximate idea of the relative size of families in relation to one another. The solid connector lines indicate a stronger connection between families than the dashed lines. Although other residents may represent the diagram differently, most would agree with the overarching patterns shown here.



This reflects to some degree the traditional leadership system where headmen were only accorded authority to speak for their local band (mostly made up of family members). However, in the context of representation of a more diverse group in a larger community, locals report that this system results in preferential treatment regarding the allocation of resources, services and employment opportunities (a form of reciprocity), resulting in the marginalization of some groups. For example, residents from Rocher River feel underrepresented within the elected leadership at the community level, and feel that their environmental and social interests are not well supported. Local decision-makers often have a limited understanding of and a lesser interest in environmental issues (e.g. water quantity and quality, wildlife concerns) related to the subsection of the traditional territory around Taltson River, and specific social concerns (e.g. limited training and formal education, mental health) that members of this group may collectively be experiencing. The perceived result is that resolving such issues becomes a lesser priority.

The tendency towards the development of powerful societal sub-groups, or 'coalitions of power' (Pelling & High, 2005), has become further ingrained with the shifting sense of cultural identity, in large part due to the incongruence in indigenous and government definitions of 'indigeneity' (Bartlett et al., 2007), and multiple changes in relevant federal legislation during the past century. Divisions among groups have been created through differential legal treatment (e.g. Indians were prohibited from drinking alcohol until 1960) and allocation of benefits (e.g. status Indians have access to treaty housing), which evolved over time. With the growing importance of treaty rights during

this era of land claim negotiations and impact benefit agreements (IBAs)[24], legal identity has become more contentious. Many Métis perceive Fort Resolution to be a Métis town that was inundated by Dene, where they are now treated as second class citizens. The Dene feel protective of their treaty rights, and neither side seems to be fully accepting of the (formerly Métis) individuals who (re-)gained treaty status due to *Indian Act* amendments in 1985. Furthermore, some of those who regained status were placed (for reasons unknown to them) by the federal government as members of First Nations located outside Fort Resolution (e.g. Lutsel K'e, Dettah, Ndilo, Salt River), leaving them with no local representation through either Dene or Métis organizations.

I don't go to the meetings at all anyway. Because I'm not from this band they don't want me to go sometimes. ... I used to be Métis before, but now I went to treaty ... and instead of putting me here [as a DKFN member] they put me in Yellowknife with all my family [and] all my kids. (Beaulieu, 2005c, pers. comm.)

Thus a range of perceptions emerges, with some residents feeling that everyone should be treated equally, while others distinguish between Métis, 'true Dene' and '*Bill C-31* Dene'.

...The leadership should be sitting down and working it out and making everybody as one. That's who we are. We want to be heard as one people from this community. We don't want to say 'well, that guy there, these guys over here, that guy's treaty there, another guy over here, he's Métis'. We want everybody the same. ... We don't want an agreement written. We [the Métis] just want to be treated fairly, to say hey you guys are all the same in this town whether you're green, black, white, don't matter. ... All these issues, they're not out on the table; to be treated fair, to be equal. (Delorme, 2005, pers. comm.)

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[24] IBAs are formal agreements between First Nation communities and resource development companies that aim to moderate predicted development impacts and designate economic benefits for affected residents. They provide a useful tool for First Nations to influence decision making about resource exploitation on their lands (Sosa & Keenan, 2001).

We [the Dene] are the signatories of the treaty, and it's our most powerful tool you have. A treaty is international; then you're bringing in these people that are not signatories to Treaties, and they're running [the local government] for us now. (Unka, 2005b, pers. comm.)

5.2.1 Social relationships and dynamics

As discussed in Chapter 2, social capital is recognized as multi-dimensional, incorporating three primary components: bonding, bridging and linking ties. In this study, bonding ties refer to relationships within the community of Fort Resolution (intra-community), while bridging ties denote horizontal relationships between Fort Resolution and other communities of place (inter-community), whether they be First Nation communities or urban centres. Linkage ties are vertical relationships between the local community and external institutions, including federal and territorial governments and other public or private organizations (e.g. corporations, NGOs; Woolcock & Narayan, 2000; Mignone & O'Neil, 2005; Pelling & High, 2005).

Four main dimensions emerge from the social capital literature: trust, norms of reciprocity, collective action, and participation (Woolcock & Narayan, 2000; Pretty & Ward, 2001; Adger, 2003b, 2003a; Pretty, 2003; Pelling & High, 2005). These are examined from a community-based perspective (primarily bonding ties), forming the focus of this chapter. Extra-community bridging and linking ties are also considered, helping to elicit an understanding of the role of social networks, or the 'structures of recurrent transactions' (Aldrich, 1982 cf. Mignone & O'Neil, 2005), across multiple levels. This outline provides an effective framework for the subsequent discussion that

attempts to characterize various aspects of social capital in the Fort Resolution context and their relationship to adaptive capacity, while providing empirical supporting evidence.

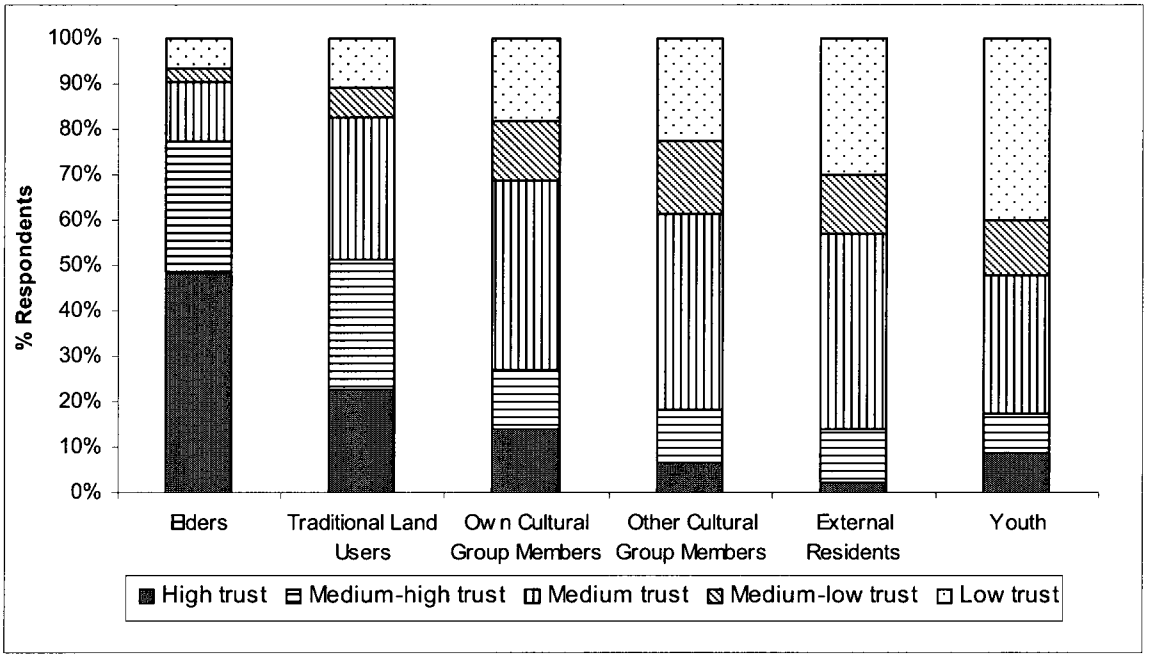
5.2.1.1 Local trust

Trust is an important factor in determining whether community members are able and likely to work together. In Fort Resolution there is a striking division in community members' trust in each other, with 40% of respondents agreeing that they generally trust people in the community compared with 30% who do not. Due to the small size of the settlement, as well as the tendency for personal and political roles to be mixed, these results may be interpreted as reflecting the social position of the respondents vis-à-vis other community members, the level to which their needs are being met by the broader community, and their perceived ability to influence local conditions. For example, having a larger social or family group that provides support appears to incite more general trust, whereas those who feel socially isolated or economically marginalized tend to report reduced trust.

Respondents also describe a wide disparity in their trust levels toward individuals in different social groups within the community (Figure 5.2). Elders are the most trusted community members, followed by traditional land users, both of which are seen as more likely to live according to traditional Dene values (or 'Laws'; see Table 7.2). Residents are more likely to trust others from their own cultural group, reflecting existing

community divisions around legal identity and rights. They also show very low levels of trust in the community's youth, citing recent increases in drug and alcohol use, and escalating delinquent behaviour among this age group. Despite these divisions, people are generally more likely to trust other community members (apart from youth) than non-locals.

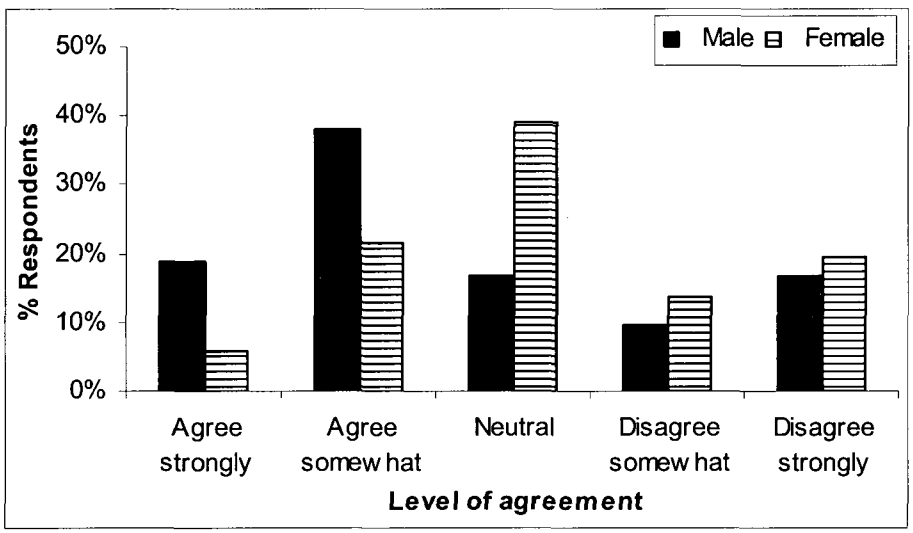
Figure 5.2: Level of trust of individuals toward community groups
(N=93)



Interestingly, men tend to be more trusting of other locals than women (Figure 5.3). This could reflect the fact that a higher percentage of men in town continue to use the land in a traditional manner, and may rely on and build trusting relationships with other land users to a greater extent than women do. Other factors may also contribute; men and women may have different understandings of trust relationships; they engage with different social networks and livelihood activities; and women have distinctive

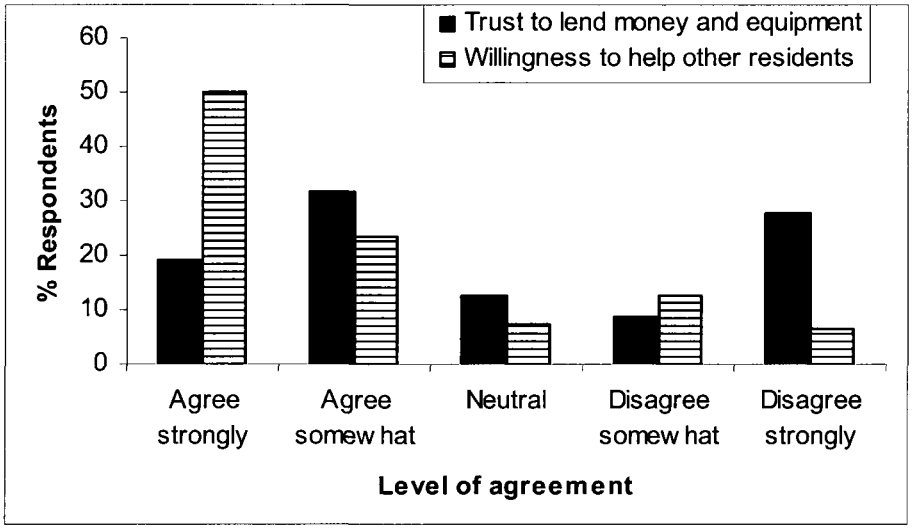
gender-based roles related to home-making and food preparation, which can limit social interaction.

Figure 5.3: Responses to the statement 'Most people who live in this community can be trusted'
(N=93)



When asked specifically about trusting people to lend them money and equipment, respondents were somewhat divided. Slightly more than half agreed either somewhat or strongly, whereas about 30% disagreed strongly. This corresponds to some degree to the indication by 64% of respondents that relationships among residents are more distant than close. The perceived distance of relationships among locals and the hesitancy among part of the population to lend equipment and money is compensated by the clear trend denoted by almost three quarters of respondents who agree that residents are willing to help each other if needed (Figure 5.4).

Figure 5.4: Lending equipment and willingness to help other community members (N=92)



This strong sense of willingness to help reflects the existence of underlying bonding ties, which are known to help communities deal collaboratively with natural hazards and disasters (Pelling, 2003). In Fort Resolution, despite existing interpersonal conflicts, residents are quick to come together and provide support in times of crisis.

I'll tell you one thing about this community. When someone is in need, when someone is hurting – whether there's a death or something in the community – I can't tell you how much love you feel. ...We come together like one huge family and ... all those differences all fall to the wayside; none of those are important. (Unka, 2005a, pers. comm.)

This underlying social net provides a layer of comfort and security. This capacity to come together in support of a common objective is important for community-level adaptation, although the fact that this collaborative intention is primarily activated through crisis may severely limit its application in non-crisis settings (e.g. land use planning, emergency response planning).

Overall, levels of trust at the local level were generally perceived as stagnant or declining over the past decade (Figure 5.5). Participants cited social conditions and political leadership as the two main reasons for this trend in trust levels (Table 5.3). Residents indicated that the frequency of theft and negative social behaviour are increasing with the recent prevalence of harder drugs in the community, although offenders are deemed to be a small minority of the population.

Figure 5.5: Perceived changes in levels of trust during the past decade
(N= 89)

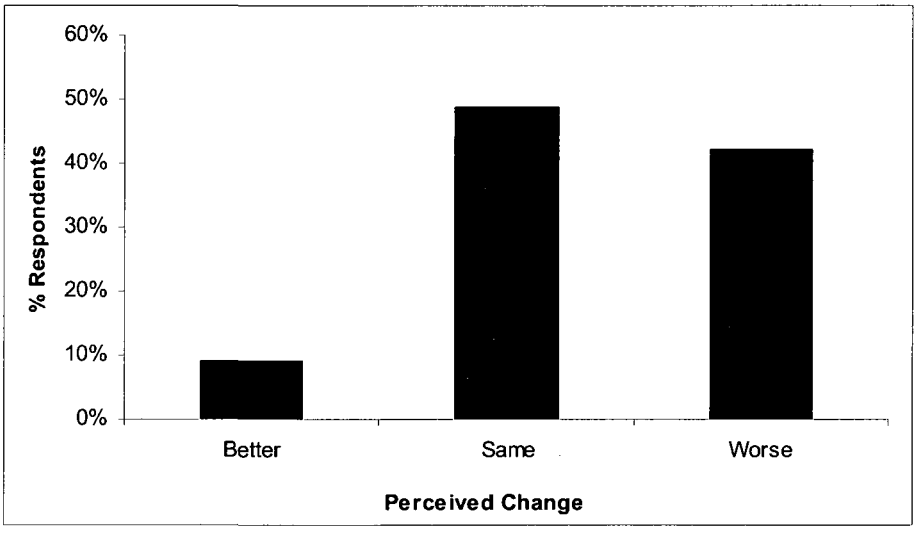


Table 5.3: Reasons for changes in level of trust during the past decade
(N=84)

Reason for change in trust	Frequency	%
Social conditions	34	40.5
Political leadership	28	33.3
Economic conditions	11	13.1
Environmental conditions	2	2.4
Other	9	10.7
Total	**84**	**100.0**

Levels of trust are directly linked to tensions in the community. The bootlegging and use of alcohol and drugs are among the most divisive elements, as well as the limited and perceived biased distribution of local employment opportunities. Some residents also indicated interpersonal and local political issues as tension-causers (Table 5.4). Various residents noted that property theft has increased with drug use, shifting the general trust level and causing people to lock up their belongings. The shift from an 'open doors' to a 'locked doors' mentality reinforces the separation between individual and communal property.

Residents indicated that prior to the 1970s more social activity occurred in public spaces and kids played together in the street. Household doors would remain open and visitors often entered and sat down without knocking or asking for entry, and everyone was trusted to treat property such as cabins and equipment with respect. The advent of television as a primary entertainment source, combined with concerns over theft, has altered these relationships and instituted a mentality that is more focused around the well-being of the nuclear family. Political leadership is also of considerable concern, and will be discussed in the next section.

Table 5.4: Causes of serious tension in Fort Resolution
(N=85)

General issue	Frequency	Specific issues
Alcohol	35	Youth involvement; bootlegger activity
Drugs	26	Youth involvement; drug dealer activity
Jobs	22	Lack of jobs; limited access (nepotism)
Judgment, gossip, jealousy	16	Distrust
Interpersonal conflict	10	Inter-familial tensions; intercultural tensions between Dene and Métis
Political issues	9	Tensions among local governments: DKFN, Métis Local, District Community Council
Financial issues	8	Mismanagement of public funds; individuals too focused on money
Assaults and criminal activity	4	Youth involvement
Ineffective leadership	3	-
Lack of social activities	1	-
Social status	1	-
Poor communication	1	-
Education levels	1	-
Business practices	1	-
Quality of life	1	-

Many people noted more than one issue. The number indicated here is the total number of times a specific issue was mentioned.

5.2.1.2 Trust in institutions

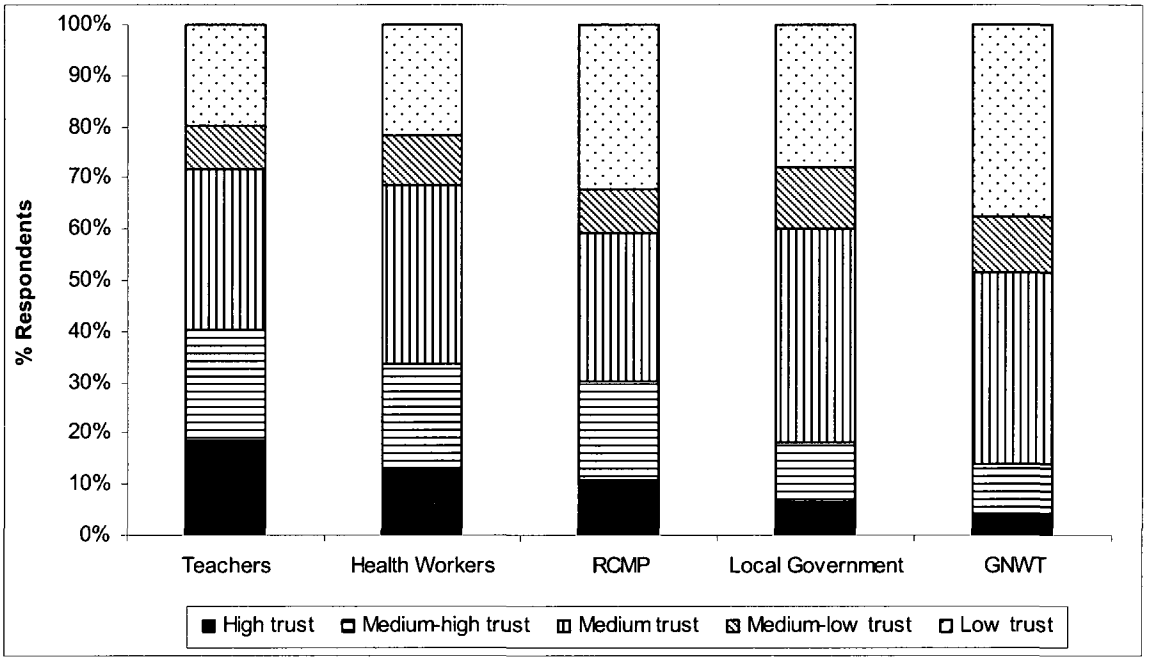
As indicated above, government and other public or private institutions are an important part of the social framework, providing essential services and implementing the rules and regulations associated with governance. The relationships between local residents and relevant institutions are shaped by whether the latter are perceived to provide for their interests, and whether they are seen as operationally just and equitable.

These conditions are reflected in the level of trust placed in them by residents. Due to the low population mobility, the nature of historical relationships with outside institutions – especially federal and territorial governments – is engrained into the memories of residents, and thus continues to be highly influential in determining current day conceptualizations. For example, many locals have either experienced or heard accounts of the many ways in which aboriginal peoples have been unfairly treated by government agencies, leading to a general distrust of all agencies and governments.

In Fort Resolution, trust in social service providers – teachers, health workers and the Royal Canadian Mounted Police (RCMP) – is very much split across all five responses, although a large group of respondents (32%) shows strong distrust in the latter (Figure 5.6). These institutions are generally managed and staffed by outsiders who have to individually earn trust within the broader context of lingering memories of past colonialist relationships.

One local organization in particular that has shown a notable position shift in terms of community relationships in recent years is the local school. The current principal has provided stable leadership for the past five years as well as a vision for improvement both on academic and self-development fronts within the community context. Positive trends have emerged as a result of his multi-phased program to improve student self esteem, interpersonal relationships, and educational effectiveness. These strides forward are improving community support for the system and for the workers that enable it to function (Bickford, 2008a).

Figure 5.6: Level of trust in service providers
(N=93)

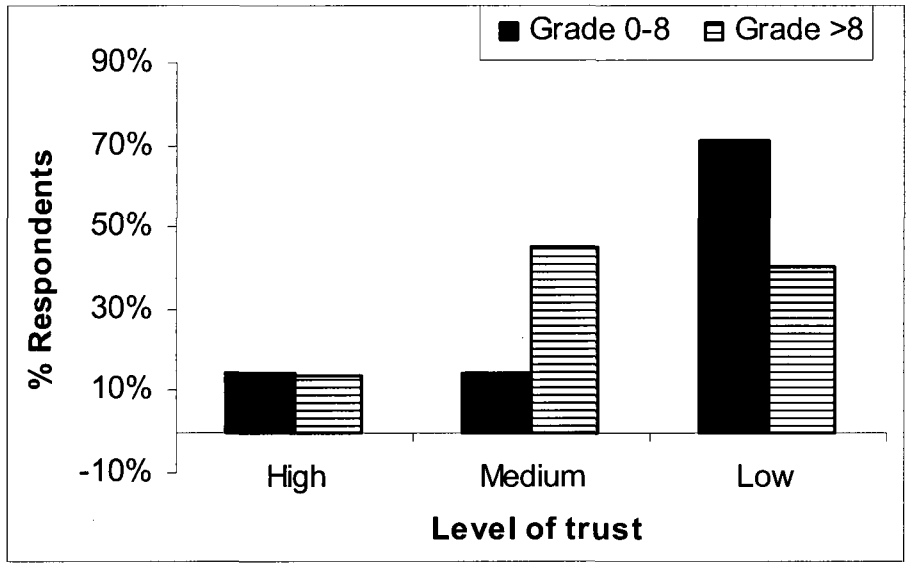


Locals have a medium level of trust in local government officials. Generally, residents show some degree of disenchantment with the local political leadership, which is perceived to be partisan and lacking effectiveness at spreading the benefits of financial and other resources in an equitable manner. There seems to be somewhat of division in perception based on familial affiliation. When asked about the effectiveness of past Chiefs and Councillors, some locals report strong support for specific individuals while others report the opposite. One local noted that individuals running for these positions often have good intentions at election time, but if they are not strong enough then they can be influenced by money, power, and other social and political forces, and may not follow through (Anonymous 3, 2005, pers. comm.). Since each leader is criticized by some and supported by others, it is extremely difficult to work towards increased unification of the populous. This is complicated by the disjuncture between the First

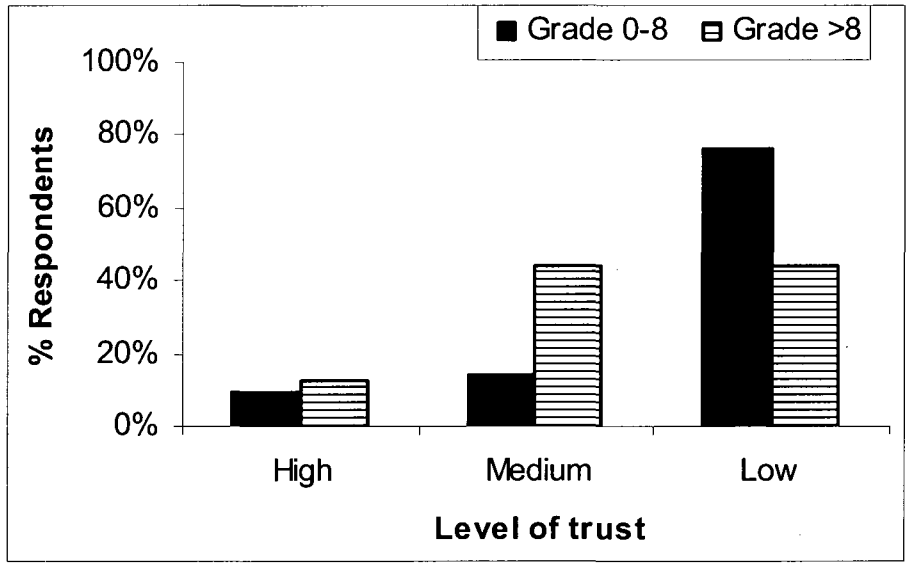
Nation and Métis leaderships, which work independently. The DKFN is also beset by substantial turnover in leadership, which threatens the stability of programs and institutional memory. Territorial and federal governments are generally not well trusted, although higher levels of formal education correspond to higher levels of trust in these cases (Figure 5.7).

These trends suggest several possible influences. First, formally educated residents are more likely to be working with or have exposure to such institutions and their representatives, and may be more able to critically evaluate the current manner in which they relate to aboriginal communities. Such residents may be more likely to be interested and open to working with governance institutions in some form of partnership, especially if they receive some kind of benefit (e.g. through employment, participation in or influence on decision-making, or other types of support). Residents who have had less direct exposure to such institutions may more likely be critical, as they lack influence and feel their needs are not prioritized. This lack of exposure to evolving government-aboriginal relationships may reinforce individual beliefs informed by the memory of past colonial relationships.

Figure 5.7: Level of trust by formal education level in (a) Government of the Northwest Territories, and (b) Government of Canada
(a) (N=85)



(b) (N=85)



5.2.1.3 Reciprocity and sharing

Reciprocal relationships are interlinked with trust; the latter can either be enacted or built through such relationships. Sharing what you have with others is the primary

Dene Law (Blondin, 1997; Dene Cultural Institute, 2007), and has been documented as an important social construct in numerous indigenous societies (Collings et al., 1998; Berkes & Jolly, 2001; Magdanz et al., 2002; Van Oostdam et al., 2003; Kishigami, 2004; Paci et al., 2004; Willows, 2005; Chan et al., 2006; Ford et al., 2006b; Anisimov et al., 2007; Damman et al., 2008). It is also a significant indicator of reciprocity (which in this study is considered as a positive rather than neutral notion). In Fort Resolution, the sharing of food is a common cultural activity that, as in many northern aboriginal societies, aids with broader group survival (Fort Resolution Elders, 1987) by improving mutual ability to adapt (Bennett, 1969; Ford et al., 2006b; Adger et al., 2007).

The one unit [that was] living over at Jean River is [together. The] families, they have big dogs and they're a well taken care of group because they work as a unit very well. They survive well; they hunt caribou together, they do things together, they work together, they work their harvesting, and they work really well as unit. (Unka, 2005b, pers. comm.)

Traditional sharing practices depended on ongoing, long-term reciprocal relationships, where 'repayment' is neither immediate nor necessarily tallied over time. As an example of how this played out in practice, one resident recounted a memory from the 1960s where a line-up formed as her father butchered a moose on the town's shoreline. He handed out segments of meat until there was nothing left, keeping none for himself. His family only ate moose that night because his daughter had also stood in line to receive a piece (Anonymous 4, 2005, pers. comm.).

[In the past] there were more people helping more people, the young people helping the old people. ... Now you gotta to work for your own stuff, not like before. ... People [used to] help each other ...[by lending equipment] whenever you need a Skidoo, you need it to hunt. ... If you're older, they [used to] help each other like that with dogs. (Sayine Jr., 2005, pers. comm.)

[In Jean River hamlet the people were] all together. [If there was] something they're short of, people they'll all help one another. If they're short on groceries, they'll help; if you're short on dog food, they'll help. They were sure to help one another. It was the good old days, people used to help one another all the time. (McKay, 2005a, pers. comm.)

[In Rocher River it was common for] everybody [to] get together just to have a little feast and pray and take all the best meat out. ... People would come, they never paid for it. You never ever see money, you didn't have to pay for it. They traded, but they never gave money. They just traded, or they just gave it to them. (King, 2005b, pers. comm.)

Maybe [some people] weren't taught the proper way of ... [giving] meat to the elders and to family. ... If they're not taught that growing up, there is no way you can teach that to somebody [when they're] older. ... [I] killed a moose yesterday, 'here, have some meat'. There's always some given away. Some parts of the moose we bring back to the elders. People are taught [to think about it] right up at the kill. Cutting, butchering, skinning ... think of who likes what ... and that's put aside. And then we come back to town and give it to people. ... That's the way we were taught. I'll pass that on to my kids too. (Delorme, 2005, pers. comm.)

Over time, these relationships have shifted due to multiple influences, including increased participation in the wage economy, influences of the welfare state, the adoption of Euro-Canadian family roles, the imposition of democracy-based governance structures (instead of the traditional consensus model), rapid immersion in the technological and industrial world, and the effects of both religion and a non-aboriginal education system (Smith, 1988). Of particular note, old age pensions and family allowance funds were distributed to individuals, and the latter specifically to mothers. These payments (and those from the wage economy) contributed greatly to the individualization of wealth and resources.

They never had no welfare in Rocher River. They had no family allowance way back then. It's only recently they started doing that, in the '50s. ... Five dollars a kid. That was a lot of money. Everything was cheap! ... When they had family allowance, men were not the boss of it, like you know before they'd be the boss, but now when they got their family

allowance, the woman could buy the children whatever they needed. ... So it changed in that [way], but it helped them a lot too because they got a little bit more groceries with that. (King, 2005b, pers. comm.)

During the mid- to late-1900s the traditional type of sharing shifted towards a more immediate reciprocity, where meat was commonly exchanged directly for favours or the use of equipment (Bodden, 1981). More recently, with the dramatic rise in equipment and gas prices and increasing valuation of money, locals are generally less willing to lend equipment and now rely largely on monetary exchange for meat.

Now, its only kill a moose or buffalo or any animal ... you have to pay for it. In the old days, everybody shared [with] everybody. Nowadays, not like that. (King, 2005c, pers. comm.)

Furthermore, the notion of family now seems to apply to a smaller group. Instead of viewing the whole community as family and sharing meat with everyone, hunters now tend to share with select people, mostly nuclear kin as well as some elders. Similar trends are also being recognized to a lesser or greater extent in other northern aboriginal communities (Kishigami, 2004; Paci et al., 2004; Chan et al., 2006).

During the recent period of increasing outside influence, the local concept of resources continues to shift from being largely communal to more individual. Before the 1960s abandonment of the settlement, Rocher River land users would hang fish (to dry and preserve them) in a common location so that all residents had access to dog food through the winter (King, 2005b, pers. comm.). This type of approach allowed individuals to focus their harvest based on their own ability and access – some people were known as good fishermen, whereas others were strong hunters – or to harvest

opportunistically without the worry of wastage. Now, with fewer hunters and fishers using the land, there is less wild meat to go around and incentives for sharing are lower due to the lack of guaranteed reciprocity. The transition from bush to settlement life has shifted the social structure and collective support mechanisms among community sub-groups, such as those from Rocher River.

[Moving from Rocher River] changed everything. They wouldn't help, they just went numb, they wouldn't help [each other]. It was always like that, ever since they moved here. ... There was hardly any jobs, so it was pretty hard for people to help one another, you know? It wasn't like over in Rocher River, it was different. ... In Rocher River ... people will go there and help one another, with fish, meat; everything will be together, and people will take it. But here ... it never ever happens like that again. (King, 2005b, pers. comm.)

The evolution of and access to new technology has also played a significant role in altering sharing relationships. The introduction of electricity and improvements in household amenities have shifted the possibility of meat storage from short- to long-term and from public to private locations (Workshop Participants, 2005, pers. comm.). In the 1960s, land users would still commonly get together for community hunts. Meat was stored in a community freezer and given out to all residents, regardless of cultural designation (Anonymous 4, 2005, pers. comm.). Now, acquisition of meat relies on whether one's family has someone to hunt for them, or whether availability allows purchase from another local source. Some land users are aware of this and report bringing meat to specific elders because 'they have nobody to hunt for them' (Mandeville Jr., 2005, pers. comm.; Unka, 2005b, pers. comm.).

I probably give out 50 percent of it. There's old people; they're my friends that I grew up [with] and I've known them since I was a kid. I've been bringing them meat since I started hunting, and I've never stopped yet. Now [my son] is taking over that part from

me, and when [he] gets a moose or something he does that same thing. The old people tell me it brings me luck to give away meat to old people. Especially the ones that can't go out and get it, that's the ones that I tend to assist. There's an old man here, he lost both of his boys so he's got nobody to do that for him. [That's] the first place I go when I get a moose, the first stop. Don't even bring the meat in the house here, I bring it there first. (Lafferty, 2005b, pers. comm.)

Some residents extend the practice of sharing to friends in other communities. When they visit, they bring gifts of traditional foods not available in that area. For example, Fort Resolution residents will bring goose meat to friends in Lutsel K'e, who in turn may bring gifts of caribou meat the next time they travel west (Boucher, 2006b, pers. comm.). This elicits an informal trade and reciprocity network that extends beyond community boundaries.

When there is not enough traditional meat available, many residents opt for often less healthy grocery store substitutes (Lawn & Harvey, 2001; Ford et al., 2006a). In addition to the social consequences of these shifts, changing food-sharing patterns also have broader implications for nutritional health and for food security (Paci et al., 2004; Chan et al., 2006).

In addition to the food-related resources harvested from the land, hunting activities also create opportunities for social interaction, networking, sharing, and therefore, increased social cohesion. For example, the spring hunt for migratory birds is an important group activity, drawing friends and relations together from communities around Great Slave Lake (e.g. Yellowknife, Hay River, Lutsel K'e) and Northern

Alberta. In addition to the social interactions, these activities also provide a forum for land users to interact and share knowledge about the state of the environment.

Each year, the moments where important seasonal shifts take place inject an energy of excitement into the community. In the spring while waiting for the ice to break up to allow travel on the Slave River, or for the migratory birds to reach Great Slave Lake to begin the hunt, and in the fall while waiting for the moose to start rutting, these topics of conversation engulf the town. In the hallways of the office complex, the aisles of the Northern Store, or out in the street, people make predictions about when the ice will break or how far into the bush the flood will extend, and they ask whether anyone has seen birds fly over or moose along the highway. These are moments that seem to bring people together under a common (and non-conflictive) interest, increase individual effort to observe the land, and remind people of their connection to and the vitality of the world around them. In this way, the conversation about and anticipation of the hunt, the activity itself, and the use of its products are important components of the TK learning process for younger land users, and help strengthen the cultural identity of local residents, helping to bind them together.

5.2.1.4 Social values and collective action

Residents remember the past as a time where it was common practice to take care of others, whether by providing a roof, food, or a helping hand. Several people recounted that early missionaries had to alter the Christmas story to align it with local beliefs; to the

Dene it was inconceivable that Mary and Joseph would not have been taken in and cared for in the first home (or inn) they visited (Anonymous 4, 2005, pers. comm.). The Dene have long been guided by their own traditional Laws[25]; sharing, caretaking and respect were, and in many ways still are, strongly linked to traditional culture and land use.

When I grew up on the land I found that we lived alone, and when people passed by you were so happy to see them. We treated them like guests; we treated them with respect. We fed them; we fed their dogs...Then when they left there was a mutual respect. (Boucher, 2005b, pers. comm.)

I used to tell my boys that, you cannot leave the front steps without respect. You go into a building; you can't go in there without it. ... Respecting people, you know; wherever you go, you respect the individual. You don't know what kind of a day that individual had. ... Yeah, always [be respectful]. And it doesn't matter to who or what. ... And those are the teachings that I give, human teaching. (Unka, 2005a, pers. comm.)

This notion of concern for and equal treatment of others has been disrupted by the transition from bush to settlement living, and from a localized subsistence-based economy to a more globalized socio-economic context that relies on monetary transactions. The residential school system also influenced these values. Children were encouraged to compete for praise and rewards, and to tattle on their friends, which caused conflict and introduced a sense of social hierarchy (Anonymous 4, 2005, pers. comm.). These influences have eroded traditional social values and shifted the essence of interpersonal relationships.

[Residential school] just created a whole bunch of animosity within family units. It split the family unit in a bad way, and it fragmented to the point that it never really re-united again. ... Like my wife doesn't really care for her family because she never really had

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[25] Traditional Dene Laws include: sharing what one has with others; loving and helping each other; avoiding harmful actions; being polite and refraining from judging; respecting others, especially elders; and passing on these values to the younger generations (Blondin, 1997; Dene Cultural Institute, 2007).

any ties to her family from an early age. She was taken away to a residential school, and her whole way of thinking was turned. So ... there's just a lot of fighting within units, and they're not supporting each other properly. It's a real, real hard situation for these people. (Unka, 2005b, pers. comm.)

The community is new to us because we're nomadic people; we're used to hunting and gathering and travelling and being part of the land. But when the people started going to the communities and the government ... tried to assimilate us and brought us to boarding schools ... that took our identity away. Because we weren't tied to the land anymore, the majority of us adopted the community value system. Whereas before the ... people that gave most of themselves [and] their resources had the highest stature in the group. [...] But, when they moved to the communities and adopted the community system, it wasn't how much they gave that gave them status, but how much we accumulated that gave status. So it went against our value system and eroded our way of looking at working together. (Boucher, 2005b, pers. comm.)

Most residents (79% of survey respondents) feel that the local trend towards individualization has negatively impacted traditional social values, noting that concern for community well-being was higher in the past. Current day community relationships have variously been described by a number of residents as a 'pail of crabs' phenomenon, where individuals are prone to drag others back down when they start to get ahead. This is seen as not only limiting development at the individual level, but also the forward movement of the entire community.

That sense of unity is not there any more. That sense of unity is gone. Everybody is sort of hoarding for themselves. It's like a pail of crabs, you know? One gets to the top and the other ones start dragging him back down. It's that kind of stuff that's not necessarily good for the well-being of anybody, because they don't want to see anybody get ahead. So that's my description of the pail of crabs analogy. ... The community needs a lot of help. There are programs out there that are available I'm sure, but we don't have the proper resources, and to help people or train people is really hard. (Unka, 2005b, pers. comm.)

The above factors affect the extent to which individuals are willing to collaborate to support or achieve joint goals. Fewer than half of community residents are perceived

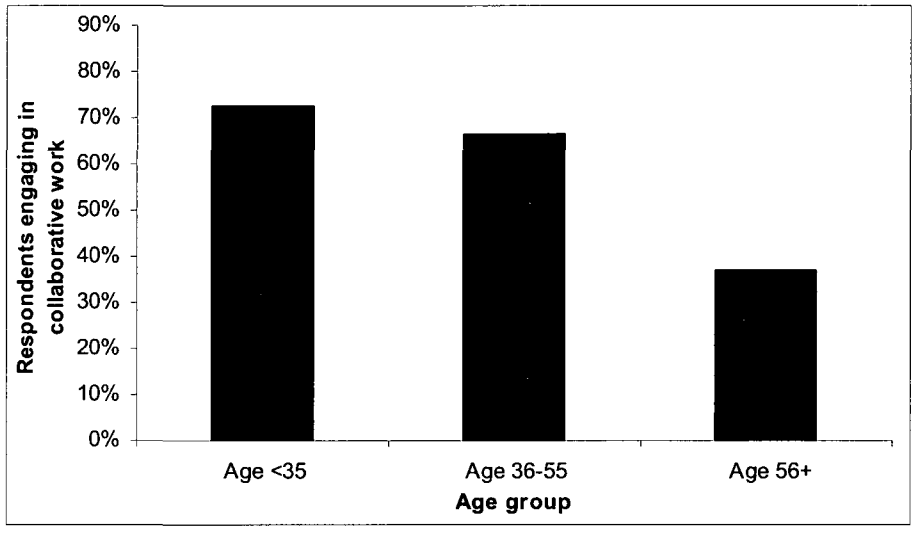
by respondents to volunteer time or money to community projects or events. By contrast, 60% of respondents report working with other residents on something of benefit to the community within the past year, indicating discrepancies between perceived and actual contribution (or false claims).

Age is a major factor in determining engagement. Respondents under 55 years of age are almost twice as likely to engage in collaborative work for community benefit as those over 56, and those with at least grade nine education are approximately twice as likely to engage (Figure 5.8).

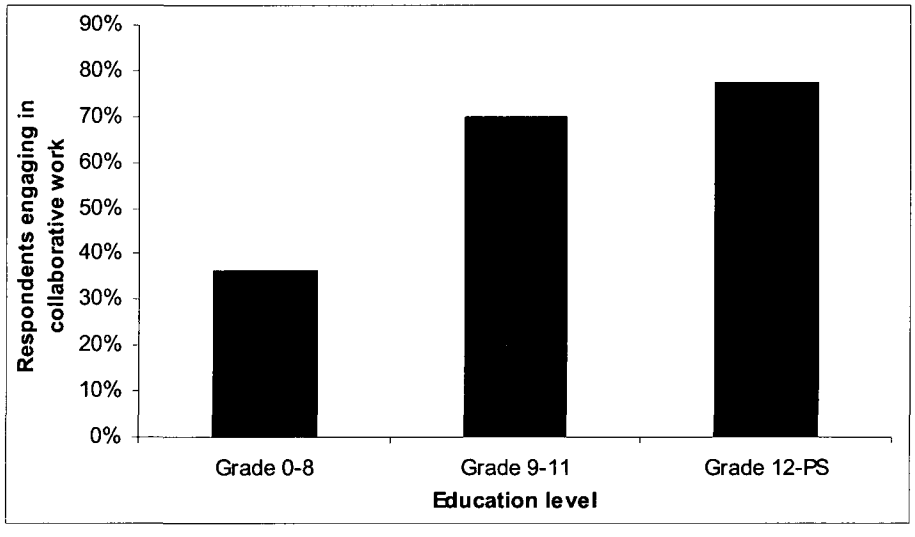
Collaboration and leadership are important for community building and adapting to change as a group. Apart from the individual actions that people take, half of the respondents indicated that community members take a collaborative approach to looking after the land. This notion appears to rely more on implied than active collaboration, based on a sense of shared values. Locals expect each other to follow appropriate environmental practices (e.g. not leaving garbage on the land, not harvesting more than you need), and generally perceive that the land will remain healthy as long as these ideals are maintained.

Figure 5.8: Engagement in collaborative work for community benefit within the past year by (a) age group, and (b) education level

(a) (N=95)



(b) (N=87)



Two thirds of respondents indicated that cooperation to resolve an environmental problem is likely, while a similar proportion indicated that community members would work together, rather than relying on any one individual or leadership group to take charge. A past example of locals coming together collectively in defence of their

territorial lands occurred in 1976 when Shell Oil received government permission to set up an oil exploration operation next to Little Buffalo River. Community members organized to send a small group to lobby the government, while a larger group stood ready to occupy the land in protest. Their efforts resulted in removal of the permit and suspension of further development in that area.

[Shell Oil] was going to put an [oil drilling operation] in on our land and the community got together and opposed it. (Workshop Participants, 2005, pers. comm.)

They were going to drill for oil there [in Little Buffalo River, and] people [were] just crying here. They don't want no development. ... Today, could have been big oil right there. ... And everybody [said] "no development, no development". That's what happened. (King, 2005c, pers. comm.)

The benefit of a small society is that individuals do feel close to the source of decision-making. Eighty-eight percent of survey respondents agree that as individuals they have some influence over future community development. This reflects the short linkages between residents and those who represent them, as well as the small size of the community.

However, these numbers contrast with the general feeling within marginalized groups that their needs and wishes are not prioritized, and that a lack of consultation at the local level limits their participation in decision-making. Furthermore, the high level of perceived influence over community development contrasts with low levels of trust in other residents and in local leadership, and reduced levels of social cohesion compared to the past. This suggests that a) high levels of trust and social cohesion are not fundamental

to such influence, and/or b) that there are other mechanisms at work behind the scenes that help residents to make their wishes heard and prompt action.

5.2.1.5 Group participation

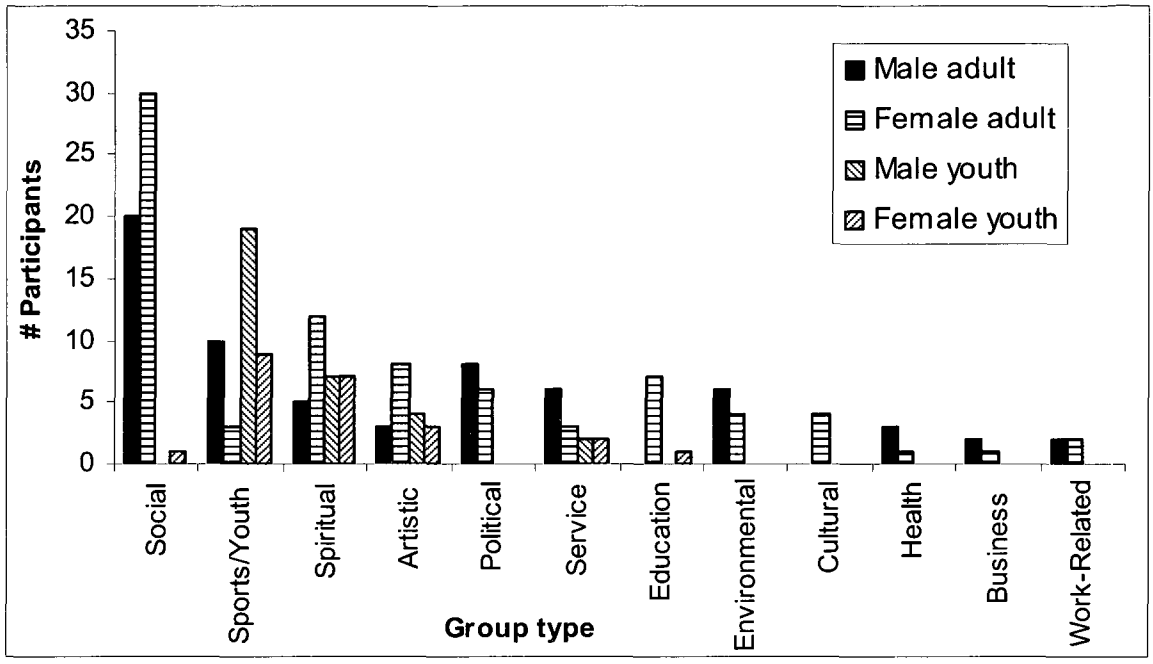
Membership in groups is one way that people connect with each other. Out of the 95 respondents, 54 (57%) reported some level of participation by one or more household members in group activities. The average household size is 2.9 people. Figure 5.9 indicates the total number of participants in each type of group, to give an idea of the most popular types of collaborative activity (individuals may be part of more than one type of group – see Figure 5.10). Group participation in Fort Resolution is very localized, with few members participating in groups outside the community.

Social groups draw the highest level of overall participation. Particularly popular are weekly public bingo events and card games organized either at the community hall or in private homes. These activities cater almost exclusively to adults and, especially in the case of bingo, do not necessarily encourage interaction.

Sports and spiritual groups are also popular, with ten households each (out of the 54 that reported participation) participating in church and hockey. Despite lower participation than in social groups, sports teams provide access to people of both genders and a broader range of age groups. The school facilities and hockey program, both of

which are largely run with outsider support (e.g. school staff and RCMP), provide essential resources for residents.

Figure 5.9: Total number of participants in different group types, by gender and age (N=54 households with an average household size of 2.9 individuals, and either individual or multiple participants in each)

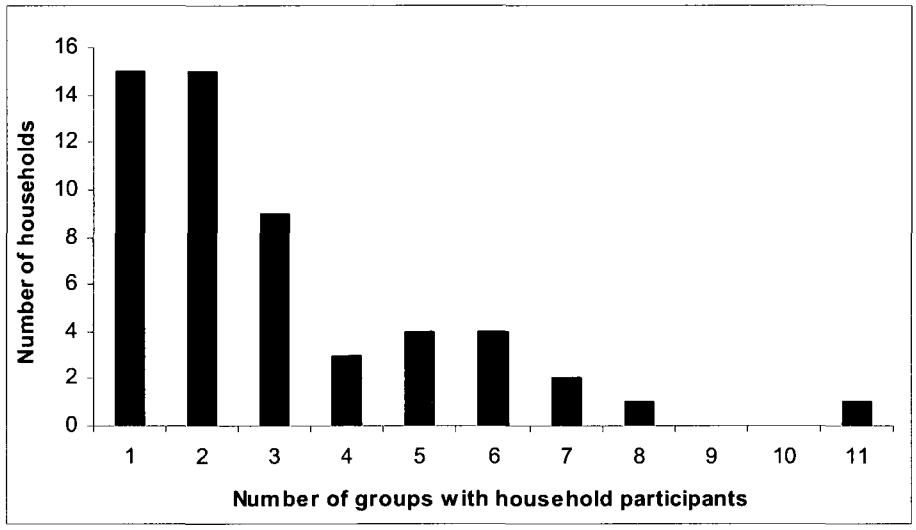


Comparatively few young people are reported to be involved in groups, reflecting the general perception that activities for youth are lacking in the community. Participating boys are predominantly involved in sports, whereas girls are almost equally involved in sport, spiritual and art groups.

Female adults make up almost half of total group participants, with predominant involvement in social and spiritual groups. They also participate more in cultural and education-related groups than do men. Men participate socially about half as much as the

women, but show higher involvement in sports and service groups. These outlets may provide a mechanism through which to build personal ties and trust among community members, and to build community engagement and pride with its members.

Figure 5.10: Number of groups in which individual households participate (N=54)



Sixty-one percent of responding households report member participation in at least one group (Figure 5.10). Out of the 54 households reporting participation, 18% reported involvement of one or more members in more than three groups. These can be considered 'engaged households', where members are active and likely more in tune with community happenings. These 15 engaged households also tend to be more inter-connected with each other as their members participate, interact and build their relationships in different settings. The heads of these households are also more likely to play a leadership role in the organization of community events, and to provide support or services to other community members in need.

5.2.1.6 Regional relationships: Bridging and linking ties

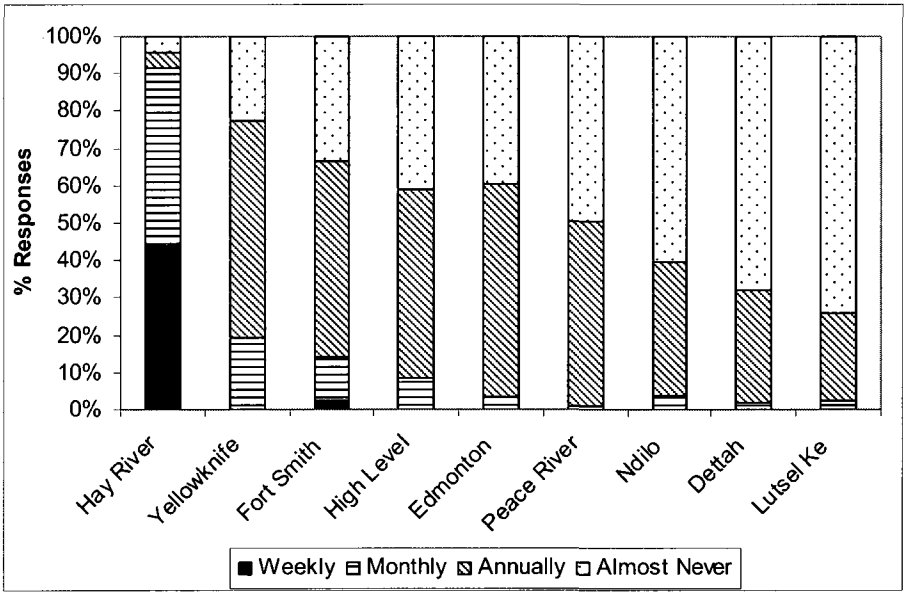
Although most people living in Fort Resolution have fairly localized social relationships, many maintain connections with relatives and friends who have moved away to other parts of the NWT, Alberta or elsewhere by telephone, occasional visits and, increasingly, e-mail and social networking sites. As both DKFN and the Métis Local maintain membership lists regardless of current address, these contacts are more likely to be maintained than in larger centres. People from Fort Resolution tend to continue to identify with their home community after they leave (e.g. approximately half of DKFN's 809 registered members live out of town (Indian and Northern Affairs Canada, 2007b)), especially since members are eligible to vote in local council elections and may receive periodic payments and benefits from their home cultural organization. A small number of residents return after being educated elsewhere, bringing with them improved skill sets that can be usefully applied for community-building. However, because of internal conflicts and the 'pail of crabs' syndrome, such skills are often underutilised, even if available. This further reduces the incentive for potential future returnees, who may be more valued and better able to apply their skills elsewhere.

At the regional level, political alliances lack cohesion as local residents feel disconnected from the other First Nation communities that ostensibly share their interests. The communities of Fort Resolution, Lutsel K'e, Ndilo and Dettah make up the Akaitcho Territory Government (ATG) which seeks resolution of the ongoing land claim negotiations in the South Slave. Although these communities have a broad shared goal,

they experience difficulties in working together at the political level, often diverging over the distribution of regional benefits such as those related to resource development in the territory (Boucher, 2006b, pers. comm.). They also lack the social and kinship ties that might otherwise unite them. Several individuals in Fort Resolution described the population of Lutsel K'e as descendants of those who migrated from northern Saskatchewan, thus they are not directly related. Additionally, Dettah and Ndilo are mostly populated by Yellowknives, who have long occupied territory north of Great Slave Lake. Although these groups have similar customs and social structures to the Chipewyan, the traditional divisions still persist (Smith, 1982). These divisions create friction, especially when the community groups are functioning under a common umbrella such as ATG, while attempting to obtain what they can to support their individual community interests. This social disconnect is reflected in Figure 5.11, which shows that other ATG communities are the least visited by Fort Resolution residents. Furthermore, the motivations for visiting ATG communities at all are largely of a political rather than social nature.

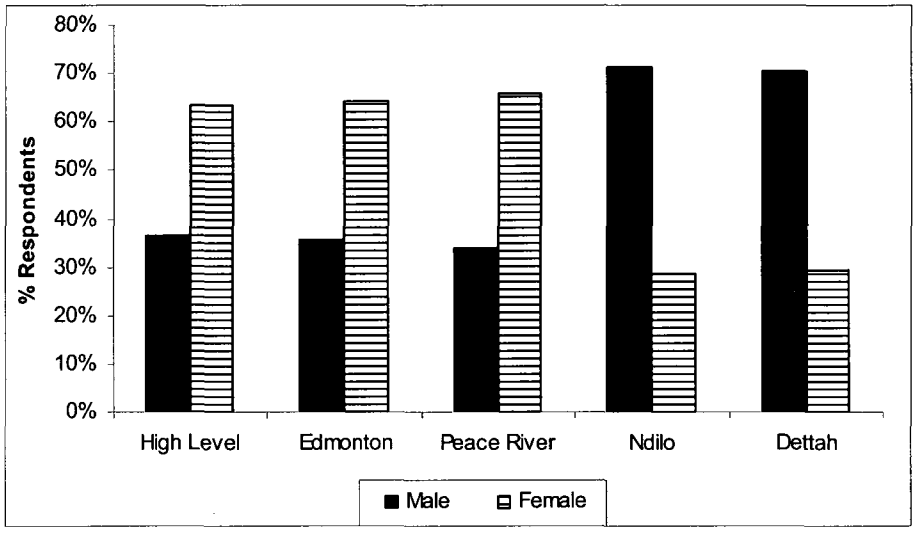
Other than Hay River – the most accessible town and a provider of essential services such as machine repair and sales of gas, groceries, and household items – few people visit other towns regularly. Visits that do occur are often for meetings, events or to connect with relatives and friends. The opportunity to stock up on cheaper and more diverse food and household goods in larger centres is also a substantial draw.

Figure 5.11: Frequency of visits by Fort Resolution residents to other settlements (N=93; N=53 for Dettah and Ndilo only)



Interestingly, women are more likely to visit larger towns and cities to the south (High Level, Peace River, Edmonton), whereas men are more likely to visit the Akaitcho communities of Dettah and Ndilo (Figure 5.12). Note that these communities require several hours of travel from Fort Resolution, and the visits indicated here are infrequent (annual or semi-annual basis). Gender differences in visitation trends for Hay River, Yellowknife, Fort Smith, and Lutsel K'e were not significant. Furthermore, residents with a higher level of formal education visit Edmonton more regularly than those with less education (Figure 5.13). These trends reflect differential propensities of specific groups within Fort Resolution society to connect with external people and places, and an uneven distribution of resources to support such ventures.

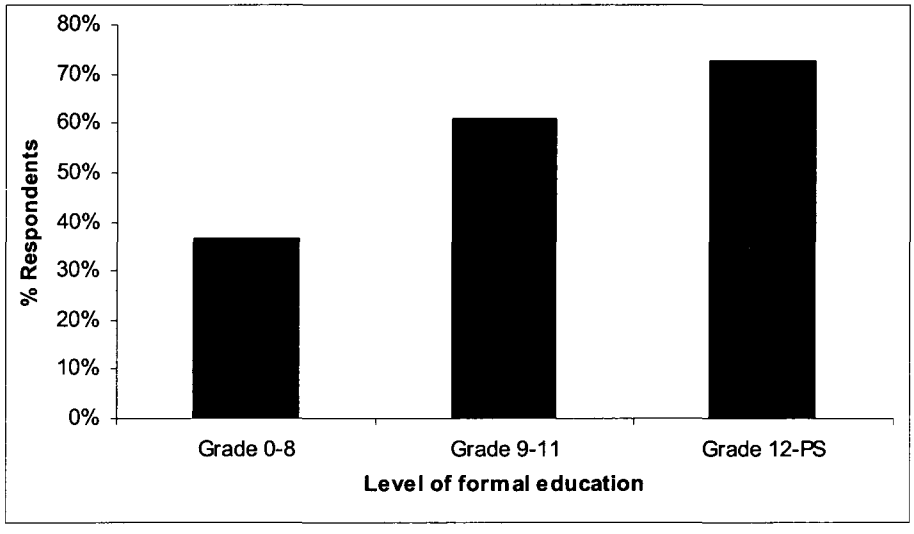
Figure 5.12: Visits to distant communities by gender
(N=93; N=53 for Dettah and Ndilo only)



The above trends show significant differences in visitation may be linked to a combination of the following factors: the propensity for women to make shopping trips for their families (to High Level, Peace River and Edmonton), the elevated levels of females in higher education (accessing higher-level schooling outside of town), and the predominance of males in council positions (incentive to visit Ndilo and Dettah for meetings). Other factors may help to explain why the additional communities show little difference in visitation based on gender and level of formal education. Hay River and Fort Smith are the closest communities to Fort Resolution, and while Hay River acts as a primary service centre, both towns are home to a considerable number of relatives and friends. Aurora College is also located in Fort Smith, drawing students from the area. Similar numbers of men and women travel to visit familiars and access these services. Similarly, Yellowknife acts as a major service centre, and has other amenities such as a large hospital (where many women from the communities go to give birth). Many meetings are held in Yellowknife, and those who travel to the mines or to engagements

elsewhere in the north are often routed through this hub. Lutsel K'e, on the other hand, is a small, remote community inaccessible by road. Reasons for the few who travel to this community range from visiting familiars, attending Akaitcho Territory meetings, attending cultural events, or passing through on the way to hunt caribou in the East Arm of Great Slave Lake. Access is possible by plane, boat or snowmobile.

Figure 5.13: Annual visits to Edmonton by residents with differing levels of formal education
(N=85)



5.3 Key Themes: Social Dimensions of Adaptive Capacity

A substantial body of research indicates that adaptive capacity relies not only on income levels and technological capacity, but that social and human capital are also key determinants at all scales (Yohe & Tol, 2002; Adger, 2003a, 2003b; Smit & Pilifosova, 2003; Armitage, 2005; Brooks et al., 2005; Pelling & High, 2005; Adger et al., 2007; Armitage, 2007; Armitage et al., 2007). The preceding sections have introduced data

related to these determinants, which are further discussed in Chapter 7. Family structures and interrelationships play a primary role in shaping social dynamics in the community. Intersecting with family structures are defining features such as identity, both formal and informal, and the generational gap between age groups caused by residential schooling and active transition away from traditional culture experienced by much of the current adult population. Social support structures are provided by both internal institutions and external linkages and networks. The many bonds and divisions among groups in the community play out at different levels and intensities.

5.3.1 Family and community structure

Local allegiances can serve as a glue that binds people together, or as a divisive mechanism that serves to benefit certain groups while marginalizing others. Both tendencies are apparent in Fort Resolution.

The normalized use of alcohol and drugs has created much disruption in the local social structure. Involvement with alcohol and drugs (whether use or sales) were the two most cited causes of tension and conflict in the community (41% and 31%, respectively), and there is significant concern in the community regarding escalating use among youths (Table 5.4). Heavy alcohol use in the Northwest Territories is documented at almost 40% of the population older than 12, approximately twice as high as the Canadian average (Northwest Territories Bureau of Statistics, 2007). Community data are not available, but it is reasonable to assume that Fort Resolution falls within this range.

When you lose your identity and your values, when you mix in drugs and alcohol, then you have ... dysfunctional [people who] don't really think of other people but themselves. ... Back in the 40s and 50s people saw them live off the land and saw the respect for each other, but once the road came in there was more access to alcohol. There were a lot of accidents. And then a lot of drugs came, too, and more people started to bootleg; they were bringing in drugs [and] alcohol. (Boucher, 2005b, pers. comm.)

These elements act to both bind and divide groups of residents. While those who consume either alcohol or drugs may isolate themselves and partake alone, these activities – especially alcohol use – also provide opportunities for social interaction. On the other hand, sober individuals generally do not spend social time with drinkers and drug-users, and vice versa. Many of those who have worked hard to remain sober for prolonged periods have disconnected themselves from previous friendships, often to avoid being pressured or drawn to consume.

A group of adults stopped [using alcohol and drugs]. They realized a better life was possible. But some don't try to stop their kids from doing it. (Boucher, 2006b, pers. comm.)

Several residents indicated that while alcohol use has decreased over the last ten to 20 years, the use of other drugs, especially marijuana, has increased. This transition from rowdy partying to more subdued forms of consumption may be contributing to more isolationist behaviour and reduced interaction with a specific segment of the population. One local noted that alcohol plays a significant role in relationships within families and how people deal with their own issues (e.g. whether it is discussed or repressed). He notes that the middle-aged adults have perspective both on the past and on the current outcomes for their children, giving them the opportunity to draw on these lessons and take responsibility for making changes in their own lives (Boucher, 2005a, pers. comm.).

The tendency towards jealousy and gossip severely impairs the development of meaningful working relationships with other residents, especially across kinship lines. This was documented as the fourth most prevalent reason for conflict and tension in the community (13% of respondents) after involvement with alcohol and drugs, and restrictions on access to jobs (Table 5.4). Several locals noted that divisions are fuelled by long-time family feuds, and jealousy has become more prevalent with increases in material wealth. Here, as in any other modern community, they feel the pressure to 'keep up with the Joneses'.

A further issue is that of gossip. The town is very small and everybody knows everything about each other. It is impossible to live anonymously; past interactions often shape current relationships and forgiveness for transgressions is sometimes difficult to obtain. Chipewyans are known for their storytelling, and in a place like Fort Resolution where day to day life is fairly low key, individuals have a tendency to talk about others, often telling stories where the facts are embellished or recreated. One community member spoke of gossip as a form of 'lateral violence' that oppresses and suppresses the spirit and dampens people's feelings, decreasing the capacity for friendship and teamwork. The oppressee has become the oppressor, as individuals and family units are oppressing their own people within the community (Anonymous 5, 2005, pers. comm.).

Gossip also works against healing. Over the years, several personal development workshops have been organized by the Wellness Centre based on client demands (e.g. parenting, life skills, women's traditional healing, etc.). However, although residents state initial interest, most workshops are not well attended. There is likely a combination of

factors at play. Many individuals are reticent to take responsibility for their position in life, lack incentive to work on personal improvement, and are concerned that they will be gossiped about when their peers see that they are taking steps to help themselves. There remains a strong stigma to seeking help (Simon, 2005b, pers. comm.).

A turbulent recent history and the need for continued spiritual and emotional healing for both individuals and the community as a whole may contribute to intra-community relations that are at times fractured. In an effort to try and address some of these issues, an annual spiritual gathering was initiated nearly two decades ago by residents in Lutsel K'e with the intention of bringing people together and trying to heal some of the addictive behaviour and resulting social disharmony. In August, community members From Lutsel K'e and Fort Resolution (and some individuals from other nearby communities) travel by boat and float plane to Reliance, an old hamlet site in the East Arm of Great Slave Lake, to camp out on the land and enjoy spending time and engaging in traditional activities together in an alcohol- and drug-free environment. One of the main events is a visit to Desneth 'che or 'The Old Lady of the Falls', a sacred waterfall on the Lockhart River, to draw on her healing energy, to pray, and to collect sacred water (Figure 5.14). One of the benefits of such an experience is to remove people from their material comforts and offer an opportunity to reconnect with the land and other people.

Figure 5.14: Welcome sign for the Desneth 'che spiritual gathering at Reliance

One of the Climate Days workshop participants reflected the paradox presented by increasing one's wealth (in a relative sense): *"People used to be very happy. Now people have everything, but they're not happy."* (Workshop Participants, 2005, pers. comm.). It is often difficult to disengage from the cumulative pressure of numerous outside influences, which can act to push people apart rather than pull them closer together.

I think in the past, culturally people worked really close together in family units for the purpose of surviving. Now... when people go into private business, it's more for themselves. ... As a First Nation, it's becoming more difficult to get the whole community to buy into concepts and work collectively on a vision. ...It's getting more difficult because of so much outside influences. (Balsillie, 2006, pers. comm.)

Despite the relative reduction in traditional cultural relationships, the underlying bonds of history and kinship do emerge in the face of individual or communal crisis, whether a tragedy (e.g. broad scale support for the affected family when a community member passes away) or a threat to collective rights (e.g. the 1970s organization of a group protest against exploratory drilling by Shell Oil on territorial lands (Dene Nation, 2008)). This underlying bond is also evident in the fact that people trust other residents more than outsiders. In the current day, it appears that issues around environmental health (e.g. impacts of climate change or proposed resource development) are recognized as having non-discretionary impacts. The understanding that impacts affect everyone, regardless of affiliation or social status, has the potential to bring people together to respond to a common cause.

Furthermore, healing personal addictions and relationships would go a long way toward improving local political decision-making and ensuring that it benefits the community. A successful example is the community of Alkali Lake, a Shuswap Reserve in British Columbia, which moved from extreme addiction rates to almost complete sobriety. The movement started with one couple who, after initiating their own healing journey, reached out to other community members. The community's journey is held up as a model of successful community healing and development (Chelsea & Chelsea, 1985).

5.3.2 Identity

Two aspects of identity have played a profound role in influencing social dynamics in Fort Resolution. First, the legal designation of 'aboriginality' by the federal government and the periodic shifting of these definitions has determined individual and group access to specific rights and benefits through time. Simon (2005b, pers. comm.) notes that local people did not recognize differences amongst themselves, but rifts were created when the Dene and Métis were independently engaged in treaty negotiations. Several locals indicated that the Métis have now come to see themselves as a distinct society and don't want to be lumped in with the DKFN Band. Additionally, the Dene are opposed to the Métis being part of the land claim, as this would involve sharing resources and rights, and could complicate the claim (Anonymous 4, 2005, pers. comm.).

Initially imposed by what is perceived as an oppressive external force over which local people had no control, and now perpetuated internally by some factions, these formal designations have both created material disparities within the community and contributed to ill feelings. While several locals indicated that the issues between groups are mainly political and do not necessarily translate to the personal, several Métis recounted how they are periodically excluded from 'members only' DKFN events (Mckay, 2005d, pers. comm.). This is especially poignant in families of mixed identity, where Métis members are not able to participate in certain events with their husbands, wives or children.

[When you] go down there [and] see your mom and dad collecting treaty [annuity], they kick you out because you're Métis. Your mom and dad are sitting there having a burger [at the Treaty Day celebration and their] kids are Métis. Parents are treaty, but you get kicked out. ... And they enforce it, the leadership here. (Delorme, 2005, pers. comm.)

A second important aspect is that of cultural identity, which is inherently tied to the land and to the traditional way of doing things, as well as to language. In the one generation it took to move from paddling a canoe, living solely off the land, and telling stories by the campfire to using speedboats, airplanes, televisions, telephones, and microwaves, people have become increasingly disconnected from the land, losing their focus on what is out there and on who they are. The combined effects of the missionizing process – especially through the residential school system – government assimilation policy, and increasingly global influences (e.g. television, goods, travel opportunities, resource development pressures, linkages with international indigenous and environmental movements, etc.) have disconnected individuals from their own cultural identities. Some of these trends were already documented in the mid-1970s during the Mackenzie Valley Pipeline Inquiry; some of the quotations from that period remain consistent with current struggles, although some of the divisions are becoming muted through continued acculturation.

For myself, I find it very hard to identify with anybody because I have nobody to turn to. My people don't accept me any more because I got an education, and the white people won't accept me because I'm not the right color. So like, a lot of people keep saying, "O.K., we've got to educate these native – these young native people so that they can become something." But what good is it if the person has no identity? (MVPI-CH, 6: 557-558 cf. Helm, 2000)

Cultural identities are place-based and are founded on communal systems of value and knowledge. Many people still describe the land as part of 'who they are': *"It is like*

my foot – I am not whole without it" (Simon, 2005b, pers. comm.). A spiritual and respect-based connection with the land and one's ancestors provides a grounding that has in large part been lost over recent decades. Modernization brings with it a tendency to re-value these aspects, with pressures to commoditize such things as land, resources, knowledge, and culture. There are some positive occurrences to counteract this trend. Locals noted some resurgence in both land use and the teaching of traditional knowledge and skills to youth.

Now I noticed there are more families that are starting to take their kids out again; showing them the land and how to get around, where to go and places to hunt. ... I'm not sure for what reason [this practice stopped for a while], but it's starting to happen more now again ... in the last 20 years. (Anonymous 1, 2005, pers. comm.)

The missionaries and the residential school system played a major role in distancing the Dene from their culture and traditions. Interviewees noted that the goal of missionaries was to assimilate the children. They considered all things traditional to be 'bad' and that their use or perpetuation would send you to hell (Boucher, 2006a, pers. comm.). A local elder noted that while she had not suffered abuse at residential school, the schools did take people away from their families and from traditional livelihoods and teachings. If you were an orphan, you were raised at the school until age 14 or 15 whereafter you might get married or go and live with relatives (Anonymous 6, 2005, pers. comm.).

My older sisters went to the Mission school and my mother had to pull them out ... because of the abuse that they were being subject to. ... You know, we might be poor, but we had a lot of love. And anything inflicted on us as children my mother, my grandmother, my dad absolutely would not tolerate. And it was not that they went and verbally abused anyone for what happened, they just silently pulled my sisters out of school [until] eventually the federal day school was built. (Unka, 2005a, pers. comm.)

I was born in ...1930. ... I lived in 'Res' – Fort Resolution – then I started going to [residential] school. ... My mother don't talk much English, or my dad, and the cops and the doctor came and then they dragged me to the convent. And I never seen my mother...until 1942. She lived only about 400 yards from the convent and my dad's working for the Mission, he didn't come and see me at all. ... And when they brought me there they wouldn't let me outside for one whole year. I stayed in there, go to school and stayed in there. Kids played outside, they wouldn't even let me outside. Then my mother died in 1942; they let me out of there, but two weeks later my mother died and I had no place to stay ... Everybody [else] was able to see their parents; I was the only one that had this, I don't know why. (Beaulieu, 2005c, pers. comm.)

Well the kids were brought mostly to Fort Smith. And the kids were taken from their homes to Fort Smith for school. ...So they were brought up like that. Once they're either six or eight [years old], they had a Mission here so they had to stay here to learn. While the kids are staying in school, [their parents] went back on the land to trap ... while the kids had to ... stay at school here or at Fort Smith. ... When the kids had to go to school here they couldn't speak their language; they had to speak English, poor things. They had no choice. They actually tried to eliminate native language, so it was a kind of school that a lot of these children lost their language. (King, 2005b, pers. comm.)

Over several generations, aboriginal spirituality has been all but supplanted by Christianity. However, some locals recognize the importance and power of aboriginal spirituality and are continuing to practice it, or are learning about and reviving these practices. Despite this trend, such practices and beliefs are not often discussed as many Christians in town are not supportive (Anonymous 4, 2005, pers. comm.). Looking back, there has been a break in the cultural line, and people respond to it in different ways. Individuals are now going through the growing pains of developing a new type of culture that incorporates some elements of their traditional identity with other 'western' elements.

5.3.3 Generation gap

A significant outcome of the Mission schooling was the disconnection between children and their parents and other family members. Many current-day adults spent much of their youth learning life skills at boarding school in Fort Smith, or from parents who were struggling with the transition from life on the land to life in town, or who had grown up at the Mission school rather than with their parents.

My mom, my dad, they died 1937; one in August, one in December. Yeah, it was hard. So we became orphans, so nobody to look after us, and Granny was over 80, so they brought us here to the Mission. It used to be a big Mission, a convent they called it. That's where they raised us. From there, I stayed there seven odd years. (Sayine, 2005, pers. comm.)

[After the school in Rocher River burnt down] the kids had no school, and they were forced to relocate to Fort Smith in Residential schools, taken away from their parents. ... My wife was telling me that they were all crying and some of them were drugged on the plane and stuff like that, and taken to totally, totally alien setting ... in the residential school. And they had to live through that. (Unka, 2005b, pers. comm.)

Many members of this current parental generation have gone through cycles of addiction and destructive behaviour, and have not been taught effective parenting skills. This is leading to a generation of youth who are following a similarly destructive path (Simon, 2005b, pers. comm.). Families are no longer living under one roof and working together as tight-knit units as was necessary to survive on the land. One resident noted that "the whole community used to raise a child", where parents would think nothing of a seven year old staying at his cousin's place for several days. Now parents are "acting more like whites", calling after their kids and regulating who can stay where when (Simon, 2005b, pers. comm.).

Now youth commonly move out of their family residence to a smaller rental unit in town or elsewhere, and elders often live in their own home or at the Elders facility. Livelihood activities are shifting away from the land and formal education is becoming a stronger focus, making the intergenerational transfer of TK more difficult. Furthermore, a language barrier exists between some elders who speak only Chipewyan, and their children and grand-children for whom English is the primary (or in many cases, only) language. These and other factors result in a generation gap in knowledge, values, and understanding.

In the past elders were looked to for leadership and advice in community life, and revered for their role in knowledge storage, transmission and cultural evolution.

Elders had a lot of say in community life in the past. They also held a lot of relevant information, told many stories and passed on information. Now elders are not utilized for their knowledge because of colonization. (Anonymous 5, 2005, pers. comm.)

Now institutional memory is being lost at an increasing rate. Elders are still trusted and consulted, but they are often deemed to be living in the past and their advice is seen as outdated. Many of the traditional leaders have passed on, so respect for elders is now not automatic, but rather must be gained. This has contributed to some elders losing their own sense of identity and the value of their role within the community.

5.3.4 Institutional linkages and support

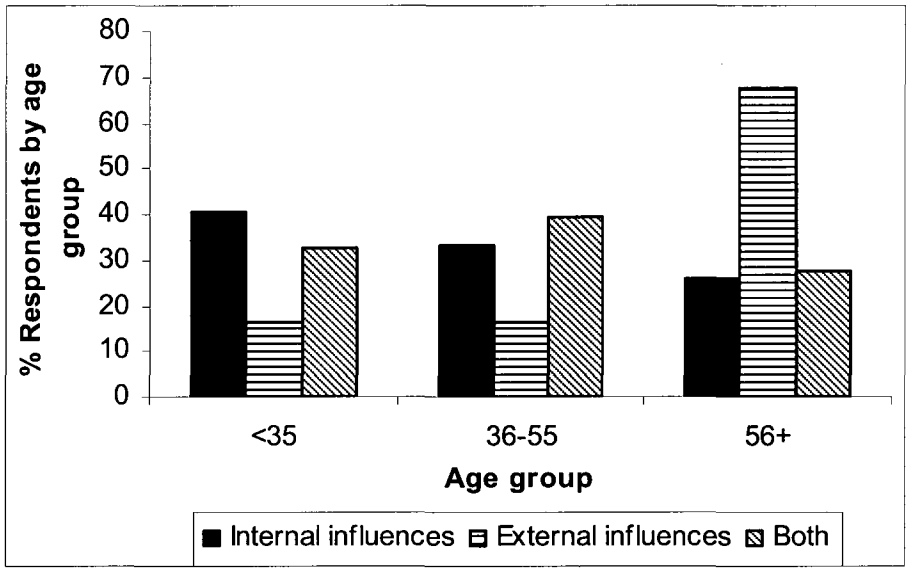
Individuals in the community have personal linkages with people in other nearby communities, often through kinship ties. The small and relatively concentrated population of the NWT means that people in leadership positions all know each other, facilitating access to resources and avoiding bureaucratic channels (reducing transaction costs). Most residents feel that regional or territorial representatives are familiar and accessible. These linkages, however, can also lead to a reverse effect. For example, to register disapproval about the handling of a minor student behaviour-related incident at the school, Fort Resolution parents may inform the NWT Education Minister directly through a phone call or bring up individual matters in a public forum rather than speaking directly with the school principal. Circumventing formal communication channels may result in unjust resolutions to such issues being imposed from above, and a clogging of the system where Ministerial time and energy is diverted rather than being spent on issues of broader significance. These seeming disjunctions are the result of a Euro-Canadian bureaucracy that overlays the more informal, but robust, aboriginal communication system, where individuals are expected to function within the imposed system.

As previously indicated, local organizations are deemed to provide essential support and information to community members. Coordination among governance organizations and other service providers is essential. At the local level this has been attempted through an Interagency Committee, which brings together representatives from various local agencies (DKFN, Métis Local, RCMP, Health and Social Services, and

Deninu School). The Committee's goal has been to collectively define some of the main service needs in the community and identify the mandate of each agency in taking action to respond to these needs. Agency progress on particular areas of interest is discussed at monthly meetings. The Committee also functions as a venue for coordinating joint activities (e.g. parenting workshops, celebrations) that fall beyond the mandate of any one agency. The continued development of such institutions, through collaboration with and using dedicated resources provided by the territorial and federal governments, would appear essential for achieving a sustainable community that supports individual and collective well-being. Most survey respondents feel that internal factors are very important in influencing the future development of the community (either on their own or in conjunction with external factors; Figure 5.15).

Many individuals of the older generations have experienced dramatic changes first hand and remember the socio-cultural and economic impacts of exogenous factors such as the rise and fall of the commercial fishery and Pine Point, government harvesting regulations, and increased access to the outside world (by road and air). Nonetheless, they are also clearly aware of the influence of each individual in the community regarding the type of choices they make, the integrity with which they live and interact in both personal and (potentially) leadership roles, and the types of decisions that locals make on a collective level (e.g. how to run the affairs of the town, the First Nation and the Métis Local; what position to take in dealings with other governments or outside companies).

Figure 5.15: Response to the question 'Does the future of this community depend more on what happens inside this community, on influences that come from outside the community, or both?', by age group
(N=90)



Survey results (and results from other components of the study) suggest that there is a recognition that change must occur from within, supporting a focus on development at the local level within a broader multi-scale relationship framework (e.g. drawing on resources from higher level institutions). The focus on endogenous factors may also reflect anticipation and optimism about the potential application of increasing authority at the local level being negotiated through land claim and self-government agreements.

5.4 Social ties and leadership

One of the perceived consequences of shifting away from the land and its values is an increased focus on individual status and a reduced spirit of cooperation among community members. For example, alongside economic diversification, more

individualistic attitudes, increased land user costs, and the safety net created by government social programs, sharing has decreased substantially among familiars. Individualistic attitudes have been introduced and reinforced through the residential school system. One individual indicated that people who grew up on the land have a different attitude toward other people than those who attended residential school, one based on simple respect. He noted that regardless of whether or not an individual is likeable and has a good attitude, they are seen to have a good spirit and should not be turned away if they are in need (Boucher, 2006b, pers. comm.).

Formerly, everyone had a role in the community. Children were helpful, showed respect, and felt a sense of identity and belonging. Extended family members provided guidance and discipline, and elders were the principal source of knowledge. Now, residents indicate that the knowledge, caring, respect and honesty of the extended family has been interrupted largely by external influences such as the residential school system and personal addictions (Anonymous 5, 2005, pers. comm.). The resulting strains on social bonds introduce further challenges for communities attempting to respond to the many pressures they are facing.

In Fort Resolution, family networks have traditionally been a key driver in shaping access to resources, job opportunities, and education. This force can be both beneficial and destructive depending on social status and perspective. While individuals can work through these ties to access benefits, they may do so at the expense of marginalizing others.

While the social structure continues to be formed around small family groups based on location of origin (Figure 5.1), the nature of inter-group relationships has changed. In the past, bonding ties between family and friends were more survival-based, being cultivated through joint activities on the land. These ties have been shifting as a result of new settlement patterns during the past four decades. Although family allegiances are still strong in Fort Resolution, younger residents indicate that they now create linkages with those involved in joint activities (e.g. work) or who do similar types of recreation (e.g. spending time on the land, athletics). Thus, in addition to family groups, these bonds create interest-based groups. On the whole, however, it appears that these groups tend to be less flexible and more exclusive than in the past when doors were open to anyone at anytime and livelihoods and material goods were more communal.

Lots of people are kind of dispersed, and that also created differences in the community. ... There are certain groups ... in the community. ... [They are made up of] family structures, friends, purists, drinkers, pot smokers – anything that bonds people. ... It's all bonded that way by relations, intermarriages; it's all bonded together like that. All these separate, fragmented groups. ... There is still the core Rocher River group that are helping each other ... they trap together and go out in groups together and food share with each other. ... We [all] have our own little group; I have some groups that I help to feed. ... But it's not black and white. (Unka, 2005c, pers. comm.)

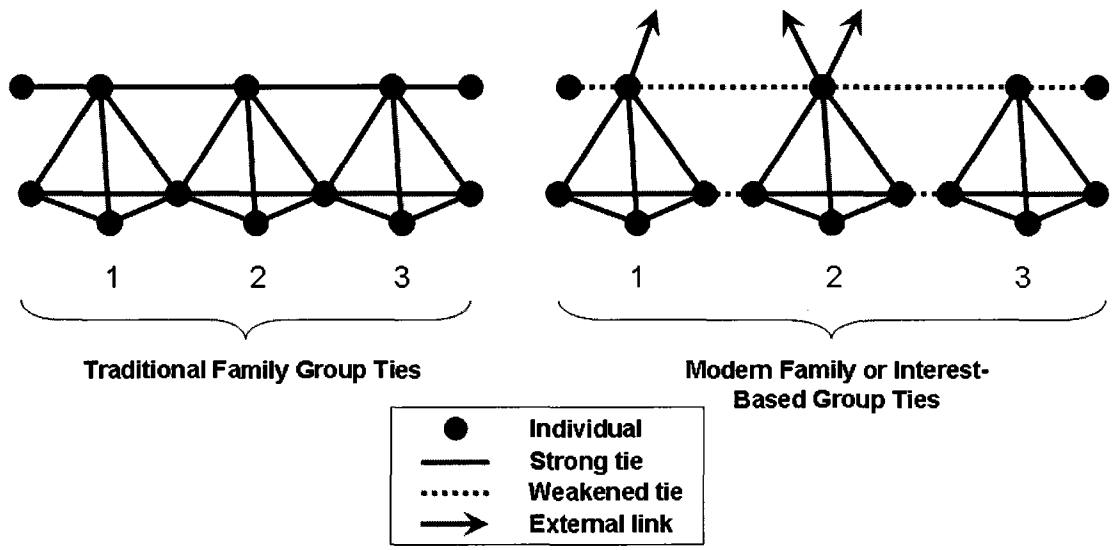
Considering both family and interest-based groups as part of the social structure, we can conceptualize the intra-group ties as those that bind people across vertical scales, where some members (e.g. elders, bread-winners, parents, elected leaders, community organizers, interest group leaders) have more influence, and are thus higher up in the social hierarchy. At the community scale the overarching sense of trust, respect and willingness to work together has diminished, weakening some of the lateral ties between family and interest groups. At the same time, the community as a whole has increased the

number and strength of contacts with outside organizations, thus facilitating the vertical transfer of resources, whether financial or information-based. Nonetheless, a limited number of people in the community (generally those in more leadership-oriented positions) have and cultivate these links, and the lack of consistent and effective guidelines or mechanisms appear to limit the sustained and equitable distribution of benefits that flow from them. For example, individual First Nation employees will regularly contact individuals in the federal government to solicit supplementary funds or support for individual events or programs that often benefit a targeted group of people. Such solicitations are often supplementary to core funding, but are relied upon to maintain local programming, albeit in a piecemeal manner (funding constraints are discussed in Chapter 6). Individuals (and families) at the bottom of the social hierarchy thus are more readily marginalized. Figure 5.16 offers a simplified conceptual sketch that shows a weakening of lateral ties between (family and interest) groups and an increase in external linkages from traditional to modern times.

This shift in the social structure has also influenced the manner in which leadership emerges in Fort Resolution. The traditional process of identifying trusted leaders to provide direction about group movements and harvesting did not transfer well to the imposed Chief and Council system for local governance. As previously noted, these formalized positions only gained some form of validity for local people as of the 1969 establishment of the Indian Brotherhood of the Northwest Territories, after which aboriginal leaders have gained increasing political influence (see Section 5.1.3). Through this movement and the subsequent land claims process, a handful of individual political

leaders from the community have developed diverse and often strong external linkages. While the road link to Hay River has also increased access to the outside world for much of the population, many young people have left the community to pursue other opportunities, however, the ones that remain show low rates of visitation and mobility (as discussed earlier in this chapter).

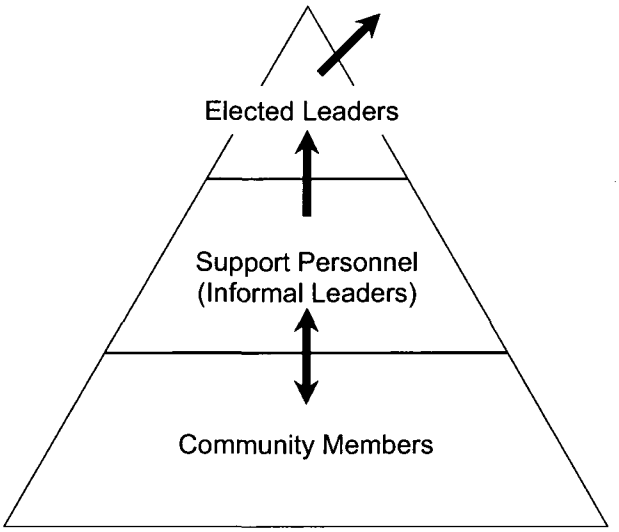
Figure 5.16: Conceptual illustration of family and interest-based group ties from traditional to modern times



At the local level, elected or hired leaders are the political face of the community who ostensibly take actions to create programs and an institutional framework for longer-term community benefit. They are required to spend significant amounts of time connecting with outside people and resources. However, when local action is required, it is often another core group of community members who quietly 'roll up their sleeves and do what needs to be done'. These individuals, who provide essential social glue in the community, are often not in designated or elected leadership positions. Rather, they tend to be otherwise engaged in community-level work, and several work in support positions

within local governance organizations. Due to the nature of their professional involvement, these individuals remain aware of the salient issues, but they spend more time in town than do elected or hired leaders who travel often for meetings. These informal leaders also play less controversial roles in the community than do government leaders who are seen to represent the interests of a specific *power base* (sometimes over that of the broader community). Perhaps due in part to their non-elected status, and thus a perceived 'neutrality' of sorts, community members seem more likely to work with these mid-level leaders and to appreciate what they do. Figure 5.17 offers a conceptual illustration of the primary flows of information and support among community members, informal leaders and elected leaders (or 'politicians' as they are often referred to).

Figure 5.17: Conceptual framework of leadership networks and representation



From a sustainability perspective, a paradox exists here in terms of drawing on local assets for leadership. Residents tend to place their highest trust in elders and

traditional land users, yet these are the groups that are marginalized in large part from community-building and leadership processes. Although elder leadership and knowledge is deemed important, it is often seen as outdated and is thus ignored. Additionally, the active traditional land users prioritize spending time on the land, and although they may be consulted, they are often not the ones making decisions in local government offices.

The social linkages described above have both negative and positive outcomes for adaptation. Weakened lateral ties among groups offer additional challenges in getting a large group of community members to work together. On the other hand, the more recent links to outside networks can be drawn upon to provide resources and contribute to an enabling environment within which adaptation can take place. Further, it may be beneficial to recognize the informal leaders as significant assets for community-building and adaptation, and engage them in a more targeted manner to encourage collaboration.

5.5 Summary

This chapter provides an account of changing socio-economic and governance trends in Fort Resolution, with specific focus on the more recent past. It provides an outline of how the social structure evolved over time, and discusses primary dimensions of social capital that are important considerations for adaptation. The latter part of the chapter focuses on a discussion of critical themes relating to the social aspects of adaptive capacity.

What has emerged as a result of shifting socio-political conditions over the past several decades is the tendency towards increased polarization among local people compared with more traditional times before the era of community settlement (pre-1960s). The experienced changes have eroded some of the ties both within and among family groups, often influenced by external pressures such as government-designated legal identity. Divisions are further exacerbated by the differential implementation of adaptive strategies (see Chapter 4) where, for example, certain people benefit economically through their creative and dedicated methods of maximizing their productivity through a range of activities, while others are not as able or willing to turn away from traditional livelihood pursuits that are less rewarding in monetary terms. In Fort Resolution, precisely because everybody knows each other, these differentiations are highly visible, and are more likely to cause polarization and distrust.

Despite emotional and social divisions in Fort Resolution, however, there exists an underlying support structure that people rely on in times of need. Residents' willingness to work together for the collective good emerges in times of tragedy and when their collective rights are threatened. This helps to create a comforting social space and increases the draw for people to remain living in the community rather than to leave it. These social ties are often latent, but may provide a foundation for building cohesion and encouraging cooperative action when the need arises.

It is generally expected that residents of small communities with fairly homogeneous cultural history and low mobility would be more likely to work together

than in larger societies with more disparate interests (Fukuyama, 2000). Although some social ties have been strained in Fort Resolution, there is scope for residents to come together to act in the face of a common threat such as environmental change. Higher levels of trust in other community members relative to trust in external organizations such as the territorial and federal governments may offer some encouragement. Wakefield and colleagues (2007) found that trust in extra-local government was negatively correlated with environmental action; individuals were *more* likely to engage in such action if they did not trust the government (perhaps seeing more of a need to undertake action themselves).

The evolution of the social structure and dynamics in Fort Resolution outlined in this chapter provides important contextual understanding for a discussion of adaptation needs and planning in Chapter 6.

CHAPTER 6: PLANNING FOR ENVIRONMENTAL CHANGE

In the climate change literature there is clear recognition of the need for human agency in responding to this threat. Options include taking mitigation actions to reduce greenhouse gas emissions and adapting to social-ecological systems to survive and thrive under changing conditions (Smit & Pilifosova, 2003; IPCC, 2007a). Mitigation is an important response strategy, especially at scales (e.g. regional, national) and within sectors (e.g. industrial development) where significant emissions occur. While I touch on this subject in this chapter, it is not the primary focus for residents in northern communities that are already experiencing the impacts of rapid change, and who often feel that emissions reductions at the local level will not have significant effects in resolving the overall problem. In light of the current and anticipated cumulative impacts of multiple and dynamic stressors being experienced by aboriginal northerners, this chapter focuses on notions of anticipatory adaptation and on enabling dimensions of adaptive capacity development at the local level, as expressed by local participants. It draws on scenario planning as a useful tool for identifying possible future vulnerabilities and adaptation strategies to address them (see Section 3.2.4). The subsequent chapter (7) takes a more critical look at adaptive capacity and the feasibility of adaptation options for a northern Aboriginal community within a multi-level institutional context.

A growing awareness about climate change and its effects on the community of Fort Resolution has emerged over the past decade. A DKFN visioning exercise in 1998 recognized that climate change could have potential negative impacts on several

important components of local life, including Dene language and culture, community cohesion, youth involvement (e.g. church, activities), safety on the land, water quality, and food security (Giroux, 2006, pers. comm.). Awareness about the issue has been further developed through various research projects such as the current collaborative study, and community meetings (e.g. Climate Change Days).

As discussed in previous chapters, residents have also experienced other major livelihood impacts related to resource development both within and beyond their traditional territory, namely the Taltson River hydroelectric project, the W.A.C. Bennett hydroelectric dam on the Peace River, and the Pine Point lead and zinc mine. The prospect of new developments in the region has heightened local awareness regarding potential future impacts (both positive and negative).

The previous chapters have examined historical and current dimensions of adaptive capacity, which provide the context for adaptation planning. The objectives of this chapter are to address some of the main areas of household and community vulnerability to future change and potential adaptation strategies, drawing on scenario planning discussions with local residents. Barriers and opportunities for adaptation are also explored.

6.1 Future Scenarios: Vulnerability and Adaptation

Small northern communities are dealing with change on a continuous basis. Change can be slow and steady, or rapid and turbulent. In recent history, Fort Resolution experienced a tumultuous social period during the 1970s and 1980s stimulated by a combination of factors, including increasing settlement, government social policy and the advent of road access, among others (see Chapter 5). Since that time community life has been relatively calm. Currently, however, community resources are taxed in a number of areas (e.g. human capital, financial resources), and powerful social and political forces are at play beneath the surface, increasing vulnerability to future stresses. As these pressures mount, residents are concerned about their well-being and quality of life, which are directly related to the community's resilience to ongoing stresses and potential future shocks.

To explore potential future changes and impacts we developed three qualitative, visual scenarios of possible change for the year 2025 (see Section 3.2.4 for an explanation of why qualitative scenarios are particularly useful for adaptation planning). Following Peterson *et al.* (2003a: 2) these scenarios are "plausible example(s) of what could happen under particular assumptions and conditions ... [and are] contrasted against one another to provide a tool for thinking about the relationships between choices, dynamics, and alternative futures". To move beyond the focus on average temperature and precipitation conditions espoused in many climate change impact scenarios (Smit & Skinner, 2002), we incorporated a broad range of possible exposures. Similar scenarios

were used in the Millennium Assessment to guide decision-making based on different possible conservation outcomes (Peterson et al., 2003a). Here, the approach was modified. The scenarios were used to focus discussion around areas of vulnerability and options for adaptation under different future conditions. The intent was to outline a range of types of conditions to which the system might be exposed, identify and prioritize areas of vulnerability, and outline a variety of actions to improve anticipatory adaptation planning and the capacity to cope with a range of potential future conditions.

As outlined in Chapter 3, the three scenarios explored the possible effects related to two main drivers of change, climate and resource development. The scenarios were designed to largely isolate the treatment of each change driver to better pinpoint specific vulnerabilities. The *Small Town* scenario, which combines moderate climate change with moderate resource development (current to slightly increased levels), depicts a continuation of 'business as usual'. It acts essentially as a baseline scenario against which the other two, which depict more dramatic change, can be contrasted. *Shifting Seasons* reflects substantial intensification of climatic trends as predicted by the higher end of the scientifically projected range. *Boom Town* depicts the implementation of a significant resource development operation in or adjacent to DKFN traditional territory, based in large part on descriptions of past development impacts on Fort Resolution residents and on the current experiences of other northern towns.

The range of scenarios presented was deemed plausible – and in some cases likely – by participants, who also noted their utility in stimulating discussion around planning

for the future (i.e. what *can* be done, rather than focusing solely on the barriers). In this process of looking toward the future, informants noted a range of vulnerabilities to both climate change and resource development, and discussed a variety of strategies to deal with potential impacts. They also pinpointed a range of barriers to improve adaptive capacity and build resilience into the system.

The livelihood activities and well-being of residents are inherently linked to the environmental milieu on many levels. Individuals most often refer to vulnerability in relation to their own livelihoods. They describe how environmental changes are likely to influence "capabilities, assets (including both material and social resources) and activities required for a means of living" (Chambers & Conway, 1991: 6) in the community. Focus group participants outlined different areas of livelihood vulnerability for each scenario. Participants noted the potential for both positive and negative impacts, and indicated the perceived severity of each. A summary of participant perspectives is provided in Table 6.1 and elaborated on below.

Upon comparison of the three scenarios, there was substantial overlap among the areas of perceived vulnerability. Regardless, each scenario offers its own unique challenges. The short scenario summaries below offer a more in-depth look at some of the dimensions deemed important by local participants.

Table 6.1: Summary of primary vulnerability concerns under three scenarios of change
Severity of impacts (as noted by local participants): Very negative (--), Negative (-), Mixed (+/-), Positive (+), Very Positive (++)

Vulnerability concern	*Small Town* Moderate change	*Shifting Seasons* Climate change	*Boom Town* Resource development
Environment and natural resources	• Disruption of animal population and migration cycles (-) • Decreased land access (-)	• Disruption of animal population and migration cycles (--) • Decreased land access (--) • Increased risk of extreme weather (-)	• Disruption of animal population and migration cycles (-) • Decreased land access (-) • Water and food contamination (-)
Culture and land use	• Loss of TK (-) • Reduction in traditional land use (-) • Uncertainty in travel safety and planning (-) • Less traditional food (-)	• Loss of TK (--) • Decreased relevance of TK (--) • Reduction in traditional land use - loss of connection to the land (--) • Uncertainty in travel safety and planning (--) • Less traditional food (--)	• Loss of TK (--) • Reduced traditional land use - loss of connection to the land (--) • Increased recreational land use – value shift (+/-) • Uncertainty in travel safety and planning (-) • Less traditional food (-)
Social relationships	• Shift to modern value system (+/-)	• Population influx, e.g. elder residents and seasonal tourists (+/-) • Decreased community cohesion (-)	• Mixed, transient population influx (+/-) • Dilution of local issues and way of life (-) • Improved self esteem and abilities (+) • Shift in family relationships and gender roles (+/-) • Increased social problems (--) • Effects on community cohesion (+/-)
Human health and well-being	• Introduction and incidence of new diseases (-)	• Introduction and incidence of new diseases (--) • Youth and elder stress from weather intensity and fluctuations (-) • Mental health impacts (-) • Decreased nutritional health (--)	• Introduction and incidence of new diseases (-) • Decreased nutritional health (--) • Increased individual well-being (+)
Politics and leadership	• *(None indicated)*	• *(None indicated)*	• Loss of local decision-making control (-)
Economy	• Decreased livelihood options (-) • Higher cost of living (-)	• Decreased livelihood options (--) • Heightened demand for social assistance (--) • Higher cost of living (--)	• Increased job options (++) • Improved community economy (++) • Mixed effects on cost of living (+/-)
Infrastructure and services	• Increased demand for services, e.g. health, social assistance (-)	• Unknown infrastructure impacts • Increased demand for services, e.g. health, social assistance (--)	• Increased demand for services, e.g. entertainment, housing (+/-)

6.1.1 Small Town

The *Small Town* scenario was deemed by participants as the most benign of the three, where potential impacts were associated with the continuation and moderate intensification of many existing trends (described in Chapter 4). Impacts were generally perceived to be negative, although largely within the realm of community members' ability to adapt.

Participants noted that people are not living off the land as much as in the past, and that livelihood activities continue to shift either partly or completely towards an increasing incorporation of wage jobs. As such, the impact of climate change alone will be most strongly felt by those who travel on and harvest from the land. Beyond these impacts, climate change is not perceived to have dramatic material effects on the general populous.

Other indirect effects were noted less frequently. For example, decreased harvesting success induced by these changes also reduces the economic options for young people in town (see Chapter 4). Individuals with limited access to wage jobs will be less likely to harvest pelts if they cannot cover their travel costs. Furthermore, residents – whether elders or others – who rely on traditional food provided by family and friends will also be indirectly affected by changing availability and access. A reduction in traditional food harvest may imperil household food security, especially for individuals in locally marginalized groups who may lack resources to purchase alternatives. Participants

were also concerned about health impacts in relation to new and more frequently occurring diseases (e.g. bird flu, asthma).

6.1.2 Shifting Seasons

Participants recognized the *Shifting Seasons* scenario as realistic, as they are already experiencing many of the depicted changes, albeit at a less dramatic level. They noted many similar environmental impacts to those depicted in *Small Town*, but anticipated more dramatic and rapid social-ecological shifts. The negative nature and severity of perceived impacts challenge existing capacity to adapt.

The most important impacts were seen to be those related to traditional food security, influenced by changing availability of wildlife and plant species, increased contaminant loads in traditional food species, and reduced access to harvesting areas due to changing water levels and quality of ice and snow cover. Traditional land users were deemed the most vulnerable group, as they will likely experience dramatically reduced trapping and hunting success, and increased safety concerns when travelling. Furthermore, with increasingly powerful machines (e.g. snowmobiles, motorboats), youth are now travelling farther and faster out on the land, often with little knowledge of changing conditions and possible dangers. Most also lack basic survival skills and many rely on others (e.g. parents, town mechanics) to keep machines in working condition. These combined factors have major implications for travel safety, and reflect the

importance of TK transfer for maintaining healthy relationships between people and the land.

With concerns about safety and food contamination, traditional land use is likely to decline, leading to decreased usage, sharing, and perceived relevance of traditional knowledge and skills in the community. Food security will become a more prevalent issue, requiring a higher percentage of income to be spent on market food, and further marginalizing poorer families and individuals. Locals will look for other ways to earn money, and the demand for income support is likely to increase.

Participants noted other possible economic impacts related to changing conditions. One concern includes productivity disruption by employees who are 'wind bound' on the lake, unable to return by boat due to abnormal or unpredictable weather conditions. Furthermore, existing logging opportunities are likely to be reduced due to the shorter winter season when timber removal is viable. By contrast, warmer weather may encourage tourism development in different seasons, although primarily during the longer, warmer summer. If not well regulated, this seasonal influx could increase land use related conflict between tourists and locals.

Aside from environmental and land use issues, human health impacts also cause significant concern. Elders and young children are seen to suffer in hotter temperatures, the increased incidence of asthma is attributed to air quality linked to pollution and forest fires, and individuals perceive likely increases in the distribution of both new and existing

diseases. Many participants also noted that limitations on land use and enjoyment and a decline in traditional food sharing practices cause mental and emotional stress for locals. These concerns correspond to those of other First Nation and Inuit communities that stress environment-culture connections as essential for good health (Richmond & Ross, In press).

6.1.3 Boom Town

Many participants related personally to the *Boom Town* scenario, drawing on their past experience with the nearby Pine Point mine (1964-1988; see Chapter 5). They noted a range of possible or likely developments in Akaitcho Territory, including hydro-electric development, mining, oil and gas, logging, and tourism, some of which are already under discussion (Table 6.2). There is also widespread concern in the community about increased downstream effects of industrial developments in northern British Columbia and Alberta (e.g. Athabasca Oil Sands).

The *Boom Town* scenario is seen to introduce the starkest mixture of positive and negative elements. Most participants recognize that a resource boom in their territory would substantially impact the way of life in the community, and that it "goes against our culture" (Simon, 2006, pers. comm.). Despite some experience with Pine Point, the concept of major resource development in Akaitcho Territory remains relatively foreign and conflicts with the relaxed and less formally structured way of life that many are accustomed to. Focus group and interview data shows that residents have mixed views

about the benefits of large-scale development endeavours and generally feel somewhat uncomfortable about how to approach this issue.

Table 6.2: Types of possible or likely development in Akaitcho Territory

Specific development projects	
Tamerlane mine (previously Pine Point)	Re-opening of lead-zinc mine between Hay River and Fort Resolution; pilot project for bulk sample approved in February 2008 (Mackenzie Valley Environmental Impact Review Board, 2008b)
Taltson River hydro expansion	Proposed expansion of hydroelectric dam and new transmission lines; under environmental assessment (Mackenzie Valley Environmental Impact Review Board, 2008a)
Slave River Dam at Fort Smith	Revival of proposal originally abandoned in the 1980s; TransCanada Corp-Atco feasibility study now underway; preliminary consultation with Fort Smith First Nations (Henton, 2008b, 2008a)
Athabasca Oil Sands	Current operation and planned expansion; increased water withdrawal from Athabasca River; residents concerned about downstream effects (Campbell & Spitzer, 2007)
General development sectors	
Pulp mills	Residents concerned about downstream effects from pulp mill effluent in northern Alberta and BC
Mining	Industry has shown interest in exploratory work for some of the following: beryllium, uranium, nickel, gold, diamonds (Boucher, 2006a, pers. comm.)
Oil and gas development	Shell Oil was stopped from drilling in Little Buffalo River in 1976 (Dene Nation, 2008); oil and gas deposits noted in the area
Logging	SRD and surrounding area have experienced small-scale logging and milling at varying intensities for decades
Tourism	Increases in sport fishing, big game hunting, and ecotourism all possible (Boucher, 2006a, pers. comm.)

Many people have personal resistance to this type of work, noting that digging up the Earth for marketable resources contravenes their cultural belief system. Some also feel that an increasing focus on this type of work takes people away from the land and hinders the continued evolution and transmission of TK. Other individuals focus on the positive aspects, including job creation, training opportunities, and economic growth. They recognize that the youth are likely to benefit the most in terms of economic success, and may consequently experience improved self-esteem and general well-being. However, these gains come at a cost. The advent of major resource development projects

would likely dramatically augment the adoption of a western value system, where the wage economy is a central component and time runs on a 'Western' clock. P. Simon (2006, pers. comm.) noted that "you can't survive for two seconds on Indian Time in this world". Participants worry about local people further losing their identity, culture and way of life as Dene and Métis, since they are uncertain of their purpose and place in this type of context. Furthermore, it is assumed that future generations will be too busy working for industrial employers to learn about the land.

Participants recognize the potential for such change to generate various negative effects, including social upheaval, human health problems, further cultural deterioration, and major stress on existing infrastructure and services. They express concern about social problems such as drug and alcohol abuse, bootlegging, physical and sexual abuse, suicides, and crime. An influx of new people into the town would have the potential to create a more distinct social hierarchy and conflicts over resource access and rights, resulting in unequal access to economic or employment opportunities, increased conflict between groups, and marginalization of certain sub-groups (e.g. those with limited education and entrepreneurial skills). Furthermore, participants noted the negative impact of rotational work on families. If one adult – often the male – is away at work for two weeks at a time, he feels disconnected from family and community, and the gender roles of both parents necessarily shift. This can result in family disharmony, interpersonal conflict, and more broken homes.

Opinions are mixed regarding the impact of *Boom Town* on social dynamics in Fort Resolution. Some people feel that an increase in employment opportunities would mitigate one of the current major areas of conflict, that of job allocation (see Chapter 5), and that this is likely to reduce social conflict. One participant noted that in other communities money and development have drawn people to work together, because everyone wants to be involved in the action. While this may be true, others feel that disparities in access to money and jobs stimulated by inequitable dealings with different families or community sub-groups would rather exacerbate existing social divisions, creating further marginalization and conflict.

Concerns related to this scenario also include the health problems associated with a population influx, specifically the introduction of new diseases and increases in sexually transmitted infections. Residents show concern at the limited community health services available to deal with these issues. Other health concerns include those related to the increased contamination of traditional foods and water sources; and mental, emotional and spiritual effects on elders and land users faced with limited land access and deteriorating resources.

The major boon is perceived to be the economic sector. Spin-off activities are likely to become feasible (e.g. a shuttle service, catering businesses and construction contracts). The location of the resource development site would determine whether workers and families would live on-site or in town, an important consideration for social cohesion. The latter could encourage an influx of workers and families. Resulting increases in housing demand could stimulate a major increase in property values making

these largely inaccessible to locals if subsidy programs are not implemented. On the other hand, the quantity and quality of goods and services would likely increase locally, and residents would benefit from decreased costs.

6.1.4 Vulnerability drivers and concerns

Many overlapping concerns were expressed during the qualitative scenario discussions. For example, the integrity of the environmental system and quality of natural resources cause concern in all cases, with slight variations in perceived severity. The potential effects of change on human health are of universal concern, especially those related to deteriorating quality of water and traditional food. All scenarios show an increase in the trajectory of existing environmental trends (described in Chapter 4); *Shifting Seasons* differs from the others in that these trends are substantially intensified, whereas *Boom Town* incorporates additional, cumulative pressures related to contaminants. Another overlapping area of vulnerability is the negative impact on culture and TK stimulated by all scenarios, especially *Boom Town*. This dimension is something that is most distinctly relevant to small, rural, often aboriginal groups.

Scenario results show that climate change as a driver causes mostly negative impacts on local livelihoods. The intensity of vulnerability correlates directly with the rate and level of climate variability and change (Table 6.1). By contrast, resource development as a driver of change brings a distinct mixture of potentially more pronounced positive and negative impacts. This scenario poses substantial threats to

aboriginal culture and way of life, causing concern among elders and other residents. On the other hand, the promise of employment opportunities in this economically depressed area is enticing to many, especially males of working age. A substantial number are supportive of the idea, while noting caveats about the need for community planning, preparedness and risk mitigation. The level of local control over these drivers also plays a role. Climate change is seen as an entirely external force that locals perceive they cannot influence, and are thus resigned to its outcomes. However, with regards to resource development, locals perceive that they have some degree of choice and control over if, when and how projects are implemented.

6.2 Adaptation Planning for an Uncertain Future

As adaptation research has trended towards producing practical and policy outcomes, the importance of involving stakeholders and decision-makers – as participants or process drivers – is well recognized (Waltner-Toews et al., 2003; Carter et al., 2007). Especially at the community level, involvement can be both engaging and empowering for stakeholders, and improves the likelihood of stakeholder buy-in to both the process and resulting outcomes. Furthermore, incorporating local knowledge ensures that strategies are considered in the context of local conditions that may not be clearly evident to, or understood by, outsiders. In short, local involvement can enhance stakeholder understanding of the issues and the effectiveness of decision-making processes (Waltner-Toews et al., 2003). These benefits were evidenced through the scenario process in Fort Resolution.

In discussing the three alternate scenarios, participants noted that running away from changes and impacts is not an option. Rather, changing conditions have to be dealt with head on. Where wholesale migration has been used as an adaptation strategy by some societies (McLeman, 2005), it is not considered here, reflecting the attachment to place felt by many residents. However, for certain individuals or families, migration is one feasible option (already in use in Fort Resolution) to improve livelihood sustainability at the household level (Chambers & Conway, 1991; Scoones, 1998) or as a response to specific livelihood pressures. During the adaptation planning workshop, local leaders noted several conditions that might cause residents to move away, mostly related to health and well-being. There is a common recognition that "water is everything", and water pollution emerged as the most serious concern. The contamination of fish, or large-scale hazard events like community flooding could also induce migration. Additionally, it is feasible that the positive cultural draw of a potential re-establishment of the community of Rocher River, which some former residents are proposing, might stimulate the small-scale resettlement of specific family groups.

Participants noted different areas of concern and areas of opportunity for each scenario, as well as a number of overlapping adaptation strategies (Table 6.3). While each of the alternate futures presents challenges, all participant groups deemed that the community would be most able to respond to the pressures outlined in the *Small Town* scenario. Since the predicted changes generally consist of slightly more pronounced versions of currently experienced trends, residents recognize their past and current ability to cope and adapt. They are fairly confident in their ability to adjust as necessary to

further intensification of these trends, while at the same time recognizing the value of planning to improve adaptation options and success.

Although the changes depicted in *Shifting Seasons* and *Boom Town* are more dramatic, the former – which relates more to environmental than human processes – is perceived to fall more consistently in line with the population's natural abilities to adapt. Under this climate change scenario, individuals feel fairly confident about their ability to respond, and in their identity as aboriginal people, as they have a purpose and place as stewards of the land.

On the other hand, many residents are apprehensive about the imminence of major resource development in their traditional territory. They are concerned about their lack of political control over decision-making related to development on their lands, and the limited nature of public consultations, but indicate that this control is improving through the ongoing ATG and NWTMN negotiations. Aboriginal rights in the north and elsewhere are increasingly being recognized and respected, giving First Nations more influence over how and if development should proceed on their lands, and in negotiating IBAs with resource companies to compensate for social-environmental costs (Sosa & Keenan, 2001). Although concerned about potential challenges, participants recognize that they are, in relative terms, better prepared to deal with development than in the 1960s when Pine Point first opened. As a group, residents now have more education, improved ability to succeed in the modern system, and increased awareness of the consequences of development.

6.2.1 Adaptation strategies and adaptive capacity

Once designated by participants, the areas of impact and vulnerability discussed above were addressed individually to generate discussion around strategies for adapting outright and for building adaptive capacity. Local stakeholders have substantial awareness regarding their needs and priorities in a changing world (Table 6.3).

Upon comparison of climate change and resource development scenarios, specific types of strategies were emphasized by participants in some cases. In dealing with pressures associated with climate change, land use activities, planning and management, and reconnecting with culture were highlighted. On the other hand, the improvement and development of local education and training opportunities and political leadership were accentuated as necessary for adapting to and benefiting from nearby resource development. This reflects the perception that climate change has more serious impacts on the biophysical environment and cultural connection to the land and place-based identity, while resource development often results in more prevalent social (as well as local environmental) concerns. The emphasis placed on economic ventures, development of infrastructure and services, and social and health related strategies was more comparable between scenarios.

Table 6.3: Complete list of adaptation strategies noted by scenario participants

Theme	Small Town	Shifting Seasons	Boom Town
Environmental planning and management	• Environmental monitoring: water, vegetation, fish, wildlife health and numbers, air quality, ice conditions	• Environmental monitoring: water, vegetation, fish, wildlife health and numbers, air quality, ice conditions • Incorporate new technology for monitoring • Maintain confidentiality of animal numbers and locations to discourage outsider use • Community food program – farming or raising traditional animals to reduce need for market food • Build a water plant inland to improve quality	• Determine monitoring programs for proposed developments • Determine environmental thresholds for development • Monitor land use by outsiders
Land use	• Shifting harvesting practices • Increased gas use	• Shifting land use practices • Land user preparedness to mitigate impacts of extreme weather • Use of new travel and harvesting methods	• Shifting travel practices
Social and health issues	• Draw on place-based identity as a social asset	• Individuals habits shift to protect against sun and heat • Research environment-human health links	• Local involvement in development planning • Ensure equal access to benefits • Highlight role models living clean and healthy lives; develop programming
Financial	• *(None indicated)*	• Invest existing IBA money for cultural development • Leverage money to start tourism businesses • Charge outsiders for land use to generate income • Seek new economic opportunities	• Take advantage of new economic ventures • Long-term community investment with development money
Politics and leadership	• Consistent meetings among three councils and with community members to ensure that people are informed and working together	• Development of long-term community plan • Emergency preparedness planning • Leverage funding and provide training opportunities	• Development of long-term community plan • Funding for local skills training • Demand fair and effective community consultation • Negotiate mitigation and reclamation plans • Ensure that all sub-groups in community and region are represented in consultation • Assert rights and develop IBAs, including local employment benefits • Draw on previous experience with Pine Point

Table 6.3 continued

Theme	Small Town	Shifting Seasons	Boom Town
Infrastructure and services	• *(None indicated)*	• Improve health centre size, capacity, services, and ability to deal with disease • Provision for air conditioning in summer • Increase social service support (number of workers) and capacity (training) • Increase infrastructure and services offered • Assessment of climate change impacts on infrastructure • Travel safety registry with RCMP	• Increase and improve infrastructure to service population influx • Increase entertainment services • Develop community wellness resource centre • Develop youth club
Culture	• Document stories from the past • Cultural development through experiential learning	• Community hunts • Cultural development through experiential learning • Traditional medicines list and workshop • Community cultural events • TK transfer to youth	• Cultural leave from work • Draw on traditional values • Apply resource development funds to cultural development
Information and training	• Environmental change education for adults and youth	• Environmental change education for adults and youth • Build awareness about environment-human health links and climate change impacts • Cultural education • Develop traditional medicine list and workshops • Develop and promote safety strategies • First aid training for all community members • Equipment training courses for adults • Local technical training for resource development jobs	• Education about impacts of resource development and environmental change • Leadership education about environmental change impacts, adaptation and planning • Education on governance to increase social cohesion and reduce nepotism • Build research partnerships • Engage external resource people and tools for business start-up training, health training • Local technical training for resource development jobs • Construction training and tools • Training in service industry • Training for reviewing, assessing and responding to environmental documents • Health education about lifestyle choices and links to disease, youth pregnancy • Encourage youth to take advantage of education and training opportunities

While responses for the Small Town scenario were limited, participants shared many ideas about adaptation strategies for both Shifting Seasons and Boom Town. This may be because it is easier to conceptualize the more dramatic scenarios and discuss responses directly related to a specific variable of change (either climate or resource development). Regardless, participants highlighted the following strategies for Small Town: environmental monitoring, individual changes in land use, cultural development, drawing on linked identities, strong leadership, and awareness-building.

Participants responded to Shifting Seasons with a broader range of options. In addition to the strategies previously noted for Small Town, they supported the use of new technologies to improve monitoring and land use, and suggested alternate food production methods (e.g. farming and animal husbandry). The need for more targeted research on human-environment links was noted, as was the need for improved health and social services to deal with changing patterns. Economic diversification was recognized as important, including the flexibility to take advantage of new opportunities such as tourism. Local infrastructure was noted as an issue of concern, requiring an assessment of potential climate change impacts and modernization where possible. From a social and political perspective, community consultation and involvement in both long-term community planning and emergency preparedness planning was deemed important. Local governments should also be involved in providing job training for industry and service sectors to offset potential reductions in economic generation from land use. Furthermore, education about environmental change, the transfer of TK about the land, and training in safety strategies (e.g. travel route planning, hauling extra materials) and

the use of safety equipment (e.g. GPS, satellite phone, mapping) were highlighted as important adaptations.

While the Boom Town scenario prompted many similar responses to those previously noted, it also elicited a number that were directly applicable to dealing with development companies and the outcomes of resource projects on their territory. Targeted monitoring and determination of environmental thresholds were deemed important for achieving a balanced development-conservation strategy. The need for strong leadership at the local level is particularly clear under this scenario; residents suggested governance and leadership training as beneficial endeavours. Locals stressed the importance of negotiating IBAs that benefit the entire community, as well as environmental mitigation and reclamation plans that are implemented from the beginning of the project. An influx of people could provide opportunities for new economic ventures, which require skills training as well as improved community infrastructure and services. To respond to the perceived likelihood of increased social and health pressures, locals highlighted the need for health education and improved health and social services. Supporting youth education and development was also deemed very important, as this group is set to be most impacted (whether positively or negatively) from development. Participants also noted that traditional values (e.g. honesty, hard work, caring, sharing, using resources wisely) are still very relevant to working within a resource development scenario.

While some of the above-mentioned adaptation options are specific to individual drivers of change, others are more generic. The most prevalent adaptation responses

discussed during the scenario interviews, focus groups, and workshop are summarized by sector in Table 6.4, effectively offering a first step towards prioritization of available adaptation options. The responses outlined here were selected based on the level of stakeholder support received, and their universal applicability to different possible future scenarios. Although each will provide differential benefits depending on which type of future conditions emerge, their broad applicability makes them key candidates for pinpointing 'win-win' or 'no regrets' measures (Handmer, 2003; Ford et al., 2007) that provide a net benefit – whether economic, environmental or social – regardless of the level or type of social-ecological change that occurs (de Loë et al., 2001).

Table 6.4: Primary adaptation options differentiated by sector[26]

Sector	Option
Environment and natural resources	• Modification of harvesting practices • Environmental monitoring program • Environmental health research
Economy	• Economic diversification • Investment in community development
Community management and development	• Community visioning and planning • Emergency planning • Improve community consultation • Industry partnerships and agreements
Infrastructure and services	• Assessment of climate change impacts on community infrastructure • Infrastructure planning for population flux • Improve health infrastructure and services • Improve social service support and programs • Develop youth club and programming
Information and training	• Environmental change awareness-building • Cultural education and development • Land use safety training • Employment training

The most commonly cited adaptation options respond to impacts in five sectors: environment and natural resources, economy, community management and development,

[26] The sectors generally parallel the themes in Table 6.3, although several have been combined here.

infrastructure and services, and information and training. These are discussed in greater detail below.

6.2.1.1 Environment and natural resources

Individually, land users continue the autonomous process of modifying harvesting practices and travel methods to adapt to changing conditions. The overall reduction in traditional food use has been compensated for at the household level through grocery purchases and intra-community sharing, trading and purchase. Food security issues related to reduced harvesting success and lack of access to hunters and gear could be further mitigated through the re-establishment of traditional community hunts, subsidized by the local government. Currently, DKFN offers $100 per caribou (to a maximum of five per person per season) to each hunter for distribution to community residents. While this method does provide traditional food to those who need it, it reinforces the commoditization of wild meat. Locals noted that altering this program to encourage planned group hunts offers the additional benefit of a forum for hunters to re-connect with each other and with the land.

There was almost unanimous consent that the major current and predicted environmental impacts in Akaitcho Territory reflect the crucial need for a comprehensive environmental monitoring program to maintain up-to-date knowledge on the quality and quantity of fish, wildlife, vegetation, water, ice, and air. Satellite imagery technology is a potentially useful tool for monitoring wildlife populations, increasing hunt efficiency, and

improving travel safety during freeze-up and break-up seasons. Implementation of such efforts clearly requires targeted capacity-building, and leadership by local government organizations.

Participants also noted the necessity of taking care of the land, both at individual and community levels, by balancing development with conservation. Research is needed to determine a threshold for development based on the ecological capacity to absorb changes while sustaining natural systems, and implement a long-term land use strategy explicitly designed to sustain multiple uses. Furthermore, it is important to implement a system to monitor land use by outsiders, especially during the summer season.

The strong level of connection between environmental and human health was consistently noted by stakeholders. Research and awareness-building about environment-health linkages was deemed essential, with particular focus on location-specific issues (e.g. environmental links to cancer and asthma in the local context).

6.2.1.2 Economy

Livelihood diversification is an important adaptation option that can help to improve community sustainability (Scoones, 1998). Fort Resolution residents already have substantial experience with adapting in this way at the individual and household level, often seeking alternate ways to make a living to compensate for reduced return from the land. These autonomous adaptations will continue as conditions shift; however,

the likelihood of such responses depends on the opportunities available at community and regional levels. Having experienced several periods of employment peaks and valleys (including the current one), residents recognize the role to be played by the local government to stimulate new opportunities.

To increase economic benefits from a possible boom, residents may be able to take advantage of possible spin-off opportunities. Several ventures identified by participants can draw on local talents. These include lumber grading, wood finishing, and the production of specialized items (e.g. timber mats for exploration). Other suggested possibilities include modular home construction, manufacturing, or the development of a local casino. Many participants proposed that income generated by development and spin-off businesses be invested in a balanced way for long-term improvements in quality of life (e.g. employment-related training, interest generation, and some pay-outs to individuals).

It is broadly perceived that local governments must take the lead in leveraging funds from the federal government and other agencies, and through other initiatives to implement a range of adaptation measures. For example, the need for funds to implement cultural and environmental programs was recognized; suggestions included investing IBA money or levying fees for land use by outsiders.

6.2.1.3 Community management and development

Participants stressed the need for strong leadership in dealing with change, as well as the need for leadership groups to work collaboratively with each other and the rest of the citizenry. One focus group outlined the following four principles as important for local leadership: consistency, communication, transparency and cohesion. Community members noted the importance of their involvement and consultation regarding decisions that concern them. They also called for increased transparency regarding local government affairs enacted through consistent meetings between the governing councils and community members. They stressed the need for First Nations and Métis leaders to work together, initially by scheduling regular meetings. Both of these actions would also act to improve social cohesion within the community, as people recognize the benefit of joining forces to respond to the impacts of environmental change.

Many environmental and other community decisions are made *ad hoc* as policy tends to shift along with changes in leadership, limiting its engagement in short- and long-term planning (Norn, 2006, pers. comm.; Odeen, 2006, pers. comm.). Workshop participants indicated that a collaboratively developed local vision (on environment, social development, health, etc.) should be prioritized. This could provide the context for an adaptive community plan that outlasts periodic leadership changes. As a complementary component, local leadership should engage in emergency planning to prepare for unexpected or extreme events (e.g. major flooding, water contamination, human health pandemics).

Fort Resolution Band members noted that past negotiations with development companies working in and around Akaitcho Territory have been undertaken with individual communities within the territory, rather than all of them. This type of approach creates conflict and animosity among residents both within and between communities in the region. Local governments must play a key role in advocating for fair and inclusive community consultation, to negotiate with development companies to ensure local employment, and to request proper mitigation and reclamation plans for development (e.g. through green design and high environmental standards).

6.2.1.4 Infrastructure and services

Locals indicated that community infrastructure and design are based on past conditions, with no planning for how the community and its needs might change in the future (Norn, 2006, pers. comm.), leaving existing structures open to a range of potential vulnerabilities. Only recently has it been recognized that the rate of environmental – especially climate – change and its effects must be considered in designing new constructions and remodelling existing infrastructure in the north (ACIA, 2004). In Fort Resolution, participants identified the need for a broad assessment of climate change impacts on local infrastructure to ensure that all systems are able to sustain major weather events, and to enact remediation where necessary.

A further issue is the lack of infrastructure to deal with a potential population influx. Participants suggested a crucial community planning phase be implemented in the

near future to prepare for the broad impacts of possible development, with an important focus on the preparedness of local infrastructure and services. Infrastructure and service concerns centred on housing, sewage and water systems, waste management, and health and wellness. Participants noted the need for increased access to nurses, doctors, social workers and wellness counsellors. Other suggested infrastructure improvements include hotels, a gas bar, restaurants, a sports-plex, improved roads, and a larger airstrip.

Regardless, participants noted the negative social and spiritual effects of a *Boom Town* scenario, and suggest a focus on building culture and social cohesion, especially among the youth. One mechanism for providing entertainment while building autonomy and responsibility is the development of a youth centre where young people run their own meetings and programs (e.g. dances, bake sales, etc.). Many people noted that this would go a long way towards reducing youth delinquency and empowering the leaders of tomorrow.

6.2.1.5 Information and training

There is a strongly recognized need for knowledge and information for successful adaptation, albeit different types of knowledge bases are more useful under different scenarios. Awareness-building about the impacts of change is essential to motivate local action. At the community level, participants suggest more inclusive meetings with local leadership and increased use of external resource people to organize and facilitate educational workshops.

Participants also recognize the value of cultural education for improving connectedness to the land and maintaining the transfer of TK, which provides individual and collective capacity to alter behaviours and activities in response to changing environmental conditions. They suggest teaching through hands-on experience and documenting traditional stories and knowledge for future generations. Since a large number of noted impacts relate to the environment, traditional culture or land use, it is imperative to draw on the knowledge of the many people who still use and hold detailed knowledge about the land. On-the-land education should be encouraged, both in the school system and through local government, to ensure the transfer of knowledge about changing conditions, and promote personal awareness when people travel.

Community members recognize the need to build local capacity to take full advantage of employment opportunities offered by potential development. To ensure equitable distribution of benefits, training must be made uniformly available to both males and females from different family groups, requiring standardized allocation policies within local organizations. For individuals, especially youth, to be equipped to deal with life in the modern world, they should be encouraged to take advantage of education and training opportunities in a range of sectors. Leaders from local government organizations, Deninu School and Aurora College are best positioned to work together with community members – particularly parents – to get this message out. The local government may also leverage available funds to provide training in areas such as: equipment operation, carpentry, drilling, welding, logging, water treatment, tourism and recreation, nursing, and office work.

Education is also seen as essential on the governance front as there is a lack of people with the knowledge and skills to govern effectively (Boucher, 2006b, pers. comm.). Specific needs to improve local government capacity include more trained personnel and paid positions to evaluate environmental documentation such as project reports and land use proposals, and advise Chief and Council on land use decisions, and to create environmental action plans. In addition, targeted education about effective and accountable governance would help to reduce nepotism and improve social cohesion. It would be useful for local organizations to work with external facilitators to determine the most effective strategies for achieving these aims.

6.2.2 Actor roles

Since adaptations are undertaken in different forms at different spatial scales (Smithers & Smit, 1997), they require a range of actors (e.g. individuals and communities, public agencies, private industry, NGOs) to take responsibility for implementation (Smit et al., 2000). In considering adaptation options for a community like Fort Resolution, it is important to distinguish the roles of different stakeholders to provide a more realistic picture of how implementation would proceed (Smit & Skinner, 2002).

Here, the two autonomous adaptations identified by stakeholders – household level modification of harvesting and travel practices, and livelihood diversification – are carried out by individuals, whereas all other responses require some level of joint action.

Participants identified local government organizations, including DKFN, Métis Local and DCC, and their sub-committees as the most essential actors in planning for change and managing non-autonomous adaptations. Territorial and federal governments were noted as playing a crucial role in providing funding for research and adaptation. The regional governance organizations, Akaitcho Territory and the Dene Nation, were also identified as important for building linkages between communities and advocating for local concerns at the regional level.

Participants noted that at the local level, the First Nations, Métis and Municipal development corporations and other organizations such as the school, social services, and community wellness programs should be included in the process, and make concrete contributions where possible. Although many suggested adaptation measures require substantial community support, the Fort Resolution membership was only mentioned once as an important entity for community planning. At the regional level, NGOs such as the Dene Cultural Institute (Yamózha Kúé Society) and the Native Women's Association may also be drawn on for support.

This discussion of actor responsibilities recognizes two important notions. First, the state of community vulnerability and potential for implementation of adaptation processes are highly dependent on current local conditions, and how these have developed over time (Brooks et al., 2005). Adaptation responses require bottom-up action driven by local actors. Several informants reiterated Simon's (2006, pers. comm.) comment about the need to 'do it ourselves' to build successful solutions from within the

community, rather than having processes imposed from the outside. One focus group noted that achieving this end requires recognition of the role of family loyalty in shaping local government and decision-making. Second, local actors cannot succeed in implementing adaptation options for communal benefit in isolation; they require support from higher level organizations. This underlines the notion that cross-scale relationships are crucial for implementing an effective range of adaptation measures (Berkes et al., 2005a), a concept that will be expanded upon in Chapter 7.

6.2.3 Adaptation planning challenges

Despite the above range of suggested adaptation strategies, the general consensus among Fort Resolution leaders and residents is that the community is currently under-prepared on a variety of levels to deal effectively with rapid environmental change (Norn 2006; Simon 2006), and that individuals often do not understand the potential consequences of change (Boucher 2006). Furthermore, community members may expect discussions and actions to be taken quickly, not having a clear understanding of the political process and the resource and time requirements to accomplish objectives. Interestingly, discussion centred more around direct impacts on the natural and human environments, with little focus on financial and infrastructure issues, whereas these aspects featured more prominently in the discussion on potential adaptations. Recognition of the direct effects of change on livelihood dimensions exists, but awareness about indirect impacts appears to be lacking. (This may also be, in part, a consequence of the types of representative symbols that were presented in the scenario graphics, as it is

difficult to represent more abstract concepts like social dynamics or economic relationships.)

Locals noted that traditional land use and cultural practices will be challenged under all scenarios, and current harvesters will suffer the most negative impacts. Furthermore, specific community sub-groups (e.g. residents from Rocher River, traditional land users, single mothers on welfare) are likely to be further marginalized when faced with changing conditions, specifically those who are poor, supplement their income with traditional food, have limited training, and/or experience barriers to employment and resource access. These groups will be faced with more pronounced impediments if land resources are limited or if they are unable to compete for new industry jobs.

The impacts of change are felt at different intensities by different age groups. Elders are not able to adapt their ways of living as quickly as younger people who have a broader knowledge base. This sentiment is captured in the environmental change book title that quotes an Inuit Elder as saying "The earth is faster now" (Krupnik & Jolly, 2002). Participants felt that today's youth would likely be most able to engage with and benefit (in non-traditional ways) from a *Boom Town* scenario as they are sufficiently flexible and exposed to western culture. However, a *Shifting Seasons* scenario would provide little for them to thrive on, especially since they lack proper skills and knowledge for land use and survival. In order to adapt as a community, residents have to deal with a number of specific challenges, each of which may be more or less applicable to each of

the individual scenarios of future change. Locally-recognized challenges were outlined during scenario discussions and governance interviews with local leaders (Table 6.5).

Social problems are prevalent in Fort Resolution, and perceived as likely to worsen under a *Boom Town* scenario. Worrisome increases in rates of property and violent crime – with violent crime incidents at 15-20 per 100 population annually – and dramatic increases in rates of juvenile crime over the past decade – now more than 90 male youth crimes per 100 population annually (Northwest Territories Bureau of Statistics, 2006, 2007) – indicate issues that run very deep within the social fabric. Individuals participating in crime, abuse, and the bootlegging of alcohol and drugs are inhibited from effective engagement in community life, and are essentially excluded from efforts to plan and implement long-term adaptive strategies. These and other factors, such as the continuing influence of the residential school system, government settlement policy, road access to nearby settlements, and the infiltration of western values, have limited community cohesion (see Chapter 5).

Table 6.5: Locally identified challenges to adaptation

Theme	Adaptation challenges
Social norms and relationships	• Inter-group tensions challenge development of a common vision • Under-representation and marginalization of sub-groups • Residential school impacts • Lack of support for local leaders • Alcohol and drug use limits community participation • Payment of honoraria for community meetings – drains financial resources and does little to encourage active participation
Attitudes and values	• Perception that elder knowledge and perspective has limited applicability in modern times • Difficult for locals to 'think outside the box' • Belief that social relationships are not going to improve, limiting individual and collective investment in community development
Human resources	• Rapid turnover of personnel • Excessive demands on employees • 'Brain drain' of individuals who leave town to get educated and do not return • Lack of literacy in communities and the use of technical terminology by outsiders are barriers to increasing awareness and understanding of climate change, potential consequences, and related issues • Youth lack survival skills for land use
Politics and leadership	• Limited planning for anything except renewable resources • Local political organizations work independently • Local organizations have different rules and priorities • Lack of strong, representative leadership willing to make difficult decisions for long-term benefit • Lack of long-term planning by local leadership; no vision statements made on environment, society, health, how to deal with future change • Leaders lack knowledge and experience for effective decision-making • Local governments often do not function effectively • Lack of planning to take advantage of new business opportunities (e.g. tourism) • Local organizations not held accountable for planning, developing functional relationships within and among AT communities • Local residents have limited input into land-use decision-making • Lack of fair and effective community consultation by industry
Regulations	• Constraints on First Nation land ownership restrict community development • Difficult to obtain local business approvals • Criminal records limit employment opportunities
Financial resources	• Lack of long-term funding to implement capacity-building • Existing financial resources spent at both local and territorial management levels; little left for implementation • Federal funds allocated per capita, disadvantaging small communities • Lack of capacity and funds for viable business start-up and maintenance
Infrastructure and services	• Current infrastructure based on the past; lack of planning for change • Inadequate infrastructure • Limited health personnel and services

A related theme that surfaced repeatedly is that of local attitude. Participants noted the prevalent belief that 'nothing will ever change' in terms of local social

dynamics, which perpetuates disengagement in community development. Participation rates are limited by lack of incentive, lack of trust in leadership, strained social relationships between residents (as there is significant overlap between the political and the personal), superior opportunities elsewhere, and other individual and collective priorities. There is also a prevailing belief among participants that residents generally find it difficult to 'think outside the box', not recognizing how the experience of rapid change requires a different kind of thinking. Some participants also noted that elder knowledge is not always applicable to current day situations, leading to decreased interest in and valuation of such knowledge. These beliefs, and the underlying trends they depict, present key limitations to creating the necessary enabling context that encourages experimentation and collaborative learning to improve adaptation.

Human resources are also severely limited. Literacy rates are generally low, further fuelled by a generation gap in formal education, and a lower than 50% high school completion rate (Northwest Territories Bureau of Statistics, 2007). Community 'brain drain' contributes to this problem, as graduates who leave Fort Resolution to further their education often do not return (Beaulieu, 2005b, pers. comm.).

At the local governance level, three main factors often inhibit capacity-building efforts: lack of long term funding, lack of continuity in personnel, and excessive demands on employees (Grieve, 2004). The interplay among these elements is captured here by a local government employee:

We don't have the capacity to keep up with it. ... We're under-resourced financially, so we can't afford to hire the human resources to do the work. ... At the First Nation level, you know, we're very under-resourced, and we're expected within timeframes to respond to certain projects in terms of environmental impacts, social impacts, economic impacts, impacts on rights, etc. ... You know, we're slowly making some progress. ... We're treading water, but we're two inches under; we're still drowning. 'Cause every time we're just getting a step up in terms of preparing ourselves for certain things, all of a sudden there's a new wave of diamond mines, and a big pipeline coming down the Mackenzie Valley, big social issues impacting on our lake because of pulp mills and development projects in Alberta. It's just ongoing. It's going to continue. (Balsillie, 2006, pers. comm.)

Local organizations also face an employment paradox. Despite their mandates to hire locally, they often struggle with an insufficiently skilled pool of workers, while having to compete with the higher wages offered by private industry elsewhere in the territory. This difficulty with adequately filling and then retaining workers with sufficient skills often results in important positions (e.g. Chief) being left open indefinitely, and leads to continuous turnover within the organization. Furthermore, due in part to culture and to the small size of the community and territory, much work is carried out through personal contacts rather than through formal channels. In this context, losing one employee has a major impact on institutional memory and operations. This is heightened by the lack of consistency in how operations are undertaken (e.g. documenting how things are done, which contacts are important, and the current mandate of each position).

The lack of focus on long-term community planning was repeatedly mentioned as a barrier to responding to changes in all scenarios. Comprehensive, collaboratively-developed vision statements in sectors such as environment, society, and health would improve resource streamlining to help meet identified targets. The current system leaves four local corporations vying for the same financial resources to undertake small, one-off

projects, while access to multiple pots of money from different regional and national governments and organizations permits activity overlap between councils. For example, both DKFN and Métis Local employ their own members to conduct water monitoring, and the lack of a centralized database and mutual agreements that address collaboration results in a dearth of information sharing between organizations. Local governance organizations would benefit greatly from the development of institutional plans to limit the high energy inputs needed for dealing with all new items on a case by case basis. Currently, there is a general paucity of protocols, templates and policies to guide decision-making at both political and operational levels. On the economic side, new business opportunities initiated by the local development corporations (e.g. logging operations) are also attempted *ad hoc* and often lack the support structure to succeed over the long term. Overall, many residents feel neither equally represented nor supported by the current local leadership, which is perceived as disjointed, weak and lacking accountability.

These trends are enhanced by the structure of the existing funding system, perceived by local leaders to limit long-term commitment to programs and planning. First, federal funds are allocated per capita, which naturally disadvantages small communities (Sayine, 2006, pers. comm.) that benefit little from economies of scale. Furthermore, as a consequence of devolution of responsibilities from federal to territorial governments, aboriginal treaty money is filtered through the GNWT (Sayine, 2006, pers. comm.), where much of it is used to 'feed the bureaucracy' rather than helping small communities (Boucher, 2006b, pers. comm.).

Various external regulations also act as barriers, including constraints on First Nation land ownership and criminal record stipulations regarding employment, limiting individual options and initiatives. Local residents also feel that development companies fail to conduct proper consultations and often ignore community concerns. This combined with other regulations limits community input into decision-making about land use, and about environmental management more broadly.

Another issue that emerged repeatedly was that of infrastructure preparedness. Current infrastructure is based on past conditions, and future community growth could be limited by inadequate planning for sewage and water systems. Limited local health services were also deemed a concern. Residents are increasingly worried about high rates of cancer, asthma and diabetes, among others (Beaulieu, 2005b, pers. comm.), as well as potential contaminant impacts from renewed mining in the area.

6.2.4 Adaptation strategies and barriers

The types of adaptation barriers highlighted above are diverse, indicating that multiple efforts are required to be able to overcome them and strengthen different elements of the community's adaptive capacity. While most of the adaptation barriers noted here are focussed at the local level, there are several further challenges at higher levels of organization that were not specifically noted by focus group members. These became apparent through discussions with regionally-involved employees in aspects of

resource management, and through other informal interactions. The influence of institutions at multiple scales on local adaptive capacity will be discussed in Chapter 7.

The adaptation strategies discussed by local participants and outlined above basically amount to a list of desired outcomes. While these have not been evaluated for feasibility or cost, they provide an initial step towards the prioritization of actions based on community needs and interests to improve local-level adaptation.

In evaluating potential adaptation strategies and barriers, an interesting distinction emerges. While the majority of the proposed adaptation strategies appear to be more explicitly technical in nature, a substantial proportion of the challenges relate to social, cultural, behavioural or cognitive issues. This contrast is somewhat misleading, however, because in the context of a small, relatively isolated, culturally-linked First Nations community, implementing many of these strategies necessarily relies on functional social relationships both within local governance organizations and between the representatives and the people they represent. This is especially true in the case of long-term program development. It is much easier to plan and carry out a one-time event such as a community workshop or culture camp; however, programs that require sustained commitment, such as environmental monitoring, community planning or cultural development require a much higher level of input and support from community members. Furthermore, the successful implementation of such long-term endeavours may require targeted local capacity-building and/or linkages with external resources (e.g. developing existing and new research partnerships). It is clear that, while technical fixes play an

important role, effective adaptation requires much more than simple injections of funds or resources. Rather, it also hinges on the willingness and ability of actors at different levels to engage in the effort with some level of collectivity and commitment.

6.3 Summary

The previous two chapters (4 and 5) have set the social-environmental context for moving forward with adaptation in Fort Resolution. This chapter builds on that foundation by identifying some of the key areas of individual and collective vulnerability to the impacts of potential future changes driven by climate and resource development. Participants recognized that each scenario of potential future change brings a combination of positive and negative impacts, thus it is essential to remain flexible and open to taking advantage of new opportunities created by changing conditions. Land use planning and management, and cultural revival were deemed especially important for preparing for and responding to climate-induced changes, whereas the need for political leadership, training and education were more prominent in the resource development scenario. However, while residents generally felt more able to adapt to climate-driven changes than those created by significant resource development, there appears to be substantial overlap in the types of adaptation strategies proposed under multiple sectors, including environment and natural resources, finance, community management and development, infrastructure and services, and information and training. Some of these could be readily implemented as 'no regrets' measures to reduce vulnerability under a range of conditions. In order to do so, however, it is necessary to recognize and mitigate a

number of both technical and socio-behavioural barriers to adaptation. The next chapter will build on this and previous chapters to discuss the feasibility of achieving adaptation in the current institutional context.

CHAPTER 7: BUILDING ADAPTIVE CAPACITY IN A MULTI-LEVEL CONTEXT

We're all the same people here, and we gotta work together. ... Whatever comes up into this community, [we should] work on it as one group of people. We could succeed at more programs ... there'd be more opportunities for the whole community, rather [than] the community being split and [some of us] being [close to the] poverty line. ... We could be sitting good, living good. ... I don't like discrimination. I'd like to get rid of it from this community, and you'll see the people as one. One voice, one people. (Delorme, 2005, pers. comm.)

The preceding chapters have provided substantive data and analytical discussion focusing on concepts related to environmental change, its impacts on society and human adaptations in the Canadian Subarctic, based on a case study in Fort Resolution, NWT. The three main areas addressed – historical environmental trends, social dimensions of adaptive capacity, and planning for future change – are informative as individual subsets; however, deeper insights emerge when they are considered together as pieces of an interconnected system that links social with ecological phenomena. This chapter aims to bring forward and synthesize important findings on cross-cutting themes generated by the study. These are presented in two sections. The first section examines the roles played by actors and institutions at multiple levels of organization in building adaptive capacity and supporting adaptation within a context of transition and uncertainty. The second section discusses implications for strengthening adaptive capacity in northern social-ecological systems. While the issues addressed here are most relevant to small, northern, aboriginal communities, they may also apply in whole or in part to other aboriginal and community-based contexts.

7.1 Actors and Institutions in a Transitional Context

Adaptive capacity must be assessed within the context of broader community objectives of improving human well-being and sustainability of the social-ecological system. While inputs of a technical nature may be important, especially in ensuring short-term coping capacity, this study indicates that the nature and dynamics of the underlying social and institutional structure must be addressed to ensure that improvements are sustainable over the long term (see Chapters 5 and 6).

It is clear from this study that groups within the community are differentially vulnerable to change, due to specific factors that increase exposure-sensitivity or constrain adaptive capacity. Beyond the local level, it is also important to address the role that institutions and organizations at multiple scales play in either facilitating or inhibiting adaptation (Armitage, 2007). This section will explore some implications from the study for a range of actors at the local scale. It then considers important dimensions of the cross-scale institutional context for environmental planning and management, taking into account its transitional nature.

7.1.1 Influence of demographic characteristics and affiliations on adaptive capacity

The literature cites a relationship between demographic variables such as age, gender, ethnicity, educational attainment, and health, and the ability to cope with risk (Smit et al., 2001). Results from previous chapters indicate that adaptive capacity at

individual and household levels in Fort Resolution is influenced by a number of demographic characteristics and affiliations. These features affect individuals' social status and relationships, their access to money, resources and job opportunities, and their influence on local priorities and decision-making. They also play a role in whether or not individuals perceive a problem, how they conceptualize the problem and related challenges, and their attitude regarding whether they are willing and/or able to take responsive action. For example, many people in Fort Resolution recognize that environmental change is occurring and threatens their way of life, yet it remains secondary to more immediate issues (e.g. social and economic challenges). Residents may not fully recognize the consequences, and many do not believe that their own actions can help to mitigate the impacts.

In considering prospects for adaptation, it is important for stakeholders to recognize both the available community assets to build on, and the differences among groups that affect some members' ability to access resources, which are often inequitably brokered and distributed (Foley & Edwards, 1999). It is important to understand underlying dimensions in order to better identify and build on existing assets through the use of targeted activities and programs. Based on the findings of the previous three chapters, the following characteristics and affiliations were identified as particularly important: legal identity (e.g. Dene, Métis, Other), family and location of origin, age, gender, education level, individual well-being, and economic and social status.

Legal identity: The Dene and Métis live under different regulations in Fort Resolution (see Section 5.1), affecting their social status and access to both local and extra-local funding and training. The Métis Local is at a financial disadvantage as it does not receive core funding comparable to that of DKFN. Furthermore, DKFN may have superior access to specific program funds for activities like training and education, and currently receives IBA money for each member. Beyond this, non-treaty people are excluded from taking advantage of some employment opportunities. Considering DKFN's larger population base, consistent funding, and its position as the predecessor of a future self-government body, it is *de facto* the primary governance structure at the local level. For this reason, the Métis feel underrepresented and politically marginalized, while considering themselves as the true founders of the settlement. This issue of differential legal identity is not emphasized in the literature and may require more research attention.

Family and location of origin: Family affiliation influences social status, the size of kinship networks and affiliations, and relative political and social power. Family members and close friends of the larger family *power bases* benefit from political influence and increased access to resources and jobs. More specifically, residents from Rocher River tend to feel socially marginalized and politically underrepresented. Although several have worked to move into higher-level positions within the local government structures and through other wage-based opportunities, many have limited financial means to adapt their practices or purchase substitute food items.

Age: Through social transformation, elders now play a reduced role in the family structure compared to the past, as society has shifted away from traditional living arrangements and relationships. Furthermore, communication with others (community members and outsiders), especially youth, may be hindered by the limited English language skills of elders. Despite their inclusion in community meetings and consultation sessions, elders feel that their advice is not always heeded as it was in the past. There is a general feeling among many of the younger residents that elder concerns and ideas are often outdated. There is some disparity between the elders' vision for the future, which is based around traditional use and stewardship of the land, and that of many individuals in leadership positions who perceive the need for pursuing economic development opportunities. Elder and traditional land user concerns are most closely aligned, but it is those individuals in political decision-making positions who have the power to take action. Some young adults, too, feel that their interests are not well represented.

Younger and middle-aged adults tend to be more engaged in community building work than elders (Chapter 5). This more apparent willingness to engage of those below the age of 56 provides opportunities to promote voluntary participation among this group. On the other hand, it is also important to recognize and address the fact that elders may feel marginalized and lack mechanisms for engagement. Providing opportunities for elders to share their knowledge and skills and encouraging their participation in community building activities should facilitate knowledge transfer, while improving the way in which they are valued.

Gender: The survey analysis highlighted some differences between genders regarding levels of trust, the nature of participation in community groups, and linkages to other communities. Differences also emerged in the perceived community suitability for child rearing and perceptions of environmental quality, where men had a more positive perspective in both cases. These and other important differences not captured by this study may have significant influence on capacity-building, suggesting the need to target activities and programs to engage a range of groups.

Education level: Respondents with higher formal education levels tend to be more engaged in volunteer work, have a higher level of trust in governance organizations, and have more contact with outside communities. This is consistent with findings that people in dominant social positions are generally satisfied with their lives and thus, on the whole more trusting (Wakefield & Poland, 2005). Such people are likely able to play a linking role between the local community and external institutions to access resources for adaptation activities at the local scale.

Individual well-being: One's state of individual well-being helps to shape adaptability, a notion that is not emphasized in the literature. An individual's state of substance use, spirituality, physical health, and emotional health affect personal abilities and motivation. The personal levels of motivation of those who have taken steps to eliminate addictions tend to translate into an improved sense of self and increased economic prospects. For example, several community members indicated that the money they saved once they became sober has allowed them to buy a boat (among other things),

so that they now spend time reconnecting with the land. This has numerous physical as well as spiritual and emotional benefits. This notion indicates that personal healing may play an important role in strengthening adaptive capacity.

Economic and social status: Notions of social capital recognize the link with other forms of capital, especially economic (Mignone & O'Neil, 2005; Wakefield et al., 2007). Those with more resources are more able to leverage capital to attain (not necessarily communal) objectives, which may work to exclude others from participating. The elite have a higher ability to move between groups and spend limited energy in accruing more social capital, further perpetuating the exclusionary cycle. Marginalized groups may be less likely to participate due to resource barriers (e.g. limited capital resources, levels of education and training, and social prejudices), as a response to previous exclusion, or due to self-perceived limitations on potential life opportunities (Wakefield & Poland, 2005). In Fort Resolution, although most residents feel that linkages between them and decision-makers are short, those who are socially and economically marginalized feel that their voices are less often heeded than those of other groups. Furthermore, other residents who are involved in marginalized activities such as drug use wilfully remain disengaged from community life. The persistence of such activities limits comprehensive engagement by the full range of community actors.

Each individual in Fort Resolution has a unique combination of affiliations to groups and social strata within the community. While residents are differentially exposed to impacts depending on their livelihood strategies, these affiliations, combined with

personal capabilities, influence the adaptive capacity of individuals and households to changing conditions. It is important to recognize which groups are being most severely impacted, and which groups have limited capacity to adapt due to barriers such as social marginalization. Understanding human agency is essential for effective adaptation assessment (Smit & Skinner, 2002). For residents in small communities like Fort Resolution, each individual identity feature or affiliation is linked to a certain level of vulnerability. Different combinations of the abovementioned factors play out in varied ways in terms of adaptation at individual and household levels. Box 1 and Box 2 provide an illustrative example of differing adaptive capacity between a Dene and a Métis household. Each narrative is modeled from a combination of two or three actual households in the community.

Box 1: Dene household
Household 1 consists of a family with middle-aged Dene parents and three school-aged children. The adult male is an avid land user with little formal education. The adult female has a full-time wage job at one of the local organizations. The female's steady wage allows the household to invest in a range of travel and harvesting equipment for different seasons (e.g. snowmobile, toboggan, truck, boat, boat trailer, ATV) which require capital inputs for purchase and continued maintenance. The male traps intensively throughout the winter in the Slave River Delta area, and hunts and fishes year-round. Financial flexibility and access to equipment allow him to participate in a range of harvesting events (e.g. group hunts by snowmobile for caribou (which can be sold to DKFN for distribution), intensive beaver and muskrat harvest by boat in spring, goose hunting by snowmobile or boat in spring, and moose hunting by truck or boat in fall). The household also has the flexibility to engage in other opportunities such as short-term contracts available through DKFN (e.g. guiding, research assistance, trail maintenance, and local forestry operations). These opportunities are also supported by strong family and friendship ties with members of the local government and other community organizations.

Box 2: Métis household
Household 2 consists of a family with middle-aged Métis parents and three school-aged children. The adult male is an avid land user with little formal education. The adult female is a homemaker, who intermittently works in short-term contract jobs. The male owns the necessary gear for trapping (e.g. snowmobile, toboggan, traps), purchased with the aid of harvester support programs and earnings. He traps intensively throughout the winter, and is able to make a small profit. However, the household has limited resources to spend time on the land in other seasons. The household resorts to lower cost activities such as fishing in Resolution Bay or at Little Buffalo River, or hunting in areas accessible to the highway to provide food for the family. They are able to sustain a living in a small rental unit, but have few luxuries. The cash-strapped Métis Local is unable to provide substantive assistance, and there are limited opportunities for extra contracts since most funding and opportunities are generated through DKFN (e.g. contracts with incoming researchers or resource companies; government programs).

Positive endowments of some of the abovementioned factors influence the choice of individual or household adaptation strategies. For example, a small number of individuals who are imaginative and dedicated entrepreneurs continue to realize substantial economic benefit in the increasingly money-driven work environment. These innovators (known as *r-strategists* to resilience theorists (Holling, 1995) or *early adopters* in the literature on technology transfer (e.g. Huang & Liu, 2008)) benefit by being flexible and creative, diversifying their activities, drawing heavily on TK, and maintaining a reliable social network through which to access opportunities and resources. In the current context, such skills adequately compensate for a lack of formal education and training, although the latter limits access to more formalized professional employment. While there may have been more room for innovator creativity as the social system reorganized after upheavals in the 1960s and early 1970s, a limited number of persistent individuals have actually become specialized in this livelihood strategy, developing a diverse and resilient enterprise portfolio. They have become known as the 'go-to guys' for any number of wide-ranging requests (e.g. tour guiding, research

assistance, provision of traditional food, manual labour, small business partnerships, and equipment rentals).

These innovators are also benefiting from the current political focus on both northern and aboriginal issues. As mentioned previously, a range of programs provide funding and training opportunities to build northern capacity and infrastructure. The limited-term nature of many of these funds (e.g. start-up funding for small businesses, or locally-administered contract-based activities such as water monitoring) benefits creative entrepreneurs with flexible schedules, while limiting their personal financial risk. Often, however, these programs benefit those who already have some level of financial, material, or social resources to draw on (e.g. Box 1: Dene household), further marginalizing and reducing the adaptive capacity of those who do not (e.g. Box 2: Métis household). For example, two extended family members who collectively own basic equipment and material joined forces to bid on a contract to provide short-term employee camp services (e.g. shelter, meals) to a mining company conducting exploratory work nearby. Regardless of supplemental start-up funds that they may have been able to access, their possession of needed material resources increased their competitiveness and the rapidity with which they were able to act. Existing resources can also provide collateral for up-front capital investments, which may otherwise be out of reach.

7.1.2 Endogenous determinants of adaptive capacity

Different combinations of the following features of communities and regions are recognized as strong determinants of adaptive capacity: economic wealth, technology, information, knowledge and skills, infrastructure, institutions, social capital or networks, and equity (Smit et al., 2001; Smit & Pilifosova, 2003; IPCC, 2007a). While these factors are all applicable and important in the case of Fort Resolution and other similar northern communities and situations, the crucial role played by social relationships in facilitating or hindering adaptation both at the household level and collectively through joint action has only received more recent recognition (Adger, 2003b, 2003a; Armitage, 2005; Pelling & High, 2005; Adger et al., 2007).

Analyses of past adaptations, existing social dynamics and perceived adaptation opportunities and constraints help to identify the determinants of adaptive capacity for the system under study. As in many small communities, there are multiple location-specific determinants that vary in space and time (Smit et al., 2001) and act to either constrain or enhance the ability of individuals, households and the community as a whole to adapt (Kelly & Adger, 2000). It is important to note that adaptive capacity depends not only on availability of resources, but also on whether they are accessible by group members at all social strata (including the marginalized and vulnerable; Kelly & Adger, 1999).

The primary endogenous determinants of adaptive capacity documented in Fort Resolution are summarized in Table 7.1. They include: (1) the ability to draw on diverse

knowledge and skills; (2) levels of access to specific resources (particularly financial) and new technology to enable travel on the land, improve travel safety, and increase economic options; (3) the extent to which local institutions (governance organizations and traditional customs) provide resources and support; (4) the nature of social networks in providing access to food, harvesting and economic opportunities; and (5) the extent to which individuals and households in Fort Resolution have equitable access to resources and jobs.

Table 7.1: Endogenous determinants of adaptive capacity in Fort Resolution

Determinant	Application
Knowledge and skills	• The transfer of TK to youth and its continued use improves livelihood choice, travel safety, harvesting flexibility and connection to culture and identity. • Western knowledge, skills and technology enable opportunities for training and career development in the wage economy, and improve the ability of individuals to connect with institutions and resources beyond the local level. • Drawing on both traditional and Western knowledge increases livelihood flexibility.
Access to resources and technology	• Land use increasingly requires capital input. • Technology improves harvesting flexibility and travel safety under uncertain conditions. • Money and resources facilitate involvement in new ventures.
Institutional support	• Local organizations provide access to resources and employment opportunities. • Traditional customs dictate that residents be willing to help others when needed.
Social networks	• Sharing of food and harvesting equipment between relatives and friends improves access for vulnerable populations. • Social networks increase flexibility to combine resources for new ventures.
Equity	• Inequitable access to resources and jobs increases social tension and divisions.

Determinants related to the community's operational context – knowledge and skills, access to resources and technology, and institutional support – are more evident due to their tangible nature. However, underlying community characteristics including social networks and the level of equity among residents also play a significant role in

shaping the capacity of individuals and households to adapt, and in influencing whether or not existing adaptive capacity remains latent or becomes engaged.

7.1.2.1 Knowledge and skills

The ability to draw on multiple sources of knowledge is recognized as important for building adaptive capacity. Furthermore, redundancy and diversity also tend to support adaptive capacity (Folke et al., 2003). These concepts are especially important for northern aboriginals who find themselves in transition between two ways of thinking and being. Developing methods for maintaining and effectively transferring traditional knowledge and skills within the community and broader Akaitcho Territory is key to ensuring that it evolves and remains a relevant and applicable source of information. At the same time, developing western knowledge and skills among both youth and adults promotes choice and opportunity.

The continued use, evolution and transfer of TK is important for ensuring that land users are able to respond to increased safety challenges due to changing climatic conditions, to preserve economic alternatives, and for cultural perpetuation. For example, knowledge of river currents and ice break up patterns allows for more effective risk assessment when travelling by snowmobile on the ice in spring, whereas a lack of knowledge about the nature of environmental variables combined with changing and uncertain conditions can pose major safety risks. Furthermore, knowledgeable land users

are better able to alter the timing and methods used for harvesting based on changing conditions.

At the same time, locals recognize the value of understanding scientific information, methods and ways of thinking, and of being able to effectively apply relevant tools. Scientific training also advances the potential for individuals to more critically evaluate environmental information from different sources, to better understand potential risks, and enables them a wider range of choice in selecting response strategies.

My grandmother insisted that we get an education ... if we wanted to be able to survive with the changes. ...Even then she knew that the changes were going to happen, and it was very important ...[for us] to learn whatever we could while we were in school. (Unka, 2005a, pers. comm.)

An education that incorporates western science and other disciplines improves individual choice regarding employment and livelihood strategies, more broadly. Such skills enable opportunities for training and career development in the wage economy, and improve the ability of individuals to connect with institutions and resources beyond the local level. For example, access to the Internet and knowledge about how to use it allows local business owners to market directly to potential visitors (e.g. those searching for accommodations, tour guiding, and local handiwork).

7.1.2.2 Access to resources and technology

Financial status has a significant influence on household vulnerability. Access to money increases the number and viability of possible adaptation options. Among other

things, personal wealth can be used to purchase substitute food when traditional food is unavailable, to buy durable equipment and fuel to improve travel capacity and safety on the land, and as base capital for new economic ventures (e.g. start-up tourism business).

The application of technology[27] is often proposed as critical for responding to the challenges of climate change. It is especially important for mitigation, but also plays a significant role in adaptation (Smit et al., 2001; Klein et al., 2006; Warren & Egginton, 2008). Financial resources and new technologies have been particularly important for individuals who travel and harvest on the land. With increased costs of machinery, gas and other materials, money has become more important for sustaining land use and acquiring traditional food. Safety technology such as GPS and satellite telephones are also becoming more important for travellers facing irregular environmental conditions, and require supplementary funds for purchase. Furthermore, changing environmental conditions affect the mode of travel during transition seasons, and harvesters that are best able to adapt are those that have access to, and can select from a range of travel equipment (e.g. boat, snowmobile, all-terrain vehicle (ATV)) based on current conditions.

[27] Distinctions are often made between hard and soft technologies, the former referring to physical products, while the latter refers to planning, practices, information and knowledge (Klein et al., 2006). *Technology* in this dissertation refers generally to hard technologies.

7.1.2.3 Institutional support

As Fort Resolution residents face many financial limitations, they rely to differing degrees on local institutional support. Examples include local governance organizations that allocate resources and jobs, and informal cultural norms that influence human interactions.

Local organizations like DKFN and to some degree the Métis Local offer members periodic access to specific resources (e.g. financial pay-outs from industry IBAs, harvesting equipment such as hunting shells) and contract employment (e.g. winter trail clearing, forestry work, shuttle driving). They also offer honoraria for sitting on committees (e.g. Environment Committee) and for consultation and/or participation at community meetings (particularly elders). For locals, these supplementary resources provide a useful input to improve household flexibility for purchases and land use.

Of further note in regard to adaptive capacity, the level of strength and stability of local governance organizations has a direct effect on whether operations are carried out in a consistent manner, whether residents feel that they are well represented, and whether long-term planning will take place, draw local support and achieve implementation. Weak and ineffective institutions generally promote stakeholder distrust and apathy, and dampen efforts towards collective outcomes.

The ability of individuals and households to adapt is also influenced by local cultural institutions (customs, norms). For example, most residents recognize that they can rely on a neighbour or other community member for help if they really need it. This customary practice provides a localized social safety net that can act to increase one's confidence in attempting untested adaptation options.

7.1.2.4 Social networks

Social networks, consisting of bonding, bridging and linking ties, are recognized as important for enabling people to act collectively (Woolcock & Narayan, 2000), and essential for maintaining well-being during times of changing or difficult environmental conditions in survival-based indigenous societies. Collective action is at the heart of all adaptation decisions beyond the household level, requiring functional networks and the flow of information (Adger, 2003a). Despite increases in individualized behaviour due in large part to the safety net provided by government subsidies, most locals in Fort Resolution recognize the underlying strength of joint history and cultural bonds in the community. These are crucial in times of crisis, and may be important to rebuild to improve collective planning and action in the face of mounting pressure (see Chapter 5).

As in other indigenous communities (e.g. Magdanz et al., 2002; Anisimov et al., 2007), the social networks in Fort Resolution consist primarily of bonding ties within and among kin-groups. The sharing of food resources in its multiple forms, whether based on giving, redistribution, or exchange (Kishigami, 2004), is one of the primary ways that

networks support community well-being (Berkes & Jolly, 2001; Magdanz et al., 2002). This role is increasingly important as land use declines and smaller proportions of harvesters are bringing home meat from the land. For example, in small Alaskan communities approximately 30% of the households contribute 70% of the total traditional food harvest (Magdanz et al., 2002).

Depending on their structure, however, social networks can either facilitate or constrain adaptation. For example, densely formed networks can lead to exclusion, restrict members' freedom, or hinder innovation (Tompkins & Adger, 2004). As such, while intra-community bonding ties are important for building resilience and contributing to adaptation to environmental change (Tompkins & Adger, 2004), bridging ties are complementary, and essential for providing access to a diversity of resources (Newman & Dale, 2005). Ties with members of other communities are critical for dealing with uncertainty and increase opportunities for renewal and reorganization (Olsson et al., 2007). They increase adaptive capacity by offering a mechanism for generating new knowledge and exposing people to ideas and experiences beyond their known local circle (Newman & Dale, 2005). In Fort Resolution, bonding ties are most prominent, while bridging ties are limited for the majority of individuals (see Chapter 5), possibly restricting adaptability.

Vertical linkages across levels are especially important for institutions. This study indicates that local institutions in Fort Resolution experience significant turnover in leadership and staff, and low levels of institutional resources often mean that a single

individual is assigned to and specialized in one program area (e.g. the one paid Environmental Manager is expected to deal with all DKFN-related environmental issues). Key stewards or individuals establish links between levels with, for example, government representatives at territorial and national levels, to increase resource access for their particular program area. In this way they improve the flow of information and knowledge among nodes. When such individuals leave their positions, both social memory and vertical linkages are lost, increasing vulnerability to change (Olsson et al., 2007). Such breaks in memory and continuity also hamper engagement in collaborative long-term projects with outside entities (e.g. the current multi-disciplinary research initiative). The diversification of networks by both lay-members and leadership can enhance resilience and support adaptation, while improving the scope for proactive decision-making at the collective level (Newman & Dale, 2005).

7.1.2.5 Equity

There is significant evidence that poor and vulnerable groups will bear the brunt of environmental change (Thomas & Twyman, 2005). Multiple researchers have noted the links between adaptive capacity, power and access to resources. They argue that adaptive capacity is influenced by the extent to which groups are entitled to access resources (Adger & Kelly, 1999), and that it can be strengthened if governing social institutions improve equitable allocation of power and resources (Mustafa, 1998; Handmer et al., 1999; Smit et al., 2001). The equitable treatment of individuals in terms of access to support, resources or employment opportunities is important both to reduce

marginalization of vulnerable groups, and also to improve relations between groups and reduce constraints on collective action. In Fort Resolution, for example, the issue that causes the most tension in the community relates to differential access to employment opportunities (see Chapter 5).

7.1.3 An enabling political environment? The multi-level context

Assessments of adaptive capacity are specific to culture, place (Adger, 2003a) and scale (i.e. different variables influence adaptive capacity at local, regional and national scales; Adger & Vincent, 2005; Vincent, 2007). At the same time, systems do not function in temporal and spatial isolation. It is essential to consider processes underway in the various scales of space, time and social organization – and interactions among them – that influence the focal social-ecological system in order to understand its dynamics and inform management decisions (Gunderson et al., 1995; Gunderson & Holling, 2002; Dietz et al., 2003; Cash et al., 2006). While this study focuses on the local scale where social linkages are shown to play a critical role (Chapter 5), many of the issues evoked in the preceding chapters indicate the importance of an enabling context created by linkages across scales – those at regional, territorial, national and even global levels. Furthermore, while a local focus is critical for adaptation, complementary vulnerability reduction measures may be required at multiple scales (Naess et al., 2005).

This section outlines important linkages for this case study related to governance and political arrangements and the manner in which they support or limit the existence of

an enabling environment to strengthen adaptive capacity. While there are many possible extra-local determinants of adaptive capacity that interact with endogenous conditions, we emphasize four in particular: (1) the effects of government-based support programs, and their role in creating a social safety net; (2) the impacts of existing and potential economic development projects; (3) aboriginal-aboriginal and aboriginal-state relations; and (4) emerging self-government arrangements.

7.1.3.1 Government support programs

Despite having a road connection to the south, Fort Resolution remains somewhat isolated, with a cost of living[28] that is 37.5% higher than in Edmonton (Northwest Territories Bureau of Statistics, 2006). Limitations on available wage opportunities pose challenges for households trying to maintain a decent quality of life. Moreover, land users have seen fur prices decline while costs for the equipment for land use increase. As noted above, additional financial pressures include increased outlay for the purchase of specialized equipment to mitigate safety concerns due to changing climatic conditions. These local economic constraints highlight the importance of external territorial social assistance programs and harvester support programs. While each of these provides essential resources for adaptation for both harvesters and non-harvesters, harvester support programs are of particular interest as they have important links to some of the key endogenous determinants of adaptive capacity relating to food security, cultural continuity and economic diversification.

[28] Cost of living is calculated based on the formal economy.

In terms of supporting basic needs, federal resources devolved to and administered by the GNWT at the community level are applied to a number of programs (e.g. income support, family allowance, pension) that act as a formalized social safety net. Although the number of beneficiaries in Fort Resolution has declined from 111 to 52 individuals from 1996-2006 as incomes have increased, the unemployment rate still hovers around 18 percent based on 2005 data (Northwest Territories Bureau of Statistics, 2006). As in many other small northern communities, social assistance continues to provide a significant portion of total income. Although the subsistence economy may account for one-quarter to one-half of total economic value in northern communities, its value is not reflected in economic accounts (Warren & Egginton, 2008). The flexibility to harvest provides a supplementary source of revenue, which can be supported through fixed income such as that described above. Particularly, a number of able-bodied pensioners rely on monthly income to support land use from which they derive subsistence, so there exists to some degree a transfer of financial resources into harvesting outputs.

In the absence of sufficient wage opportunities and in light of the interest in preserving culture and maintaining livelihood choice for northern residents, harvester support programs are particularly important for supporting and promoting continued land use and subsistence activities. The GNWT has implemented a complement of programs to support continuity within the territory's traditional economy. The Genuine Mackenzie Valley Fur Program has a targeted marketing strategy to promote high quality authentic NWT-harvested fur, while sub-programs (Guaranteed Advances, Prime Fur Bonus

Program and Grubsteak Program) have been established to reduce individual risks to trappers. They provide financial support to encourage the harvest of high quality pelts, and help to stabilize fur market fluctuations through guaranteed minimum pelt prices. Subsidies for equipment purchase are also periodically available through local institutions. Funds from the GNWT Community Harvester Assistance Program are distributed to defray capital and operating costs for harvesting activities, and DKFN also periodically provides hunting shells to its members. Another complementary suite of GNWT programs – Take a Kid Trapping, Trapper Recognition and Trapper Workshops – aim to promote and recognize trapper and general bush skills, and counteract the degradation of traditional skills in the NWT (Rossouw, 2004, pers. comm.; Government of the Northwest Territories, 2008a). Culture camps run at the community level also help to reinforce these skills. In combination, these resources help to support the viability of trapping activities for individual residents.

7.1.3.2 Economic development in Akaitcho Territory and beyond

The north has experienced rapid economic development over the last half century. The combined effects of a declining fur trade, a shift toward extractive, non-renewable industries, and government settlement policy encouraged a bush-settlement transition that peaked in the mid-1900s. Many adults who had spent their lives on the land had few skills to take advantage of wage employment and suffered from a loss of identity and way of life. In Akaitcho Territory, some of the younger men began working seasonally in areas such as timber production, the commercial fishery, and Pine Point Mine.

Resource development occurred concurrently in other parts of the NWT. Gold mining has stimulated development in and around Yellowknife since the late 1930s, and a diamond staking rush has been underway since the first major discovery in 1991 (Government of the Northwest Territories, 2009). More recently, some Akaitcho residents are gaining employment and training opportunities in the diamond industry, although a lack of professional qualifications and clean criminal records limit participation.

Residents have experienced significant challenges with the rise and fall of employment opportunities. Since the fishery decline in the early 1970s (Mackenzie River Basin Board, 2003) and sawmill and Pine Point mine closures in the 1980s, government offices and seasonal contracts make up most of the available local wage work. Some individuals maintain more than one part-time job, whereas others find it difficult to break into the market (Workshop Participants, 2005, pers. comm.), resulting in feelings of inequitable treatment. Many families draw on a combination of occasional or seasonal employment, trapping income, and welfare to meet basic needs (see Section 5.1.2).

A range of possible or likely developments exist in Akaitcho Territory for the foreseeable future. These include hydro-electric development on Taltson and Slave Rivers, mining, oil and gas, logging, and tourism, some of which are already under discussion (see Table 6.2). There is also growing concern about the downstream effects on water quantity and quality caused by the operation and planned expansion of Alberta Oil Sands activities (Campbell & Spitzer, 2007). For some residents, these developments

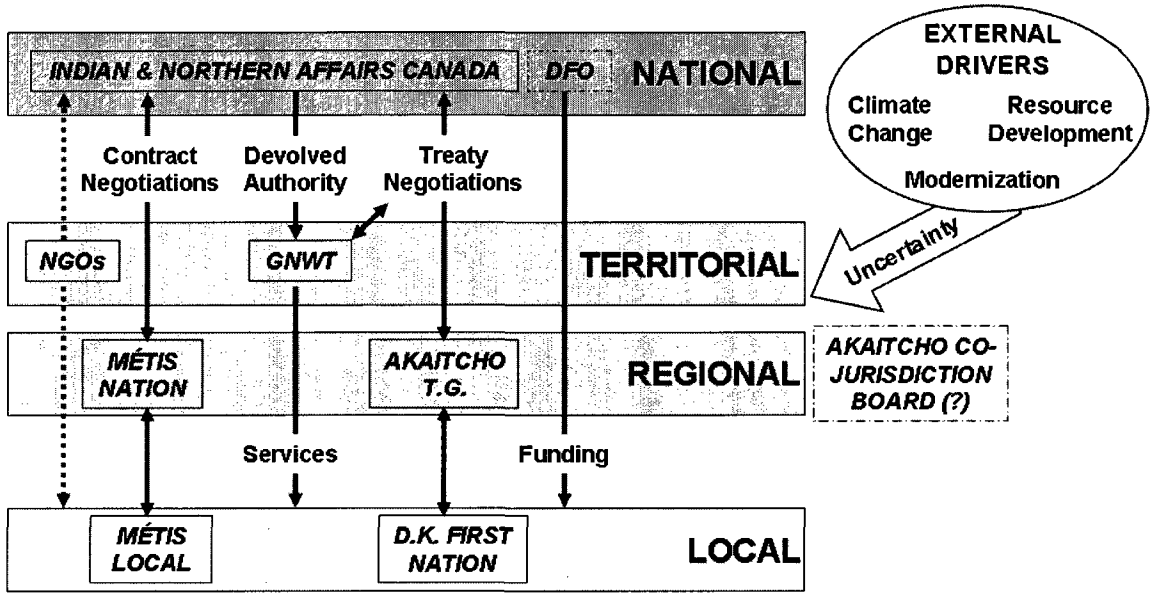
offer both opportunities for wage employment and novel business ventures. For others, the lack of diverse knowledge and skill sets, limited access to resources, social exclusion and inequitable employment opportunities may severely challenge their capacity to adapt.

7.1.3.3 Aboriginal-aboriginal and aboriginal-state relations

Stable enabling environments, consisting of the multiple social structures that help society function at different levels (Klein & Smith, 2003) are required to support collective adaptation. In the case of Fort Resolution, the implementation of most programs (e.g. social support, harvester support, employment training) occurs within a top-down, multi-level institutional structure (Figure 7.1), where funding and services are allocated directly from the federal government or by way of the territorial government.

The regional aboriginal organizations (ATG and Métis Nation) play an important role in mediating relationships between local and national governments. In the case of the Dene, the ATG Lands and Environments Division provides a regional forum to enhance local to regional knowledge transfer on relevant issues and to help standardize policies and procedures for making joint decisions in the territory (Boucher, 2006a, pers. comm.). At the same time, this additional layer adds a level of bureaucracy that may also act either as an information barrier or a funding sink.

Figure 7.1: Primary organizational relationships across levels and drivers of change
(The co-jurisdiction board indicated here is one possible model post-treaty ratification.)



Environmental NGOs are also actively working at different levels and act to bring salient issues to the fore (e.g. climate change). Organizations such as Ecology North and Energy Alliance (both based in Yellowknife) play an important role in connecting with and communicating community values and interests to municipal, territorial and national policy makers. Broader public attention to issues relating to climate change and aboriginal well-being is also garnered through the work of other often unrelated, or indirectly related NGOs (e.g. WWF Canada, Canadian Arctic Resources Committee), providing indirect benefits through awareness-building and education.

The historical relationship with the Government of Canada has evolved as a paternalistic one, with aboriginal communities on the receiving end of programs, policies and resources. Community development was pursued by federal Indian administrators as

a solution to assimilation in the 1960s, ostensibly to encourage self-determination and devolve authority to the local level. Rather, this program resulted in an abdication of federal responsibility and "*abandonment [of aboriginal groups] to the dominant society ... [leading to] today's increased bureaucratization of Indian bands – particularly in their administration of government programs, including social assistance*" (Shewell, 2004: 337). Currently, the Chief and Council system stemming from the Indian Act relegates elected leaders to a two-year term, a systemic weakness which seriously impedes development.

These and other imposed regulations stimulate a general attitude of mistrust at the local level, which reinforces the belief that it is important to take advantage and get what you can while it is on offer, rather than taking a longer term view. This attitude has led to the common practice of individuals using public forums to air their concerns, and such behaviour is often reinforced by the 'squeaky wheel getting the grease'. Since residents feel that such relationships have generally been divisive (in the past), they may fail to recognize the potential opportunities for organizations at supra-local levels to provide support for the less tangible social aspects of capacity development to support adaptation. If locals continue to be mistrusting in these relationships, they are unlikely to support measures where money and resources are used for activities that do not bring immediate benefits, thus clearly constraining the feasibility of anticipatory adaptation planning.

At the same time, often competitive and protectionist relationships have developed among the four First Nations within Akaitcho Territory, stemming in large

part from the perception that inclusiveness will infringe upon local rights and benefits. Each community is working mostly for its own benefit, rather than the benefit of the broader region. Balsillie (2006, pers. comm.) notes that "*there's a lot of room for more collectivity within Akaitcho in terms of regionalized visions in economic development that we should move on, that would be beneficial for the region, but it's not happening*". While there is substantial political leverage when aboriginal governments work together, such efforts are often stymied by the (often correctly) perceived 'divide and conquer' approach taken by the Government of Canada and industry. For example, resource companies have been known to approach communities independently to try and broker a deal, insisting that the local piece of the pie will be diluted if other communities in the region become involved. Local governments on the receiving end are caught in a dilemma, feeling pressured to choose between desired economic benefits and their loyalty and ties with surrounding local governments and residents. "*People are almost afraid to rock the boat because all of a sudden a diamond company might walk away saying [our] policies are too stringent*" (Balsillie, 2006, pers. comm.). In Akaitcho Territory, one such instance led to Fort Resolution's exclusion from an IBA with a mining operation located on the far side of Akaitcho Territory. A combination of strong aboriginal leadership and solid reciprocal relationships between and among communities is crucial to ensure that all relevant parties are included in important land use negotiations.

The nature of these relationships is evolving, as Aboriginal groups assert their collective rights, and the benefits of stakeholder participation in decision-making become more widely recognized. Aboriginals in Fort Resolution and elsewhere are now more

effectively using western tools, such as legal court cases, to take the State to task. For example, in the 1973 Paulette case, it was successfully argued by the Dene of the Northwest Territories (including Akaitcho Dene) that the treaties should not be interpreted as having extinguished aboriginal title over their lands (Government of the Northwest Territories, 2004). Communities must recognize the value of bolstering their local capacity to adapt by developing endogenous determinants (e.g. building the community knowledge base, improving social cohesion, and ensuring equitable treatment of members), while continuing to pressure favourable policy development at higher levels of governance.

7.1.3.4 Emerging self-governance arrangements

During the past decade the Dene and Métis have been participating (independently) in negotiations to have their inherent rights to land and self-government formally recognized, and to gain a legal mandate to make decisions about land and resource use in their traditional territory. Developments in these negotiations foster optimism for increased and improved involvement of local authorities and residents in management decisions regarding their territory and resources, and the potential for incorporating mechanisms for strengthening adaptive capacity and enhancing adaptation options. The creation of new levels of organization and strengthening of existing local capacity can help to achieve this goal through reductions of top down management control and increased devolution of authority (Walker & Salt, 2006).

In the case of Akaitcho Territory, the first stages of this process have already been implemented. An Interim Measures Agreement (IMA) was signed in June 2001, authorizing Akaitcho First Nations to pre-screen land use licenses, permits and dispositions (Indian and Northern Affairs Canada, 2001). More recently, local environmental officers worked with elders and land users in each of the Akaitcho DFNs to outline lands of specific cultural, spiritual and environmental interest in their joint traditional territory. This resulted in the federally-sanctioned Interim Land Withdrawal in 2007, safeguarding approximately 62,000 square kilometres from mineral staking, sale or lease while negotiations continue (Parks Canada, 2007). Pending ratification of the Treaty 8 Final Agreement, it is anticipated that renewable resource management decision-making will be transferred largely to a combination of (a) a First Nations committee for Dene Title Lands, and (b) a co-management committee (made up of representatives from the federal government, the GNWT and the settlement area) for Co-jurisdiction Lands. Improving and re-drawing the power relationships inherent in these linkages provides increased opportunity for the development of stronger social and institutional networks, integration of diverse information and knowledge, mutual learning, and the development of management approaches that better serve a full range of stakeholders.

These multi-level relationships are further complicated by horizontal linkages at each scale. Despite their shared history, differential legal treatment has created divisions between the Dene and Métis at the local level (see Chapter 5). The Métis tend to be strongly affiliated with the territory adjacent to Fort Resolution where they had historically founded small hamlets, including Little Buffalo River and the mouth of the

SRD. Many of the Dene are more attached to other more isolated parts of the traditional territory. Consequently, individuals and family groups have different levels of concern for specific territorial zones, contrasting with the centralized management of the territory at both community (DKFN) and regional (Akaitcho Territory) levels. While the territory is administered as a single block, it is not necessarily perceived as such by the people who use it. Furthermore, the Métis are not considered to have any legal territorial rights at present, which leaves land use planning and decision-making largely in the hands of the First Nation, and can exacerbate differences of opinion. For example, while K'atlodeeche First Nation on the Hay River Reserve and DKFN in Fort Resolution have both signed agreements with Tamerlane Ventures that indicate support for the Pine Point Pilot Project – a preliminary bulk extraction of one million tonnes of lead and zinc – the Fort Resolution Métis Council opposes the project due to concerns about environmental impacts and the lack of direct benefits to members (Fort Resolution Métis Council, 2007; Bickford, 2008b).

Both the Dene and Métis have entered into these relationships with an awareness of the power dynamics at play, and recognizing that they are functioning within a western framework, rather than one they themselves devised. Like other groups (e.g. Nadasdy, 2003a), they envision the process as the only realistic way at this juncture in history to preserve their territory and way of life. This choice comes with costs to the very way of life that they are trying to protect. It moves people off the land and into offices or industrial sites, and the financial influx for wage earners reinforces social and economic

divisions at the local level. However, despite the costs, negotiating such claims is perceived to be more beneficial in the long term than the possible alternative.

The Dene and Métis are both in the fortunate position of having a range of preceding land claim arrangements to learn from. They benefit from the many lessons learned from other groups that have followed a similar trajectory and are further along in the process of either negotiation or implementation. Direct influences on the negotiation process can be seen, for example, in Akaitcho DFNs' choice to pursue co-existence under their Treaty Land Entitlement negotiations (Akaitcho Territory Government, 1995). Recognizing some of the challenges experienced by other northern aboriginal groups implementing co-management under Comprehensive Claims agreements, Akaitcho DFNs have taken an alternate route in focusing on co-existence and co-jurisdiction. While the outcome of this model is as yet unknown, the concept as applied to the Dene is being developed with some of the following principles in mind: respect for and accommodation of Dene sovereignty and political autonomy, collective rights, a separate Dene legal system, free and informed consent in dealings with the Government of Canada, and the exercising of Dene jurisdiction (Akaitcho Territory Government, 1995).

For the Dene, the treaty negotiation process has taken on an adaptive approach, which bodes well for the development of a more flexible and functional Final Agreement. There is a concerted effort underway for community negotiators to learn from the experiences of existing land claim and co-management arrangements, to apply positive aspects to current negotiations, and make alterations where deemed necessary (Boucher,

2006b, pers. comm.). As proposed by the Canadian Royal Commission on Aboriginal Peoples (RCAP, 1996), Treaty 8 negotiators are working under the concepts of co-existence and mutual recognition, rather than a comprehensive claims process (preferred by the Federal Government) that seeks to extinguish aboriginal title, as expressed in the following statement.

We the Dene continue to assert our sovereignty and self-determination over our territory through Dene governments and institutions as we define them. We the Dene have no mandate to extinguish, alter, or change the creator's laws as instructed by our ancestors. We the Dene have the responsibility to ensure that all newcomers respect and honour the creator's laws within our territory to live in peace, friendship, and harmony: to coexist with our nation. (Akaitcho Territory Government, 2008; see APPENDIX K for full text)

This approach emphasizes the difference between the recognition of existing rights and the devolution of powers to give new rights from within an externally-defined system. ATG communities maintain that they have pre-existing rights determined through the original Treaty 8 agreement, and are pursuing bilateral negotiations with the Federal Government (without territorial participation beyond observation) representing the two original signatories (Kendrick, 2003).

Furthermore, they are employing adaptive management principles to the negotiation process. The intention is to proceed with a negotiation-implementation cycle in order to learn, determine what works and what doesn't, and develop capacity at each stage. The first phase of the process of devolving decision-making began with the 2001 IMA. It recognizes that the Akaitcho DFNs have "their own internal processes for determining the use of lands and water" (Akaitcho Territory Dene First Nations et al., 2001: 2) and lays out the conditions for developing a pre-screening process for land and

water use applications within Akaitcho Territory that includes representatives from each of the four communities. In this way, each community has a chance to first implement its own process, later evaluate its ability to implement, and subsequently address outstanding issues within a smaller scale process before being struck with the task of implementing the Final Agreement. This iterative learning process allows negotiators to assess the effectiveness of IMA policies and either modify or transfer them to other areas (e.g. lands management), and use it as a springboard to extend the discussion to items that would otherwise be left off the agenda (e.g. jurisdiction over prospecting permits). Community leaders anticipate positive structural outcomes from this process, including the re-empowerment of families for improved local governance, and more equitable decision-making (Boucher, 2006a, pers. comm.). While such goals may be attained, collaboration among local governance organizations is essential for spreading these benefits beyond DKFN Band members to other residents.

Likewise, on the resource development side, Akaitcho communities have much to learn from the consultation and deliberation process of other communities that are contemplating or experiencing major development in their territories (e.g. diamond mines, Mackenzie Gas Project). The experience of nearby development provides a unique opportunity to assess how the environment and northern livelihoods are being impacted, where information can be incorporated into local land use plans and decision-making.

Not only are the aboriginal governments in flux, but territorial responsibilities and relationships are also shifting. While the GNWT currently has provincial-type authority

over specific services (health care delivery, social services, education, airport administration and forestry management), the Government of Canada is engaged in negotiations to devolve remaining INAC responsibilities regarding lands and resources to the GNWT, and possibly to aboriginal self-governments (Indian and Northern Affairs Canada, 2003b; Government of Canada et al., 2004; Irlbacher-Fox & Mills, 2007). The Government of Canada's stated aim is to enable "the territories to become more self-sufficient and prosperous and to play a stronger role in the Canadian federation" by increasing territorial control and accountability (Indian and Northern Affairs Canada, 2008).

While regional aboriginal Governments in the NWT[29] are at the table as part of the government-to-government-to-government process (with national and territorial governments), ATG lacks active involvement in the talks due to its unresolved land claim agreement. Key aboriginal concerns about possible outcomes include the potential adverse impact on recognized and unrecognized aboriginal rights, adequate resource revenue sharing with aboriginal governments, and meaningful aboriginal participation in implementation (Irlbacher-Fox & Mills, 2007). Understandably, ATG's concerns are increased due to its limited input into the process, and lack of knowledge about how devolution may affect ongoing negotiations. Local leaders in Fort Resolution also worry that increased GNWT authority undermines their nation-to-nation relationship with the

[29] Since 2000 the Aboriginal Summit, comprised of a caucus of NWT regional Aboriginal government leaders, has represented collective Aboriginal interests in negotiations with the federal and territorial governments on devolution and resource revenue sharing. After the 2007 folding of the Summit, individual regional governments have represented their own interests. Akaitcho Territory Government and the Deh Cho First Nations maintain observer status while continuing to negotiate land claim agreements (Indian and Northern Affairs Canada, 2003b; Government of Canada et al., 2004; Irlbacher-Fox & Mills, 2007; Indian and Northern Affairs Canada, 2008)

Government of Canada, and adds another layer of bureaucracy that diverts unnecessary funds which could otherwise be transferred for use at the local level.

There is substantial recognition of the need for a dramatic shift in aboriginal-state relations to improve the equitability and sustainability within the system (RCAP, 1996). Akaitcho communities possess many of the fundamental building blocks to design and develop a newer community structure adapted to the modern realities of settlement life and flexible enough to accommodate increasing social-ecological change. This can only happen as aboriginals, as individuals and groups, increasingly recognize the historical antecedents and insidious nature of their long-lived oppression, and recognize the need to draw on collective strength as a unified force to reverse this trend. The more recent trend towards increasingly collaborative governance relationships through land claims legislation requires a new approach, a shift in current rules-in-use by parties at all levels. While co-management attention is often focused on the vertical relationships, it is also notably important to pay attention to the horizontal linkages among First Nations communities (Berkes et al., 2005a).

It remains to be seen how substantially the system will be influenced once a treaty agreement is reached. While this change in governance seems to provide a significant opportunity for transformation towards an increasingly equitable and sustainable system, it is uncertain whether the entrenched power structure can and will be significantly altered. If not, the anticipated transformation may result merely in a shift in outer image,

while having little influence on the underlying structures and functions that currently exist.

7.2 Strengthening Adaptive Capacity in Northern Social-Ecological Systems

In the context of historically produced socio-political and economic inequities, the vulnerability of northern communities is increasing. Those such as Fort Resolution face a myriad of emergent challenges and changes on social, cultural, economic and ecological fronts. O'Brien and Leichenko (2000) have referred to similar experiences elsewhere as 'double exposure', where communities must simultaneously respond to the multi-faceted effects of globalization and climate change. Arguably, northern Aboriginal communities face additional constraints due to existing and difficult initial conditions and the legacy of colonial influences. They continue to experience significant external influences causing rapid changes to their culture, to livelihood options and broader economic systems, and to the environment around them, which has long been a primary source of sustenance. As such, it may be more correct to call this 'multiple exposure'.

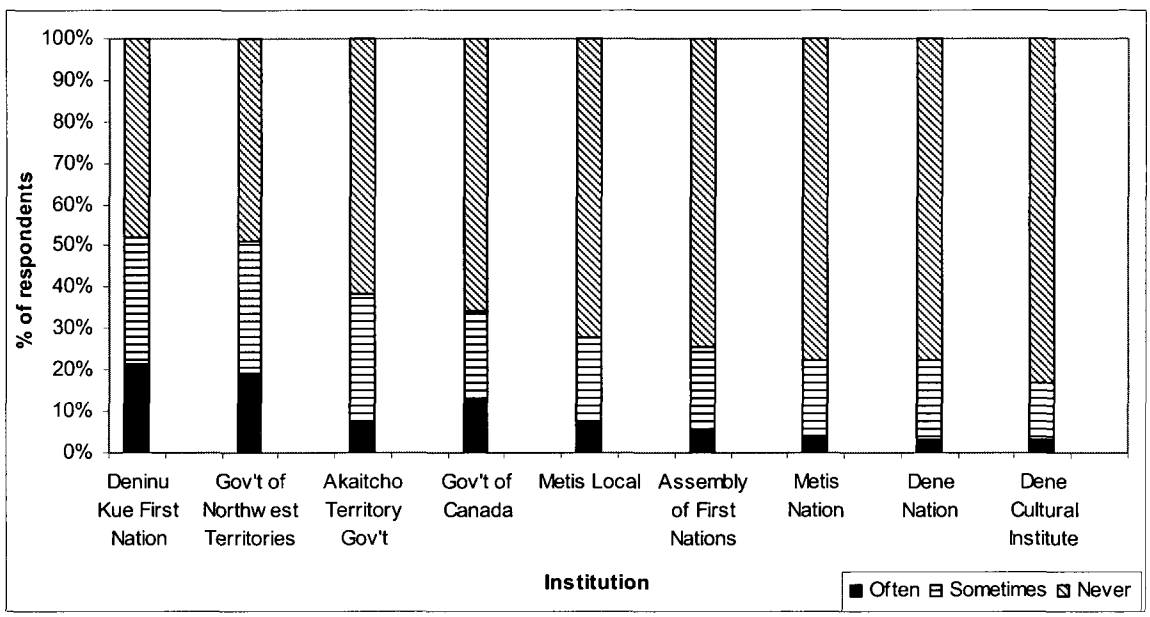
Building adaptive capacity in the context of multiple exposure demands careful attention to its determinants (local and non-local) and the manner in which it is linked to emerging governance regimes in the north. While all communities have some degree of adaptive capacity, it is generally not specifically developed to combat environmental change (Handmer, 2003). While adaptation measures can be targeted to deal with a specific pressure (Downing, 2003), building adaptive capacity reflects the idea of

developing resilience within the system to deal with a range of shocks and stresses (see Chapter 2). It is important to note which elements in society undermine adaptive capacity; in other words, what makes people vulnerable (Handmer, 2003). However, while it is necessary to understand these challenges, a sole focus on negative aspects and barriers threatens to re-pathologize aboriginal people, ignoring their many inherent strengths and capabilities. The sustainable livelihoods and community development literatures recognize the importance of identifying and building on existing assets (Kretzmann & McKnight, 1993; Beck & Nesmith, 2001) to foster system resilience (Walker et al., 2004). Capacity-building efforts should focus first on the identification of assets and second on active support to strengthen them (e.g. targeted activities and policy).

Understanding the relevance of institutions for local residents is important for determining where capacity-building efforts for adaptation should be focused. Not surprisingly, and due in large part to the strong local ties of the Fort Resolution populous, locally active institutions are the most relevant to residents (Figure 7.2). Despite the mixed population, the First Nations Band is seen as the primary source of important information, with the GNWT (which provides essential services such as housing, health, family allowance and harvester support) also showing similar levels of importance. The ATG (which is housed and provides employment in town), the Government of Canada and the local Métis office show mid-range results, while the regional and national aboriginal agencies show the least relevance. Residents also indicated that local organizations and individuals are more trusted than those external to the community

(Chapter 5), indicating the utility of focusing capacity-building efforts at this level. I suggest that a bottom-up approach to addressing capacity issues is required.

Figure 7.2: Significance of organizations in providing important information to residents of Fort Resolution
(source: survey data, 2005)



Interview and focus group results indicated that individuals who have not worked in the central governance offices or acted in formal leadership positions are often insulated from the inter-institutional workings beyond the local level, having limited understanding of how local livelihoods are affected by outside influences. Survey data indicated that residents tend to recognize the importance of endogenous factors (e.g. internal social relations, social issues such as crime and drug use, employment and training opportunities) in influencing future development of the community, and that change must occur from within. Older residents are somewhat more conscious of the strong role played by exogenous factors in influencing the community's development path (Figure

5.15), likely because they have lived through the effects of residential schools, Pine Point mine, and settlement policy, among others.

While it is important that strategies to build and apply adaptive capacity are focused at the local level, solutions will only be successful and sustainable over the long term if pursued within a broader enabling context. To ensure that this occurs, we must recognize the importance of cross-level linkages among governance organizations, as building and strengthening adaptive capacity will not happen spontaneously. There is a need for developing formal communication mechanisms or organizations to ensure that local issues are addressed and capacity-building for adaptation is supported at higher levels.

7.2.1 Moving forward: Building adaptive capacity for the future

There are several dynamics that have emerged as important in influencing the manner in which local adaptation resources are both distributed and used, including the local-global dichotomy, the land-settlement dichotomy, organizational structure versus function, and connectedness as divisive or unifying. These are synthesized below.

Local-global dichotomy: At the local level, residents recognize their shared future and the fact that exogenous drivers like climate change are not selective in terms of which people or groups are impacted. As such, local representatives and residents talk about the need to work together as a group, but as yet such ideas have generated little

action. Clearly residents are able to collaborate, as is shown in times of crisis, both in dealing with internal issues (e.g. providing family support after the death of a community member) or when threatened from the outside (e.g. group protests to protect land from exploration and drilling by Shell Oil). It is arguable that climate change will bring residents together because they are facing a common threat (Ritchie, 2006, pers. comm.). However, this will likely not happen until communities face extreme conditions that threaten their livelihoods, or unless they are brought together in another way, such as through community capacity-building programs.

Land-settlement dichotomy: Culture and identity, both of which are strongly linked to the land, play a significant role in First Nations well-being in Fort Resolution. It was reported repeatedly by interviewees that locals act differently when they are on the land; they are productive, happy and relaxed. These same people, when in the settlement or in the city, may feel listless and lacking in both direction and motivation. Those who have committed actively to ensuring that their livelihoods are more balanced, including spending quality time on the land, derive various aspects of well-being from it. Furthermore, those who use the land respectfully, especially for traditional harvesting activities, tend to garner more trust from others in the community (see Chapter 5). An increased sense of well-being and higher trust levels may help to support land user adaptability.

Organizational structure versus function: Many of the organizations in place at the local level give the appearance of intact and well-structured systems. However, many

residents note that the apparent form does not necessarily translate into functionality. The Chief and Council governance structure currently in place was imposed by the federal government, rather than being designed and implemented based on local principles (see Chapter 5). The 'democratic' electoral system relies in large part on kin-based networks and popularity rather than on ability to govern effectively, often allowing larger families to maintain power. The opportunity presented by new co-jurisdiction regimes for shifting governance towards more equitable and adaptive outcomes should be recognized (Armitage et al., 2007). In designing and developing new organizational structures through the anticipated implementation of the land claims agreement, all implicated actors – regardless of which organization they belong to – should be cognizant of the need to create structures that support flexibility, social learning and adaptability.

Connectedness as divisive or unifying: Relationships at different levels can create either divisions or strong networks to draw on in times of need. Clearly, the shared inter-generational history and connection to place has created strong social bonds between many residents in Fort Resolution, and to some degree with kin in nearby settlements. On the other hand, an increasing focus on individual wealth and the effects (e.g. physical and substance abuse) of traumatic events such as residential schooling and road access has weakened these ties, but not to the point of breaking. Their continued existence is recognized by many locals and is reflected in times of crisis. Other types of connections can supersede this underlying network. Family allegiances influence local politics and individual opportunities, while vertical linkages between locals and external individuals (e.g. those working for the territorial or federal government) are seen to be used largely

for personal benefit. Prioritizing individual over group benefit fuels a lack of trust among community members, thus limiting joint action. However, opportunities exist to reinvigorate and reinforce foundational bonds at the local level.

7.2.1.1 Building on culture

To address these dichotomies, the importance of improving and strengthening the social bonds between community members and of reconnecting with culture and land-based traditions is clear. Culture is important in shaping values and attitudes, and associated norms which "embody place-specific memory of change, feedbacks, and repercussions" (Robards & Alessa, 2004: 416) can provide insights into existing resilience. For example, the Dene have built lessons about resilience into their legends and laws (Newton et al., 2005). In Fort Resolution, reconnecting with cultural roots predominated as the primary mechanism for dealing with a changing landscape and for improving cohesiveness and well-being in the community.

I think what people need to do is take back their responsibility, and their responsibility is to take care of Mother Earth. We were given the responsibility of stewardship, and that stewardship meant that we have to take care of the land and the environment, and every organism had to be in balance. And somehow man is lately unbalanced. We are not monitoring regularly; revisiting, reviewing the detrimental impacts that we are having. (Unka, 2005a, pers. comm.)

Aboriginal Peoples across the north and elsewhere are increasingly recognizing the importance of revitalizing cultural ties by reconnecting with their identity, traditions and language (Smith, 1999; McGregor, 2004). For Fort Resolution, making efforts to highlight and celebrate the long history of its people may help current residents to rebuild

and affirm interconnectedness to other people and to the land, helping people to regain their sense of place-based identity, spiritual relationships, and general sense of being whole. "*Connecting is about establishing good relations*" (Smith, 1999: 149), with multiple outcomes for community well-being.

Potential exists for building on shared community identity and history at the grassroots level in order to instil collective stewardship values and encourage people to work together. Despite inter-familial and inter-cultural factionalism created in large part by generations of colonial influence and social upheaval, local residents still do feel connected at a deep level. This point was made in many conversations with local people, and is further evidenced by the strong and unquestioning support provided to one another in tragedy or crisis situations.

At the household level, a focus on building the "home fire" (Boucher, 2006b, pers. comm.) is essential, requiring individual healing and cultivating the strengths of existing relationships. It is well recognized that "restoring stable, nurturing families, in their diverse contemporary forms, is essential to achieving the social goals of aboriginal people" (RCAP, 1996). Furthermore, healing factional divides among community subgroups and rebuilding trust are strong determinants of sustainable economic development and self-governance in small aboriginal communities (Chataway, 2002).

Many community members expressed their recognition that the traditional Dene way of living and interacting, as outlined by the Dene Laws (Table 7.2), is an essential

part of who they are as Dene and provides an important basis for societal development. Despite, or perhaps due to, the fact that they have a long history, the spirit of these laws remains applicable for current and future generations. Dene Laws are fundamentally relationship-based; sharing is the umbrella law that all others sit under. They outline an equitable way of being in this world, by showing respect for all living and non-living things. As such, they support the development and well-being of the collective society.

Table 7.2: Dene Laws
(Blondin, 1997; Dene Cultural Institute, 2007; Dehcho First Nations, 2008)

Law	Examples
Share what you have	• Share all big game you kill • Share fish if you catch more than you need • Share what you can if others are in need
Help each other	• Help elders with heavy work • Help sick people who are in need • Share your sorrow with families when someone dies, so they do not mourn alone • Help widows and their children • Take care of orphaned children • Help travellers in need
Love each other as much as possible	• Treat each other as brother and sister • Do not harm anyone
Be respectful of elders and everything around you	• Do not run when elders are eating • Be polite • Do not hurt anyone with your medicine power • Do not harm anyone with your voice or actions
Pass on the teachings	• Elders should teach the laws, teach children to be good people, and tell stories about the past every day • Parents should teach children how to be good citizens, to love one another, and to use medicine power only to help people in need
Be happy at all times	• Take care of Mother Earth, our gift from the Creator, and she will provide food and shelter • Make the best of everything • Do not judge people; find the good in everyone

Dene Laws have formed the basis of a culture that has promoted flexibility and adaptability within Dene society, allowing them to deal with a long history of environmental change. It is not surprising, then, that these laws match up well with the

dimensions of adaptive capacity outlined by Folke et al. (2003). These linkages are presented in Table 7.3, as interpreted from my fieldwork and readings.

The Dene Laws focus on the 'cause of the cause' (Marmot, 2005), the relationships that form the structural underpinnings upon which Dene socio-economic systems are built. In an ideal world, the spirit of these laws would be considered in all actions taken on a daily basis and in policy-related decisions at both local and extra-local levels. However, since the initial development and teaching of the laws was strongly linked to cultural and spiritual beliefs (e.g. medicine powers, adherence to the Creator; Blondin, 1997), their value and use has been diminished with increasing westernization. As well, many of the inter-human linkages that these laws depend on have been weakened or stretched, seemingly requiring a strong incentive for re-activation (Chapter 5).

Despite these challenges, the mere existence of the Dene Laws and, to some degree (especially by Dene elders) recognition of their past and potential role in society, provide a way forward. As outlined here, they could apply quite readily in modern society regardless of religious or spiritual belief (or lack thereof). The laws provide a guiding framework for re-developing some of the connections and ways of being that are important for Dene identity and well-being. For example, instituting more equitable and respect-based approach within local organizations would go a long way toward healing some of the social rifts within the community. If DKFN and Métis representatives were able to sit down together in an atmosphere of respect, openness and concrete intent to

achieve a win-win situation, there might be scope for both groups to work together to initiate a mutually beneficial planning process.

A reinvigoration of Dene and Métis cultures in Fort Resolution can be supported through multiple mechanisms. For example, northern communities commonly organize 'culture camps' or 'land camps' (e.g. Ford et al., 2006a) to encourage the transfer of TK to community youth through experiential activities. The camps last between one and several days, where elders and youth are brought together on the land to share stories and traditional skills, such as harvesting and preparation of traditional food. These camps also offer a chance for youth and other community members to connect with the land and with each other away from the modern mediating influences in town, such as television and video games. GNWT harvester recognition and training programs support such endeavours.

Cultural education is supplemented in the local school with curriculum-based Chipewyan language classes and culture days. At the community level, the Chipewyan Language Centre runs various activities, including language instruction and traditional skills development (e.g. sewing traditional garments). These programs provide important access to community members, but require improved organization, 'marketing' and consistent resources to maximize effectiveness.

Table 7.3: How Dene Laws support adaptive capacity

Dimension of adaptive capacity	Application of Dene Law
Learning to live with uncertainty and change	The Dene have learned to buffer uncertain ecological conditions through continuous sharing of food and materials, by helping others in need, and by taking care of the vulnerable members of their group. The result is a more resilient society that is able to weather the pressures of exogenous disturbances. The sharing of stories from the past allows community members to integrate lessons from the experiences of their ancestors and elders, to evolve their society through learning and through finding innovative ways of dealing with both old and new problems.
Promoting diversity and redundancy	By showing respect for all things (both animate and inanimate) and developing a reciprocal relationship with Mother Earth, the Dene promote long-term sustainability of food and other resources. This same respect, combined with a commitment to sharing and supporting each other, promotes redundancy within the social system that all people can draw on in times of need. As well, teaching skills and knowledge to the younger generations creates a social memory where many individuals share overlapping knowledge, reinforcing retention and redundancy.
Integrating different types of knowledge	The teaching of elder knowledge and skills provides a platform upon which the next generation builds understandings and expectations. TK is constantly evolving, incorporating new understandings as different changes and challenges are faced over time and space. An openness to and inherent respect for all things (e.g. welcoming travellers or outsiders to share their experiences) encourages the evaluation of new modes of thinking and new ways of being. Due to long-term interaction with people from the 'south', Dene knowledge has now evolved to include a combination of traditional and western conceptualizations. Many locals recognize the value of understanding both traditional and scientific methods, information, and ways of thinking, and of being able to effectively apply a range of relevant tools.
Developing opportunities for self-organization	The continuous interaction among members of a society that are enacting reciprocal relationships through sharing and caring for others acts to connect individuals and their challenges together. Individual issues thus become group issues, and resources to deal with them are drawn from group assets (e.g. only specific people have medicine power). This close-knit web also means that mobilization of people and resources can be stimulated both easily and quickly, when necessary.

7.2.1.2 Strengthening social capital

Issues around social dynamics and cohesion lie at the base of many environmental and resource management problems, and particularly so in the north where the strength of aboriginal culture has been challenged by colonial influences. Traditional culture and livelihoods rely heavily on kinship bonds and other social ties at the local level. Although lifestyles are changing with increasing western influence, these linkages continue to play an important role in influencing how political systems function at local and regional levels.

Social capital cannot be assessed using a single indicator, and 'trust', commonly used as a proxy for social capital, fails to reflect other components. Data from this study indicate that while participation in networks may be limited, and social norms are shifting and losing potency, residents tend to maintain shared values and understandings about some fundamental elements of the social-ecological system that continue to be essential for healthy livelihoods. For example, residents repeatedly remarked on the need for protecting water quality and the health and numbers of traditional food species. There was also general agreement about linkages between healthy land and healthy people, recognizing the importance of the ecological system for aboriginal identity and well-being. This suggests that steps towards building cohesion should (initially, at least) highlight and focus on these areas of common interest to encourage joint participation. Building on this foundation, the other areas of social capital can then be addressed. If local residents can begin to work together (through choice or necessity) on an area of

joint interest and importance, this can act as a starting point for the evolution of new network forms, and eventually the development of new social norms.

It is clear that adaptive capacity is influenced in a substantial way by social structure and dynamics. The 'cause of the cause' (Marmot, 2005) must be addressed to understand and be able to enhance the social determinants of adaptive capacity. While applying technical or financial solutions may aid in improving short-term coping capacity, the implementation and persistence of long-term adaptive strategies requires conscientious attention to the structural underpinnings of the existing social system. "It starts in the home" (Boucher, 2006a, pers. comm.), where individual healing must occur and relationship blueprints are re-drawn. These are challenging efforts that begin with the individual (and a group in Fort Resolution has started such a movement). They can also be stimulated by external forces. An example of the latter noted by one community leader involves the community-scale re-empowerment of family units through redistribution of authority for collective decision-making (Boucher, 2006a, pers. comm.). The path towards self-government provides the opportunity to build components that support adaptation into the design of the new structure.

In a community such as Fort Resolution, where residents have a shared history and shared culture tied to place, there exists an underlying web of relationships to draw on in times of need. The enduring effects of colonization, government assimilation and settlement policies, the residential school system, and dominant western political frameworks have combined to weaken the strands in the communal web. The resulting

abusive and sometimes violent behaviour of individuals throughout the past four decades has permeated many relationships. Participants noted substantial progress since the 1990s as many individuals learn to distance themselves from destructive behaviour; however, many of the old wounds remain. More open recognition of these wounds by community members, combined with a concerted attempt towards the community-driven design and implementation of a healing program (Simon, 2005b, pers. comm.) may provide an opportunity to shift the structure on which these social dynamics are built, a fundamental need for improved community well-being.

Attention must be paid to both structure and process in achieving community development goals. Much past effort has focused on structure and technical needs, neglecting the importance of the role of (often informal) social relationships in effectuating long-term development strategies. Social cohesion is important for successful economic development and self-government, a process that should be grounded in culturally relevant values, focus on developing working relationships among community members and sub-groups, and actively include community members in the decision-making process through formal, personal and social empowerment (Chataway, 2002). This research shows that community members and leaders in Fort Resolution recognize the importance of these components for adaptive capacity and local development; the challenge remains how to implement and encourage their expansion.

7.2.1.3 Improving human resources

Beyond the necessary rebuilding of social networks and cultural ties, locals also see the need for capacity-building in such areas as access to financial and human resources, expertise in governance and resource management, and sustainable employment opportunities. The local Treaty 8 Negotiator Paul Boucher (2006b, pers. comm.) maintains that local leaders must be dedicated and well-meaning for the community to move forward. Preparing the leaders of tomorrow requires incorporating traditional values within the education system, and the re-empowerment of family units. Boucher (2006a, pers. comm.) stresses that "*if the family unit isn't strong, then the community's weak*". The focus on education and training is uppermost in many local leaders' minds.

> *You see a lot of kids that are finishing high school, which is a good thing. Hopefully with our [ongoing treaty] negotiations we get more help from the government, and people in place and jobs in place and ... we could govern ourselves [...]. Maybe not my generation, maybe my kids' generation or my grandkids' generation -- we might be able to do that.* (Boucher, 2005b, pers. comm.)

There are also possibilities of looking beyond the community to build local human capacity. Teachers and other professionals have long looked to the north for temporary training opportunities, resulting in high employee turnover and limited potential for positive, collaborative relationships that contribute to long-term community goals. With movement toward self-governance, community leaders and membership will have increasing control over how local organizations are managed, which type of employees they want to attract and hire, and the type of work environment they would

like to promote. Investing time in creating a supportive and dynamic learning environment that offers a range of opportunities will both attract local employees and encourage them to engage with the community and commit themselves to making a difference. Deninu School has been successful in this regard, where community- and relationship-focused leadership has led to longer employee retention, more effective engagement in community events and committees, and stronger employee-community member relationships. The success of this strategy is reflected in community perceptions of institutional service providers, where teachers enjoy the highest level of trust in this group (see Chapter 5).

In recognition of the importance of both education and locally-relevant research, community leaders have also noted their wish to continue developing a long-term partnership with southern researchers. In the case of Wilfrid Laurier University, for example, the research relationship with Fort Resolution dates back to the 1970s. While such partnerships can provide a framework for addressing local concerns and building capacity through local involvement, leaders also mentioned benefits in engaging researchers as mentors for young students.

Another resource includes kin who have moved away from Fort Resolution. Historically, people didn't travel far beyond their traditional territory, but the past decades have seen some increase in out-migration of individuals and families, mostly to access education and employment opportunities. As a result, Fort Resolution roots are spread widely, with members attending post-secondary programs and working in a range

of areas (e.g. government, industry). These roots provide a social asset with links to the community. If economic opportunities were made available in the community (through resource development, for example), this might encourage some previous residents to return, injecting the community with new human resources and ideas.

Despite the out-migration trend, there is still a strong sense within the community of cultural identity being tied to place. A majority of residents find it difficult to leave town, so do not take advantage of training and employment opportunities elsewhere. Even for youth, who may not feel as connected to the land in a traditional sense, the idea of leaving their comfort zone is a challenge. After school trips to Toronto and Vancouver, high school-aged youth reported that while they had enjoyed experiencing something new, they were very grateful to return home to their calm and familiar community. Due to this low mobility, a large percentage of the working-age population is committed to living in Fort Resolution, or indicates a preference to stay if jobs are available. They appreciate the slower pace of life, the feeling of being part of a community where they know everybody, easy access to the land, and the connection to culture and history. Furthermore, there are financial benefits to staying in the community (e.g. subsidized housing) for those with limited resources. Although perhaps economically limiting at the individual level, this sense of place and attachment to community can serve as a positive foundation for long-term planning. Prioritizing relationship- and capacity-building activities with this group of people would likely provide long-term benefits to the broader community. Long-term residents have an inherent interest in community sustainability and may be more easily mobilized to develop and implement plans for a better future.

7.2.1.4 Education and knowledge transfer

Northerners have a major stake in research and policy outcomes, highlighting the need for more engaged and effective participation of northerners in shaping them. This requires improved capacity for research and policy development that is '*based in* the Canadian North, conducting research *about* the Canadian North, *by* (primarily) Northern researchers and *for* an audience that includes northerners' (Abele, 2006: 4). Such objectives require action at multiple levels. Improving research capacity begins with the type of education being offered to youth across the north. It also involves educating community leaders about effective governance, creating new centralized research facilities (Graham & Fortier, 2005; e.g. the proposed Great Slave Lake research centre proposed by Fort Resolution leadership (Boucher, 2006b, pers. comm.)), and developing regional research planning, coordination and education centres (e.g. the Yukon Research Centre of Excellence initiative, which has a primary focus on climate change adaptation (Council of the Federation, 2007)).

Building human resource capacity starts with education at elementary and secondary school levels, which is highly dependent on effective staff and requires support from local parents. Fort Resolution has been fortunate to have a dedicated husband and wife team who, as Principal and Vice-Principal, have received substantial recognition for transforming the school into a quality learning environment since their move to the community in 2003 (Bickford, 2008a). This is an example where the community has benefited from the expertise and long-term commitment of dedicated outsiders to boost

capacity, and where knowledge transfer from these activities will have a lasting impact. Drawing selectively on such resources for specific purposes can help to develop local human resources through empowering partnerships.

Researchers can – and should – also contribute to knowledge transfer within the communities they work with. Researcher-community collaboration and partnerships are being increasingly identified as significant components of northern research (Krupnik & Jolly, 2002; Armitage & Clark, 2005; Graham & Fortier, 2005), to improve contextual applicability and policy-relevance (Wolfe et al., 2007) while offering an opportunity for mutual knowledge transfer and capacity building at the local level. Deninu School has also benefited from research being conducted in the community by taking an active partnership approach. In the case of the broader interdisciplinary environmental change program (Chapter 3), mutual support has been provided, where the use of space and equipment for research was reciprocated through periodic research presentations and educational activities for students, as well as active involvement in the school where feasible (e.g. career day mentor, international day facilitator, student poetry judge).

The increasing availability of technology and information can also be useful for improving knowledge exposure and transfer, if effectively applied. Northern-focused education that draws on both indigenous and western concepts can now be further enhanced with an increasing number of educational tools produced through multiple sources, including indigenous organizations, NGOs and researchers. For example, interactive CD-ROMs have been developed on the subjects related to Arctic climate

change (Fox, 2004) and resource development (Willett & Janes, 2005). Other text-based products offer documented information about indigenous experiences of environmental change (Sherry & Vuntut Gwitchin First Nation, 1999; Krupnik & Jolly, 2002; SnowChange, 2004; e.g. Berkes et al., 2005b; Riewe & Oakes, 2006). Applying existing technology such as the internet enables new types of knowledge transfer into classrooms, from elementary to university levels. Remote communities now have access to on-line courses, allowing them to further their education without leaving their community, and providing more options for individuals coping with multiple responsibilities (e.g. families, jobs, care-giving).

Furthermore, there is much for northern residents and communities to learn from each other. There are well-recognized, existing gaps in information-sharing both within regions and across the broader north (Abele, 2006), indicating the need for increased focus on, and implementation of new ways to build bridges and collaborative partnerships. Maori Professor Linda Tuhiwai Smith reinforces this point:

> *The survival of one community can be celebrated by another. The spiritual, creative and political resources that Indigenous peoples can draw on from each other provide alternatives for each other. ...To be able to share, to have something worth sharing gives dignity to the giver. To accept a gift and to reciprocate gives dignity to the receiver. To create something new through that process of sharing is to recreate the old, to reconnect relationships and to recreate our humanness.* (Smith, 1999: 105)

In this way the sharing of experiences and best practices between communities can help to empower both the givers and the receivers, while each provides tangible support to the other in their endeavours to enhance collective quality of life and well-being.

Events like the NWT Climate Change Leadership Summit (Ecology North & Dene Nation, 2007) and annual Science in the Changing North conference in Yellowknife (Science in the Changing North, 2008) are essential for sharing and communicating environmental change knowledge across groups, including community, regional, territorial and federal leaders and resource people. These are further reinforced through the multidisciplinary, northern-focused research and knowledge transfer projects supported by efforts such as ArcticNet (ArcticNet, 2008) and the International Polar Year (International Polar Year, 2008).

Unfortunately, for small communities to send participants to each of the many ongoing meetings about a large range of topics at community, regional and territorial levels, often results in financial and human resources being stretched to the limit. In Fort Resolution – and likely in other northern communities – the Band Council may be hesitant to spend their limited budgets, and may be compelled to send representatives only to selected meetings. When they do participate, there are no clear requirements for representatives to report on or disseminate the information learned to the leadership or broader community. As such, much of the knowledge transferred at these meetings remains with individual community members, while any commitment statements made there are unlikely to be transmitted to all residents, thus limiting benefits to the broader community. Creating a consistently applied, structured approach to disseminating knowledge at the local level would go a long way to improving awareness among residents about priority issues. In Fort Resolution, this could be achieved with a bi-

weekly mail-out, supplemented by summary spots on the regional radio station. (Unfortunately, there is no local radio station as exists in many other northern hamlets.)

Local leaders have also expressed interest in the creation of a central database for environmental knowledge, which would contribute greatly to knowledge retention and transfer. Drawing on necessary outside resources to select the best program, set it up and train local users would allow for fairly rapid implementation. Data and outcomes from past and ongoing projects could be digitally archived in a searchable format to ensure that permanent records are available for consultation and use. To achieve the greatest utility, local organizations should pre-negotiate open access and cost-sharing. Such an endeavour would provide some insurance against loss of institutional memory due to employee turnover, while improving the sharing of information between organizations at the local level (e.g. DKFN and Métis Local).

7.2.1.5 Policy development for adaptation

Effective policy response is an important mechanism for strengthening adaptive capacity and expanding adaptation options. At the regional policy level, the lack of a territory-wide adaptation strategy has resulted in erratically applied and unsustained response activities at a range of levels. Communities are struggling to survive, ensure that their rights are respected, and benefit from development on their land in this era of rapid change. Leaders and community members recognize the impact of environmental change,

but feel limited in their ability to help mitigate the problem and often uncertain about how to adapt.

Treaty negotiations provide the opportunity to consider adaptive measures during discussions and decision-making in the lead up toward an agreement in principle and a Final Agreement. Table 7.4 outlines the objectives guiding the negotiation process toward the development of the Akaitcho Final Agreement. These include the development of self-governance arrangements and provisions relating to land and resource rights, use and management (Akaitcho Territory Dene First Nations et al., 2000).

Within the scope of these negotiations there are specific areas that may be directly relevant for adaptation. For example, in the process of developing governance structures and defining the relationship among federal, territorial, Akaitcho, and individual DFN governments, it is important to consider the types of relationships and allocation of power both at local and inter-institutional levels. The possibility of a clearly defined and consensually agreed upon allocation of authority, and a forum (e.g. a co-jurisdiction board) where new and more equitable relationships can be brokered, offers the possibility for encouraging fair treatment and mutual support among member bodies. If roles and objectives are clearly defined based on mutual agreement, there is room to (re-)build trust among individuals and groups, to learn together, and to develop the flexibility to act rapidly and in unison when required.

Table 7.4: Contents of proposed Akaitcho Agreement
(Akaitcho Territory Dene First Nations et al., 2000)

Governance arrangements	Land and resource provisions
• Enable the Akaitcho DFN to govern their affairs • Describe the nature, character and extent of Akaitcho DFN government • Describe the relationship between public government and Akaitcho DFN government	• Provide for clarity of rights respecting land and resources • Enhance the capacity of the Akaitcho DFN to participate fully in all aspects of the northern economy • Provide for the use, management and conservation of land, water and other resources, including wildlife and their habitat

In the interim while treaty negotiations are ongoing, there are a number of existing projects and interests at the local level that can be built on or extended to improve adaptive capacity. For example, DKFN began developing a Deninu Kue Land and Resources Management Plan (DKLRMP) under the Integrated Resource Management Planning process in 2002, but was deterred by lack of funding in subsequent years (FREWC, 2003, 2004; Simon, 2006, pers. comm.). Focusing resources to revitalize this effort as part of a broader community planning process would provide a more structured framework to guide environmental- and resource-related decision-making. Initial documents, including a vision, terms of reference, and framework for the DKLRMP process, were developed in 2002-03 during two FREWC meetings and two community workshops. These could be used as a planning foundation and updated to meet current realities. Substantial relevant information has been documented as outputs of projects and research efforts during the intervening years. For example, DKFN recently went through a process to designate areas within the traditional territory that should be withdrawn from development in the interim before a treaty agreement is reached with the federal government. Elders and land users were consulted multiple times as boundaries were clarified with neighbouring communities. Participants took into

consideration changing environmental conditions and past experience with Pine Point mine, and prioritized areas of particular cultural and resource development significance.

Residents recognize that local capacity-building must be supported by government policy and practice at all levels to be effective. Yet, to date, little has been done to develop policies to mitigate and adapt to change. Where they exist, government attention and policy development have revolved specifically around aspects of climate change, rather than dealing with the broader concept of environmental change. Nonetheless, especially in the north, the impacts of other environmental changes (e.g. such as those due to resource development) are often incorporated into climate change discussions. Furthermore, the outcomes of adaptation planning and adaptive capacity-building will likely be useful in dealing with a broad range of possible future scenarios.

It is essential for federal and territorial governments to engage actively in climate change adaptation planning and implementation. They are the only entities that hold the necessary resources and staying power to 'do the heavy lifting' (Ritchie, 2006, pers. comm.) needed to develop a broad structure to support and implement long-term strategies for environmental change adaptation. As Federal climate change policy remains unpredictable at present due to the political conditions, Canada's provincial and territorial governments are increasingly recognizing the need to implement regional programs, to work collaboratively, and to share information (Council of the Federation, 2007). The GNWT has recognized climate change as an important policy issue since 1998 when it adopted an official position on the issue, which was reconfirmed by the

Executive Council in 2004. The position statement recognizes climate change as a "serious concern that could in future significantly disrupt the global environment, affecting the ability of northerners to lead healthy and productive lives", and commits the GNWT to supporting both global and local actions to reduce greenhouse gas emissions in line with targets set out in the Kyoto Protocol (Government of the Northwest Territories, 2007a: 27).

The GNWT has also formally recognized the need to balance mitigation efforts with economic development through the development of a territorial energy plan. The plan recognizes the responsibility of northern stakeholders, including government and industry, to conserve and promote the development and use of renewable energy (Industry Tourism and Investment & Environment and Natural Resources, 2007). With respect to climate change, these strategies are clearly mitigation-focused; however adaptation has recently been formally recognized as an important avenue for research and planning. A Territorial greenhouse gas strategy was released in 2001 and updated in 2007 to include plans for the creation of a Climate Change Network within GNWT's Environment and Natural Resources Division to "provide improved communications and coordination, improved monitoring and tracking and ... support efforts to address adaptation to climate change impacts in the NWT" (Government of the Northwest Territories, 2007a: 70), including the development of an impacts and adaptation plan.

Adaptation planning and action may be furthered by specifically targeted efforts including federally-funded programs such as the Northern division of the Climate Change

Impacts and Adaptation Network (C-CIARN North) and the Aboriginal and Northern Community Action Program (ANCAP). These have focused on improving understanding about environmental change, and engaging aboriginal and northern communities as active partners in climate change action. However, due to the pervasiveness of the issue, and recognition of the linkage between planning for climate and other types of change, considerations about environmental change implications are best integrated within other government programs (i.e. 'mainstreaming'; Smit & Wandel, 2006; Adger et al., 2007; Ford et al., 2007). For example, the recently implemented Aboriginal Aquatic Resources and Ocean Management (AAROM) program in the Great Slave Lake watershed recognizes that climate change ties into all environmental aspects under its mandate, and its implications must be considered in all decisions and actions (Giroux, 2006, pers. comm.). Programs like AAROM can be used to bring a range of stakeholders to the table, and to encourage inter-community collaboration around an issue that affects everyone within the Great Slave Lake watershed (Akaitcho Territory Government, 2006).

7.2.2 Themes

Adaptation is increasingly being recognized at all levels as an important focus for responding to environmental change. The above section outlines multiple important foci to address adaptation in the current context. This study clearly recognizes the importance of social and cultural ties as either facilitators or barriers to adaptation. Strengthening these dimensions is an important focus for capacity building. Strengthening human resources and improving education and knowledge transfer are also essential in this

endeavour. Policy development offers another area in which to incorporate environmental change planning and capacity building for adaptation through consideration and mainstreaming at local, regional, territorial and national levels.

7.3 Summary

Drawing on the previous results-based chapters, this chapter has identified and synthesized important findings on cross-cutting themes generated by the study. The first section discusses the role of actors and institutions in influencing adaptive capacity within the context of a dynamic social-ecological context. It outlines the predominant demographic characteristics and affiliations that appear to influence adaptive capacity in this study, including legal identity, family and location of origin, age, gender, education level, individual well-being, and economic and social status. It then discusses the determinants of adaptive capacity that emerged from this study. These include knowledge and skills, access to resources and technology, institutional support, social networks and equity. The local-scale study is then considered in the context of a broader, multi-level environment, foregrounding issues around aboriginal-state relations and the nature of ongoing negotiations for land and rights by the Dene and Métis.

The second section examines opportunities for strengthening adaptive capacity in northern social-ecological systems, using a bottom-up approach. It suggests several areas in which forward-looking steps can be taken, including building on culture, enhancing

social capital, improving human resources, and advancing efforts in education and knowledge transfer. It also discusses possible policy foci for adaptation.

CHAPTER 8: CONCLUSIONS

This dissertation draws on my research experiences in Fort Resolution (Deninu Kue), Northwest Territories, a small Dene community on the south shore of Great Slave Lake. Along with three other First Nations, DKFN is involved in land claim negotiations for Akaitcho Territory (Treaty 8), thus finding itself in the context of evolving self-government arrangements including some form of future co-jurisdiction for managing land and resources.

Dene and Métis leaders and local residents recognize that climate change is a cross-cutting issue that must be tackled collaboratively, as reflected by statements made in a July 2005 community workshop. Thus far, however, adaptation strategies undertaken in Fort Resolution have been reactive. To deal effectively with the increasing rate and multiple drivers of change, community leaders recognize that a more strategic, holistic approach is necessary (Boucher, 2005c, pers. comm.; Norn, 2005, pers. comm.; Simon, 2005a, pers. comm.). A range of different short- and long-term adaptation responses may be implemented to cope with individual or multiple changes (e.g. land use planning, local education campaigns, directed training, community-level financial investments). These strategies may also be undertaken in a sequential progression as changes intensify or as other options (e.g. new technologies, financial resources) become available. Focused planning and research activities, supported by local and regional initiatives, can encourage the recognition and implementation of proactive, adaptive policies and

activities to address areas of increasing vulnerability and support capacity-building at different scales.

Previous studies examining adaptive capacity and resilience in aboriginal communities have generally focused on those where culture and traditional livelihoods are prevalent, and where these factors are most relevant to adaptation. Most of these studies have focused on the Inuit, providing a striking picture of change and impacts, albeit relatively little focus on adaptation. These communities tend to be culturally homogeneous, providing discrete case studies where cause and effect relationships are fairly easy to discern. By contrast, this type of work is limited with other aboriginal populations in the Subarctic, a gap that has been addressed in part through this current study.

Fort Resolution is a relatively heterogeneous community where individuals and families have been artificially concentrated, where different rights apply to community sub-groups, where a series of major socio-economic as well as environmental upheavals have occurred throughout its history, and where a complex system of interrelationships exists. In such a system where culture is less intact and livelihood dependency has to some degree shifted away from the environment, community members experience change and its impacts in a different way than more traditional societies. The complexity of this context increases the difficulty of undertaking a truly holistic study, and may lead to more tenuous conclusions. This study has shown the important influence of socio-economic factors on shaping adaptive capacity and community resilience.

This study took on the difficult task of looking at interrelationships within a complex system, one that is not as easily tackled in a truly profound fashion as could be done in a more homogeneous community. As such, a complex mixed-methods methodology was used to ensure that the various parameters were covered. This type of holistic study is effective, but more difficult when applied to a complex system, where conclusions are necessarily more tentative. This chapter provides a summary of the dissertation, some areas for future research, a discussion of the main conclusions, and an outline of recommendations stemming from this study.

8.1 Dissertation Summary

This dissertation begins by introducing the context for this study, focusing on environmental change, impacts and adaptations in northern Canada. It provides a brief overview of the Northwest Territories case study site of Fort Resolution and the surrounding traditional territory. It also places the current social dimensions research within the broader context of a multi-disciplinary environmental change research initiative being undertaken with natural science colleagues.

Chapter 2 begins with a literature review of relevant themes. It discusses the elevated rates of biophysical change in Canada's north, related to climate and other anthropogenic causes such as resource development, hydroelectric dam development, and pollution. Changes in aboriginal socio-cultural and economic systems are also discussed, and linked to environmental changes. It is important to recognize that aboriginal

livelihoods and well-being continue to depend on connections with the 'land' in their traditional territory, and that environmental change is causing significant livelihood impacts. These strong connections to the land are reinforced by detailed TK, made up of knowledge, practices and beliefs that have evolved and been passed down over generations. The importance of this knowledge to more holistic understandings of environmental change has more recently become clear to researchers, who now advocate for aboriginal stakeholders to participate more collaboratively in the research process. Some examples of studies focusing on local observations of change are given.

Chapter 2 continues with a review of the bodies of theory that underpin this research. Concepts related to social-ecological systems are introduced, highlighting their interactive and dynamic nature. The systems approach to research and related understandings of resilience are discussed. Recent literature advocates more adaptive and flexible resource management to improve systemic resilience to change by improving its ability to respond to stress, learn, self-organize, and adapt. Understandings of vulnerability, adaptive capacity and adaptation are then discussed, with an emphasis on their relationship to sustainable livelihoods and well-being. Strengthening the capacity of individuals, households and communities to adapt to change is important for reducing vulnerability and for stimulating adaptation. At the policy level, adaptation is recognized as complementary to mitigation in dealing with ongoing environmental change. Vulnerability and adaptive capacity are socially and geographically differentiated, with localized processes often dictating the impacts on particular groups, and their response to exposure. Social and institutional dimensions of adaptive capacity play a particularly

important role in local-scale systems. The chapter outlines several aspects of social capital of particular interest, including connectedness among people (ties and networks), trust and reciprocity. After a note about the importance of local level analysis, an integrative conceptual framework for the study is presented, based on the above concepts.

Chapter 3 describes the methodological approach used, outlines the various data collection activities, briefly summarizes data analysis procedures, and outlines important methodological opportunities and challenges. This study was collaborative and primarily field-based, incorporating a mixed methods approach. Community-researcher partnerships were essential for ensuring that research responded to community interests. While the research focused primarily on TK and social science perspectives, natural science data were incorporated in multiple ways, as the case study was set within the context of a broader interdisciplinary initiative. Fieldwork was conducted in multiple return field visits between June 2004 and November 2006. Data verification was undertaken in March 2007, and final results were presented to the community in November 2008. Methods were integrated and complementary, including a two-day climate change workshop; semi-structured interviews with 33 land users and elders, and 19 individuals involved in environmental governance; a social dimensions questionnaire of 104 households; five focus groups based on scenarios of future change; 15 field visits with local guides in different seasons; and participant observation throughout the 10 months I spent in the field. Data analysis was conducted using NVivo® software for interviews and focus groups and SPSS® software for numeric questionnaire data. Rigour

and ethics were important considerations in this study, and data were periodically verified through presentations to community members throughout the project.

Chapters 4-6 are based on empirical study results. Chapter 4 provides an examination of past socio-environmental change and the resulting impacts on local livelihoods in Fort Resolution. It opens with a brief introduction to the three major perceived drivers of change in the SRD – natural deltaic evolution, climate change and river regulation – and identifies other environmental stressors. Much of the chapter is then dedicated to exploring local observations and understandings of variables within the environment that are undergoing change. Climatic variables include temperature, seasons, precipitation, snow pack, winds and storms. Major trends include warmer winters, more variable transition seasons, and more variable and unpredictable weather. Observed changes in the hydrological system were linked to river discharge, water levels, freeze up, ice thickness and quality, break up and flooding, and water quality. Important trends include increased variability in flow, reduced water levels and flooding, and reduced ice quality. These changes cause challenges for travel safety, among others. There are also many noted shifts in wildlife populations, including fish, migratory birds, ptarmigans, muskrats, beavers, other fur species, caribou, moose, bison and black bears. Observed trends include changes in migration patterns, population size and health, which alter availability and hunter access for harvesting. Furthermore, warmer winters result in animal pelts not reaching 'prime', translating to lower income for trappers. Other observations include changes in vegetation and fire patterns. Although mixed livelihood impacts are noted for most of the above variables, the large majority are negative.

The second part of Chapter 4 outlines human adaptation to changing conditions. The main strategies include the altering land use patterns, drawing on TK, using new technologies, economic diversification, drawing on social relationships, and accessing government resources. The relationships among change, impacts and adaptation are often non-linear and complex. Livelihood impacts often result from cumulative environmental pressures. Various factors or 'variables' are mutually reinforcing and may precipitate secondary and tertiary effects. Individual impacts can also be reinforced by non-linear, synergistic change and feedback. The consequence of these relationships is that certain sub-groups within the community are more vulnerable to the impacts of change. Land users are the group most affected by changing environmental conditions; however other disparities exist. It is common that the people who would benefit most from subsistence harvesting experience increased limitations on their land use. In contrast, those who have alternate income sources and use the land for recreation or for economically profitable activities such as tourism have access to technologies that facilitate and improve resource exploitation and safety.

The discussion about past adaptations provides the context for Chapter 5, which focuses on the range of social relationships and institutions that influence opportunities for adaptation in a complex and evolving social-environmental context. This chapter begins by outlining the major historical events and influences that have shaped the current socio-cultural and economic context in Fort Resolution. It briefly describes the fur trade history of the region and transition to a settlement-based mixed-wage economy. It also describes the evolution of governance and settlement in the region and introduces

the ongoing negotiations for both Dene and Métis. This historical information provides context for discussions of kin-based social structure, and interpersonal dynamics within the community. Important elements of social relationships are discussed, including trust in people and institutions, reciprocity and sharing, the link between social values and collective action, levels of group participation, and extra-community relationships.

Some critical themes emerge relating to the social dimensions of adaptive capacity. Social and human capital are recognized as key determinants at all scales. Family structures and interrelationships play a primary role in shaping social dynamics in town, acting either as a glue that binds people together or as a divisive mechanism that benefits certain groups while marginalizing others. Intersecting with family structures are defining features such as identity, both formal and informal, and the generational gap between age groups caused by residential schooling and active transition away from traditional culture. These challenges manifest in social issues such as abuse, crime and drug and alcohol use, and existing social dynamics often limit healing. However, social support structures are provided by both internal institutions and external linkages and networks, and these become most evident in times of crisis. As social conditions change, the types of ties between and among groups of people are in flux. This research indicates that while family group members generally remain strongly connected, the overarching sense of trust, respect and willingness to work together has diminished, weakening some of the lateral ties between groups. At the same time, adult family members have increased the number and strength of contacts with outside institutions, thus facilitating the vertical transfer of resources. This shift in the social structure has also influenced the manner in

which leadership emerges in Fort Resolution. Elected or hired leaders often spend significant amounts of time connecting with outside people and resources. However, when local action is required, another core group of community members steps in to accomplish what needs to be done. These individuals, who provide essential social glue in the community, are often not in designated or elected leadership positions, but tend to be otherwise engaged in community-level work. A further paradox exists in terms of drawing on local assets for leadership. Residents tend to place their highest trust in elders and traditional land users, yet these are the groups that are marginalized in large part from community-building and leadership processes. The above social linkages have both negative and positive outcomes for adaptation. Weakened lateral ties among groups challenge collaborative efforts; however, links to outside networks can be drawn upon to provide resources and contribute to an enabling environment within which adaptation can take place. It may also be beneficial to recognize the informal leaders as significant assets for community-building and adaptation, and engage them in a more targeted manner to encourage collaboration.

Chapter 6 examines current and future challenges and risks associated with two major drivers of change – climate and resource development – and outlines a number of adaptation strategies to prepare for possible future scenarios. Three qualitative scenarios of change were used to elicit community perspectives about possible futures based on either moderate or high rates of climate change and resource development in the area. The *Small Town* scenario was based on moderate influence of both drivers, *Shifting Seasons* focused on impacts from significant climate change, and *Boom Town* focused on

resource development (see Chapter 3 for full scenario descriptions). Vulnerability concerns for each scenario were related to the following areas: natural environment, culture and land use, social relationships, human health and well-being, politics and leadership, economics, and infrastructure and services. While there were many overlapping concerns, each scenario also presented unique challenges. Livelihood impacts are more generally negative, although *Boom Town* offers the starkest contrast between perceived likely negative and positive outcomes. In response to these areas of vulnerability, residents discussed a number of strategies for adapting outright and for building adaptive capacity. While some adaptation options are specific to individual drivers of change, others are more generic. The most prevalent adaptation responses respond to impacts in five sectors: environment and natural resources, economy, community management and development, infrastructure and services, and information and training. Clearly, a range of stakeholders must be involved in selecting and implementing such strategies.

Chapter 6 also outlines a range of adaptation challenges in the following areas: social norms and relationships, attitudes and values, human resources, politics and leadership, regulations, financial resources and infrastructure and services. While the majority of the proposed adaptation strategies appear to be more explicitly technical in nature, a substantial proportion of the challenges relate to social, cultural, behavioural or cognitive issues. This contrast is somewhat misleading, however, because in the context of a small, relatively isolated, culturally-linked First Nations community, implementing many of these strategies (especially over the long-term) necessarily relies on functional

social relationships both within local governance organizations and between the representatives and the people they represent.

Drawing on the three results-based chapters, Chapter 7 draws out some main themes from the study and discusses their relevance for research and policy-development on environmental change, with specific focus on resilience and adaptation. It discusses the roles of actors and institutions in building adaptive capacity and supporting adaptation within a context of transition and uncertainty. It considers the influence on demographic characteristics and affiliations among community members on adaptive capacity, including legal identity, family and location of origin, age, gender, education level, individual well-being, and economic and social status. The endogenous determinants of adaptive capacity in this context are then discussed. They include knowledge and skills, access to resources and technology, institutional support, social networks and equity. The chapter then places the local-level context in a broader perspective, considering the exogenous factors that affect adaptive capacity from the perspective of a multi-level enabling environment. It provides some insight into the nature of government support programs, regional economic development, aboriginal-aboriginal and aboriginal-state relations, and emerging self-governance arrangements.

The chapter goes on to discuss implications for strengthening adaptive capacity in northern social-ecological systems. It proposes that capacity-building efforts be focused at the local level and considered from a bottom-up perspective, recognizing external influences. The influence of several dynamics on the distribution of adaptation resources

are outlined, including the local-global dichotomy, the land-settlement dichotomy, form versus function, and connectedness as divisive or unifying. Several foci are proposed to address these dichotomies. Building on culture is of primary interest, and it is recognized that adaptive capacity corresponds well to traditional Dene Laws. Strengthening social capital also emerges as an important thrust, and may be initiated by building on shared values and understanding. A focus on developing human resources and education and knowledge transfer are also essential, and can be accomplished through activities at multiple levels. Further effort must also be made in the area of policy development. Adaptation should be considered and mainstreamed within policy at local, regional, territorial and national levels. The transitory nature of negotiations and anticipated development of new local-level self-governance structures provides an excellent opportunity to address and integrate these issues into the *modus operandi*.

8.2 Avenues for Future Research

This study has opened up interesting avenues for further complementary research. In terms of the social aspects of adaptive capacity, the issue of differential legal identity is not emphasized in the literature and may require more research attention. It would also be fruitful to undertake a comparative study in a community where individuals and groups are already collaborating on adaptation strategies to evaluate the influence of social dynamics. In fact, this research has already stimulated follow-up work by members of the SRD interdisciplinary environmental change research team with Vuntut Gwitchin First Nation in Old Crow, Yukon.

There are also multiple avenues for research focused on the selection and implementation of adaptation options. It may be feasible to implement a significant range of adaptations with minimal cost; however, comprehensive studies of costs and benefits require more attention (IPCC, 2007a). Fort Resolution and other small northern communities require a targeted, in-depth analysis of these factors. It may be beneficial to implement an adaptive management approach, where experimentation with individual capacity-building efforts is periodically monitored and evaluated to determine the most effective application of response strategies.

In this time of transition as treaty negotiations evolve towards a final agreement, it will be instructive to monitor progress and address multiple aspects. Avenues of particular interest would include an evaluation of how considerations about the impacts of environmental change are incorporated or 'mainstreamed' into the planning process. Follow-up work could be done around the question of whether and how policies to support adaptation and capacity-building are incorporated into the agreement itself and how they are subsequently implemented.

There are other avenues of equal interest. An important research endeavour could address the implications of reduced or changing TK and land use for control and monitoring over the traditional territory. Issues around land-based identity and sense of place may offer important perspectives. These and other efforts to link TK with social science approaches may better help to address how traditional knowledge and skills are linked to health and well-being (e.g. in areas such as food security and food safety).

There is also substantial scope for furthering comparative work that draws on TK and both natural and social science knowledge. For example, a combination of harvesting, food use and food preference data with wildlife population data and models of ecological change could contribute to more precise wildlife management and harvesting recommendations for targeted areas. At the same time, both back- and forward-projections of hydrological and climatic conditions can improve community understandings of how future conditions might relate to past conditions, and help in identifying past adaptation strategies that may be useful in the current or future context.

8.3 Conclusions

This research explored a number of gaps in current vulnerability and adaptation research in the northern Canadian context. It focused on a critical deltaic ecosystem and a small northern community (Fort Resolution) that has complex historical and present-day connections to that environment. The focus on the social-ecological vulnerabilities of a delta-dependent community is important for other communities in the Mackenzie Basin system and others that rely heavily on hydrological conditions for their livelihoods. However, results are also applicable to other small, rural, aboriginal communities in Canada and elsewhere.

As this research has progressed, there has been a parallel and complementary advancement in the field of community vulnerability to northern change (e.g. Ford & Smit, 2004; Ford et al., 2006b, 2006a) and in the field of northern impacts and adaptation

research more generally (e.g. ACIA, 2004, 2005; Nickels et al., 2006; WWF, 2008), the majority of which is focused on Inuit regions. This study adds to the growing literature in these areas and adds a local perspective from the Dene and Métis that is both holistic and highly detailed, addressing multiple dimensions of change and vulnerability.

Primary contributions include theoretical advancements regarding social capital, traditional knowledge, and the relationship between local-scale social dynamics and adaptive capacity in rural aboriginal communities; methodological advancements relating to the mixed methods approach and application of qualitative scenarios; and practical outcomes including an improved understanding of the applicability of adaptation options, and the identification of challenges and opportunities for both multi-level governance and capacity-building for adaptation. These are discussed in more detail below.

8.3.1 Theory

The results of this largely empirical study make important contributions to the theoretical literature. Research outcomes more clearly link aspects of social capital to adaptive capacity, and offer several threads of interest for further study. As well, the research contributes to understandings of traditional knowledge in the contemporary context.

8.3.1.1 Social capital and adaptive capacity

Responding to the need for local-level adaptation assessments, this study provides an improved understanding of adaptive capacity at the local scale, with particular relevance for small, rural, aboriginal communities in northern Canada. It identifies both endogenous and exogenous determinants of adaptive capacity in this context, with particular focus on often informal social dimensions.

Of particular interest is the influence of demographic characteristics such as age, gender, ethnicity, educational attainment, and health on the ability of individuals, households and communities to cope with risk (Smit et al., 2001). Two additional factors emerged from this study as having important influence on adaptive capacity, ones that likely apply to many other small, aboriginal communities situated within broader colonial states. The notion of legal identity is likely most relevant in Canada where the Métis are now recognized as aboriginal, but have different historical experience from the First Nations in terms of their treatment and designated rights. This difference plays out in the current day as a mechanism for marginalization and under-representation (Chapters 5 and 7). Similar dynamics may occur in other states where individuals are required to prove aboriginal status to receive material benefits, thus ensuring some marginalization. The second characteristic, that of family ties and location of origin, is of particular importance in aboriginal communities whose structure consists of an amalgam of multiple smaller, previously semi-nomadic groups that have settled together, whether through coercion or choice. Family affiliations influence social status, the size of kin networks and affiliations, relative political and social influence, and access to resources and jobs

(Chapters 5 and 7). These notions reflect the importance of recognizing heterogeneity within a community, and identifying barriers to achieving collective action. Existing system structures serve the interest of some people, while marginalizing or excluding others. In this context, we must ask whether it is realistic to contemplate collaboration. This research shows the importance of taking power relationships into account, understanding how they develop, assessing their rigidity, and determining the contexts that might stimulate collaboration. Depending on context, it is important to identify whether such power relationships may be positively influenced only through internal dynamics or whether external inputs might also play an effective role.

Underlying social norms in the community play an important role in facilitating or impeding joint action towards collective outcomes. While traditional cultural norms (e.g. those around reciprocity and trust) are changing with the increasing influence of Euro-Canadian society and goods, locals recognize that traditional norms (e.g. those outlined by Dene Laws; Table 7.2) are still applicable to current day situations, and that they can support adaptive capacity in the community (Table 7.3). The existing grassroots interest in reviving and drawing on these norms should be encouraged through collaboratively-determined policy measures and activities at multiple scales, beginning with local organizations. While not specifically targeted at dealing with environmental change, an increased focus on cultural education and activities would provide a strong foundation and base of knowledge to draw on in times of need.

Through the research process, it became clear that there are different layers of social capital that exist at the local level and contribute to collective outcomes in different and sometimes contradictory ways, depending on context. In this small, highly interconnected society, while interpersonal tensions and conflicts visibly impact local relationships, strong bonding ties based on kinship connections exist below this surface. The strength of these ties becomes evident when community members, despite their differences, band together and support each other in times of crisis or when their collective rights are threatened. At the same time, psychosocial patterns such as the belief that 'things will never change' can negatively impact the effectiveness of such bonds. Similar patterns likely exist in other communities. Further work to identify barriers and effective trigger points for activating this underlying resource in non-crisis situations would be useful.

At the same time, local-level relationships in remote communities are changing, and external ties are increasingly important within a rapidly modernizing socio-economic environment. Connections between locals and others outside the community (especially those external to the kin group) are resources that can enable the leveraging of financial and human support, among other benefits. As such, individuals who have the capacity and have learned to speak the necessary 'language' to engage in political and economic affairs, are significantly advantaged. While these relationships may enable cross-scale collaboration and facilitate local economic development, they may also act as further participation barriers for groups that are already marginalized. The evolving and

heterogeneous nature of local scale social capital and implications for cross-scale collaboration offer important avenues for continued research.

8.3.1.2 Traditional knowledge

Much of the foundation of this dissertation is based on the traditional knowledge of community members in Fort Resolution. However, both insider and outsider understandings of what TK is and how it can be usefully applied are in a continued process of transition. It is important to recognize some of these trends and consider theoretical as well as practical implications (e.g. effects on research design, implementation, analysis and interpretation).

First, TK is not distributed evenly throughout the community (Chalmers & Fabricius, 2007). Locals have different levels and foci of expertise, thus TK about changes on the land is concentrated with a specific group of individuals. In Fort Resolution, while the 'priority experts' determined through community consultation provided very detailed knowledge about environmental phenomena, the knowledge of each individual was determined by the intensity and consistency of his or her land use over time, the diversity of activities undertaken (which relates to seasonal use), and the geographic location of these activities. While many individual observations were consistent both within and between locations, there were exceptions (discussed in Chapter 4). The variation in levels of knowledge about the land was reflected in several of the focus groups where active and knowledgeable land-users dominated the discussion, and in semi-structured interviews where higher priority experts tended to share more

detailed and nuanced knowledge. It is important to design one's research approach to take such variation into account.

Second, all but a few of the residents in Fort Resolution reported that the spiritual dimension of TK has been greatly suppressed, and in many cases lost, due to religious conversion, residential schooling, and the now ubiquitous influence of western worldviews and knowledge. This trend is also evident in other northern communities (e.g. Old Crow, Yukon; Kyikavichik, 2008, pers. comm.), where the younger generation may learn skills and knowledge about land travel and harvesting, but are not privy to the ethical values and spiritual associations that add connectedness and meaning, and the establishment of a conservationist ethic. As such, traditional knowledge as a concept may be differentially conceptualized by different groups within the community (e.g. elders defining it in a more traditional way compared to youth who may define it in more functional terms), leading to an evolution in the definition of 'traditional knowledge' that is more in line with its contemporary uses. As a researcher, it is important to recognize that the term 'traditional knowledge' may not have exactly the same connotation to members of different generations within a community, and this may impact the type of knowledge that people are willing to share.

Third, TK interpretations are often influenced by external information generated and communicated by the popular media and by scientists. Television, especially, has brought in many outside ideas that would not previously have been accessible, and these new ideas have influenced the way local residents interpret their environmental

surroundings. In this way, the nature of knowledge in most communities takes on a hybridized form. In Fort Resolution when participants were asked about their knowledge of environmental changes during semi-structured interviews, several spoke about specific events (e.g. forest fires, tornadoes, presence of cougars) that they had learned via radio or television, or through interactions with scientists. Their thoughts shifted freely back and forth between observations from their own on-the-land experiences and those garnered through secondary sources. This is consistent with traditional modes of knowledge generation and evolution. Land-users traditionally (and still) confer with each other about the location of animals and the state of specific environmental variables (e.g. weather, ice and water conditions for travel), and incorporate this into their knowledge base. Television and other knowledge transfer modes such as scientific presentations have become but another source of information to draw on, contributing to a more holistic understanding. The embeddedness of this externally-produced knowledge makes it difficult (and counterproductive) to clearly distinguish between TK and 'other' components.

8.3.2 Methodology

While the mixed methods approach used in this study offered multiple challenges in terms of implementation and analysis, the product is much richer and more holistic than it would otherwise have been. This section outlines the primary methodological contributions from this dissertation.

Many assessments of vulnerability and adaptation to change isolate the effects of specific types of stress or hazards (e.g. drought) on specific sectors (e.g. agriculture) or systems (e.g. socio-economic; Reid & Vogel, 2006). However, it is increasingly recognized that exposure to multiple stressors may increase vulnerability and require a more comprehensive approach (O'Brien & Leichenko, 2000; O'Brien et al., 2004). The mix of methods used in this study provided complementary information that facilitated triangulation and allowed the examination of specific issues from a range of perspectives. It also provided scope for a dynamic dialogue with community members who were involved in varying capacities throughout the project.

A mixed methods approach allowed me to integrate different, but complementary research foci. The study of past environmental change, impacts and adaptations (Chapter 4) required the gathering of detailed information from individuals with the most intimate knowledge of their environment, namely current-day land-users and elders who have lived parts of their lives on the land. These data were most readily obtained through in-depth interviews and participant observation with a small segment of the population. The further two main research foci, the social dimensions of community adaptive capacity (Chapter 5) and planning for change (Chapter 6), required engagement with a broader cross-section of stakeholders.

Through repeated visits and interactions, the nature of my fieldwork allowed me to build iteratively on information collected in the early stages of the project. For example, the strong focus of respondents on socio-cultural change in early interviews

highlighted its importance as a factor that affects vulnerability and adaptive capacity in the community. I was able to explore this aspect in detail using other complementary methods later in the project (e.g. a community survey and focus groups). In this way, data collected in early project stages formed the foundation upon which subsequent work was developed (see Figure 3.1).

In a research setting where one is interested in somewhat abstract concepts like 'adaptive capacity', visual images help to make the research more accessible and concrete, thus encouraging the local population to participate. Here, the use of different types of visual tools was important for stimulating discussion during interviews and focus groups. Topographic maps (1:50,000 and 1: 250,000) of the DKFN traditional territory were used in the TK interviews to better determine the location of events in space, while providing a stimulus for discussion about areas that might otherwise be ignored.

The graphic scenario images (Chapter 5) were particularly useful in reaching a broad audience, both through group and individual discussions. They were used to engage people of all ages, backgrounds and levels of education. Their effectiveness was reflected in the first focus group, where we used both visual images and several pages of typed bullet points describing the symbols and general content of each scenario. One participant later commented that the pictures were very useful, and that he was able to fully participate in the discussion despite his inability to read the textual material.

Furthermore, these types of scenarios may be particularly useful in an aboriginal context. Two community leaders described the scenarios as living, breathing models, consistent with the holistic aboriginal worldview. Since the scenarios are more symbolic than predictive (or prescriptive), the discussions they generate become stories that change and evolve, much like oral history that is passed down from one generation to the next. Such scenarios offer an alternate and relatively inexpensive approach to more intricate scientific models of change, and help to translate complex scientific projections into locally-relevant terms. Other visual materials (e.g. research presentations, pamphlets, posters) were also important for the effective sharing of preliminary findings and results.

This study showed that there are many nuances within the local context that influence adaptive capacity, but may not be readily recognizable through more cursory evaluations. The long-term nature of this study, the duration of time in the field, the depth of relationships with community members, my integration into and participation in daily community life were all essential to gaining a more nuanced understanding of the dynamics that shape access to resources, the allocation of authority and participation in decision-making. A more ethnographic approach is important for gaining such detailed understandings of local-scale adaptive capacity. This approach fits well within the new collaborative research paradigm espoused for northern research. Relationship-building is key to the success of research partnerships in this context, and must be approached as a long-term endeavour.

From a cultural sustainability perspective, encouraging the active use of TK within aboriginal communities as conditions change helps to ensure that it evolves and remains a relevant and applicable source of information. This requires a shift in research mindset and approach, from one of documenting TK to prevent or pre-empt its extinction, to one that recognizes and values TK as a source of knowledge that changes and *evolves* with the world around it (McGregor, 2004). Maintaining the ability to draw on different types of knowledge is important as the rate of change and amount of variability continue to increase. These understandings point to the need for the fundamental involvement of local communities in decision-making about their lands, stemming from the grassroots level. Some authors believe that scientists, managers and communities must move beyond the western paradigm and seek out culturally-relevant ways of being and doing environmental management to identify important elements through reconnection to culture. Some believe that this can only be effectively carried out by indigenous community groups themselves (McGregor, 2004).

While there are many positive outcomes to drawing on multiple types of knowledge, and addressing TK in particular, this is not by any means a straightforward and easy process. The cross-cultural nature of the work introduces further complexity (Twyman et al., 1999). There are multiple strategic and operational issues that must be considered by an outside researcher working in a northern aboriginal community such as Fort Resolution. Several challenges experienced in this study are addressed earlier in this dissertation (see Chapter 3) and in conjunction with other cross-cultural research experiences in Wesche et al (In press). Here, I synthesize some of the most important

contributions to inform other researchers contemplating similar types of approaches or work.

First, at a strategic level, the intention to incorporate TK as a substantive component of this research study, as requested by members of the elected community leadership in 2002 was the driving factor in developing an appropriate participatory research approach and study design. The participatory nature of this study took the form of a people-centred learning process for which there is no clear blueprint. While this encourages the inclusion of diverse views and issues, it also introduces some unpredictability in terms of how the process develops (Chambers, 1997). Thus, while such an approach has many benefits (Sillitoe et al., 2002), it requires significant inputs of time, energy and flexibility throughout (St. Denis, 1992). For researchers, it also requires ongoing personal reflection, creative thinking and action, and – especially for those who are newer to the field – trust that the endeavour will result in a worthwhile outcome on multiple levels (e.g. as an academic endeavour, in terms of benefits to community partners, and on the level of personal experience).

In this study, one of the strategic challenges was matching academic requirements with community-driven time-frames. With regards to the academic process, researchers are often limited by time and funding, and must produce viable results within a specific time period. In my case, when unexpected events affected local participation levels during one period of fieldwork, I was uncertain whether I could complete the desired number of interviews before my departure date. It is essential to find creative ways to

ensure that the job is completed (e.g. hiring additional research assistants, finding new ways to recruit participants, etc.), otherwise neither the researcher nor the community will benefit. Building in extra flexibility with regards to the timing and duration of field visits and the manner in which available funding can be utilized is vital.

With such a long-term endeavour, levels of community interest and participation naturally ebb and flow over the course of the project, depending in large part on the emergence of other personal or communal priorities. Although I made recurrent presentations of my research progress, it was at times difficult to maintain local interest over the long-term. Designing the research so as to produce a cumulative series of directly applicable, shorter-term results is preferable, if possible.

At the operational level, there are practical and technical issues to consider in the implementation of such a study. First, and most importantly, attention and time must be put into the development of collaborative relationships with community leaders in both political and other community-based organizations. While gaining the support of such individuals and their organizations is critical to the initial and long-term success of the research, it is not sufficient. In small communities such as Fort Resolution, turnover in leadership is high, and individuals also commonly change positions within organizations. Researcher-community partnerships must be actively maintained and cyclically renewed, often requiring repeated presentations of research ideas and progress to newcomers at fieldwork intervals.

Second, with the advent and boom of resource development interest and projects and renewed research focus in the Canadian North (e.g. International Polar Year), both community leaders and members are saturated with information and requests for their time and input. Many communities have multiple information sessions and consultation meetings around a diverse array of issues and events each month which members are expected to attend. This can lead to research burn-out, where some individuals (or possibly entire communities) become unable or unwilling to participate in studies. It is difficult to gauge likely participation levels for interviews and focus groups solely through communication with community leaders during the project initiation stage. This underlines the necessity for an on-site scoping visit to meet and interact with lay-members, improve understandings of locally-shared issues, and gain perspective on community dynamics and other potential challenges that may influence the research.

Third, as an outsider one must realize that things often work differently in cross-cultural field sites, and be ready for unexpected consequences (Wesche et al., In press). For example, in many small, isolated aboriginal communities, it is common that all meetings and work will stop during several days after a resident passes away, since the entire population is affected. The energy of the residents will be collectively focused on the family of the deceased and on dealing with their own grief, rather than following through on research commitments, and rightfully so. As well, individuals may have their own priorities, whether pre-planned or not, that may preclude their participation in research activities (sometimes at the very last minute). Effective cross-cultural research requires one to be a respectful listener, engage in sometimes difficult and challenging

discussions and relationships, and pay careful attention to nuances in the lives of participants (Howitt & Stevens, 2005). Researchers can best prepare for this by developing their study design with flexibility in mind, and by being able to respond rapidly and creatively to the delays and changes induced by unexpected events.

In this study we were fortunate to engage in an interdisciplinary process that was largely bottom-up (particularly this social science/traditional knowledge component; see Figure 1.2) and linked stakeholders, researchers and information across scales. While the development and implementation of the complementary components and the incorporation of a range of researchers and stakeholders was a challenging endeavour, it resulted in a wealth of cross-cultural and cross-disciplinary sharing and learning. The outcomes from this type of model reflect many of the potential benefits of a multi-level governance structure that emphasizes a holistic perspective and facilitates communication across multiple levels of organization.

8.3.3 Practice

While contributing to both methodology and theory, this research also resulted in a range of practical outcomes that offer insight to both community members in Fort Resolution and researchers, while also being applicable in other similar contexts.

Environmental change affects people through multiple pathways, where groups are differentially impacted depending on their social and economic circumstances. While individuals and households may be able to respond to certain types and degrees of

change, the cumulative impact of multiple stressors often weakens their ability to respond effectively. The nature of existing and projected environmental changes, which are likely to be both rapid and non-linear, requires a collective response. Developing understandings of adaptive capacity for northern communities is not a straightforward endeavour. Each community is a complex system (within a nested hierarchy of systems) where different drivers act at multiple levels. Adaptation requires an understanding of what one is adapting to, and a vision of where one wants to go. Adaptation is easier to implement on the individual level, but more difficult in larger societal groups. This research exposes many contradictions and disconnects among community members in terms of both their understandings of what is driving change, their interpretation of the resulting impacts, their aspirations for the future, and priorities for resource allocation. This greatly complexifies the task of developing a common strategy through consensus-building at the community level.

Adaptive capacity is socially differentiated (Ford et al., 2006a), unevenly distributed, and lacking in many areas (Burton, 2003). It is also specific to culture and place (Adger, 2003a), limiting the potential to scale up models (Smit & Wandel, 2006). Policy interventions for planned adaptation at national/other levels may not reflect local sensitivities, and thus will differentially affect the adaptive capacity of communities (Adger, 2003a). This reinforces the notion that capacity-building and adaptation must be grounded in the local context. This study contributes to an important sub-set of climate change adaptations research, which focuses on 'practical application'. This type of work takes a 'bottom-up' approach, relying heavily on community participation in definition of

variables that contribute to exposure-sensitivities to change, and adaptive capacity. Furthermore, this depth of involvement improves the likelihood of adoption of resulting recommendations, as they have contributed directly to ensure that outcomes reflect local needs and priorities, and take into account the feasibility of implementation (Ford et al., 2007).

The qualitative scenarios were particularly useful in prompting participants to consider potential changes in their environment and to pinpoint areas where they can make improvements. The analysis of results shows that there are many types of impacts that overlap between scenarios, highlighting areas where adaptation planning and capacity-building is most likely to be effective, regardless of outcome. The most prevalent and broadly applicable adaptation options outlined by participants fall under the sectors of environment and natural resources, economy, community management and development, infrastructure and services, and information and training (see Chapter 6). Recognizing these areas of overlap and evaluating the ease of implementation of various adaptation strategies can help communities prioritize areas for resource allocation and capacity-building.

The reliance of community members on external sources of income (e.g. transfer payments from the Government of Canada) does little to stimulate local engagement in collective efforts. Decision making about the various aspects of resource and environmental management must be done in conjunction with local users. While the trend in Akaitcho Territory may shift towards improved cross-scale collaboration once the land

claim is resolved, this process will likely further marginalize non-First Nations Band members, regardless of their historical and current participation in land based activities. Beyond the development of a multi-level co-jurisdiction body, there is a need to create horizontal connections among local-level governing bodies (e.g. Band, Métis and Municipal Councils) to streamline policies around issues like resource user access and monitoring.

Enhancing the adaptive capacity of the larger community within the context of human well-being and sustainability will necessarily also enhance individual capacities. To ensure that positive adaptive action is implemented, it is necessary to address the structural underpinnings that contextualize the social and institutional system. As such, it requires a dual process of *stimulating* latent adaptive capacity by drawing on existing assets, and of *strengthening* and *developing* that capacity by further building on those assets. At the same time it is important to assess how potential interventions may differentially affect social groups, and prioritize actions that benefit the most vulnerable. Improving the well-being of marginalized groups stands to raise collective well-being.

Waiting for communities to develop their latent adaptive capacity is unlikely to succeed (Ritchie, 2006, pers. comm.), thus proactive assessments, planning and action are necessary. These require external inputs of resources and in some cases, expertise. Adaptation will not be cost-free; cross-scale coordination and commitment of appropriate resources is essential. The Government of Canada must take an active role in dedicating both human and financial resources to capacity-building at the community level.

Interventions and policy decisions, whether direct or indirect, must be made in a way that supports multiple response pathways to deal with a range of stresses. Examples of direct support include subsidies and education programs for traditional land use activities, and training and education in self-governance that targets both youth and adults. An example of indirect support includes improving economic activity in the region.

'No regrets' measures can provide an initial focus, while environmental change considerations are mainstreamed over time with development policy to ensure that outcomes are sustainable over the long term and relevant to local priorities. On the political scene, managers are needed to run programs and help build human capacity within the community (Boucher, 2006b, pers. comm.). At a more basic level, the government is expected to take a role in educating people, both youth and adult, about climate change (Sayine, 2006, pers. comm.) and other global pressures. The school system provides an important mechanism for transmitting relevant messages and educating the next generation of northerners to effectively understand the issues, think critically, and be creative and adaptable in determining solutions.

The responsibility for leadership in dealing with climate change is clearly shared among multiple levels of government (Council of the Federation, 2007; Ecology North & Dene Nation, 2007), requiring cross-scale collaboration and synchronization of activities. Implementation may be addressed through partnerships with industry and NGOs, and relies on the cooperation and initiative of individual members of society. There is a need to address environmental change at a range of different levels, from local to international,

and assess both challenges and opportunities for implementing effective strategies. To achieve results, local governments must identify and build on existing assets, and support capacity-building in different sectors. Regional and national governments must recognize the need for an encompassing enabling environment by engaging in collaborative development of adaptation strategies and providing resources where needed.

Despite the many challenges to building adaptive capacity and effectively adapting to change in Fort Resolution, the current era is one of much opportunity. Major shifts in political power and involvement are underway in Akaitcho Territory, further strengthened by rising public awareness, both within and outside the North, and interest in climate change in general and northern issues in particular (thanks in part to the International Polar Year, and to recognition of the work of activists like Sheila Watt-Cloutier, 2007 Nobel Peace Prize Nominee, and Al Gore, 2007 Nobel Peace Prize winner). As the effects of environmental change become more apparent and recognized in the north, people have been adapting at the individual scale, while a longer response period is required for necessary shifts in the broader organizational and institutional structures. This current time of transition provides an opportunity to address the impacts of environmental change for future generations through the effective incorporation of necessary changes into new plans and policies.

8.4 Recommendations

Efforts to adapt to environmental change and variability in northern Canada must be understood in the context of regional-scale resource development and other social processes such as institutional changes produced through comprehensive claims agreements and self-government. To date, adaptation research in the northern Canadian context has not been explicitly linked to the institutional development and capacity building implications of these decentralized management models. This dissertation offers practical recommendations in a number of areas, particularly for actions at the local level and for policy at multiple levels. Finally, it offers recommendations for other researchers undertaking this type of work.

8.4.1 Environmental quality

Survey participants contributed to a list of concrete actions that could be taken to improve environmental quality in the community and surrounding area. The primary recommendation was to clean up the town, with specific focus on reducing garbage and pollution, removing abandoned buildings, and implementing a waste management program. Environmental monitoring was also seen by many as an important undertaking, and emerged again in the focus groups in relation to adaptation. Various infrastructure upgrades were also suggested regarding the garbage dump, the local roads and the sewage lagoon, among others.

8.4.2 Visioning and adaptation planning

Results from this study indicate that the development and implementation of a concrete adaptation plan is difficult unless based on a broadly agreed-upon community vision, a joint sense of purpose and direction. Local government organizations should take a proactive role in working together to move forward with both of these endeavours. This could be done through the establishment of a multi-agency environmental change working committee to encourage cooperation and provide accountability to residents through the visioning and planning processes. With the help of an external facilitator, it would be useful to build on the environmental change scenarios developed in this study to engage community members in visioning exercises about the future, extend discussion around priority issues, collaboratively prioritize objectives for resource allocation, and develop a concrete adaptation plan for the community. As a requirement, the plan must be consistent with the objectives set out in Treaty 8 negotiations to improve the feasibility of implementation.

Local governance organizations (DKFN, Métis Local and DCC) can also take important steps to improve policy to respond to a rapidly changing environment. The identification and implementation of 'no-regrets' options would provide a net benefit regardless of social-ecological change outcomes (e.g. environmental monitoring, community planning, improved community consultation, environmental education, cultural development). Furthermore, climate change considerations should be mainstreamed into all local government decision-making and programming.

Capacity-building within the community must occur concurrently. At a basic level, continued efforts must be made to raise awareness among community leaders and membership about the impacts of climate change and other environmental stressors. Building on existing local assets will improve outcomes. A focus on repeated or longer-term activities (rather than discrete events) that develop cultural identity and encourage social cohesion (e.g. culture camp programs, annual community hunts, elder-youth sessions on cultural themes) is preferred.

8.4.3 Governance

Adaptation planning cannot occur effectively unless governance bodies are appropriately structured and activities are coordinated between local and regional levels. Local governments would benefit from active engagement with other South Slave communities to share knowledge and best practices. Furthermore, the development of a centralized and accessible information database or climate change coordination point within DKFN or elsewhere in the community would facilitate information exchange among organizations and avoid duplication of efforts. As a start, local organizations should partner with agencies that monitor environmental variables (e.g. NWT Power Corporation, GNWT) to improve information exchange. Once an adaptation plan is outlined, local leaders should work with GNWT and Federal Departments to garner an appropriate commitment of resources for implementation. Actions should be integrated with other programs wherever possible (which may become more streamlined with the development of the NWT climate change adaptation plan).

8.4.4 Collaborative research

This research process offered a significant learning opportunity for me. Here, I outline some recommendations for other researchers contemplating similar research approaches (see Section 8.3.2 and Wesche et al. (In press) for a more in-depth discussion). First, collaborative, people-centred approaches require significant inputs of time and energy, as well as personal reflection, creative and flexible thinking, and trust that the result will be worthwhile. Second, leave-and return field visits are important for demonstrating commitment and allowing time for analysis and preparation of next steps. An initial scoping visit allows the researcher to understand the context and pinpoint issues that are of interest to the community. Finally, the importance of spending time building relationships with community partners cannot be overstated. These relationships are essential for high quality and effective research outcomes and, on a personal level, can be a most satisfying benefit of undertaking this type of work.

8.5 Final Thoughts

The research process and development of this dissertation has been an important journey for me on both academic and personal fronts. I have learned much about how individuals and communities are being affected by a rapidly changing environment, how they cope, and how some positive steps are being taken towards more collaborative and coordinated adaptation efforts. I also learned a lot on the human front, and have much gratitude for the many people who taught me about community living, social dynamics,

worldviews, cultural traditions and the human spirit. I hope that what I have written here offers a positive contribution to your efforts at renewing the sense of strong community that I see in each of you.

APPENDIX A: List of land user interviewees

Name (N=33)	***Territory of Primary Expertise***
Alphonse King	Taltson River, East Arm Great Slave Lake
Angus Beaulieu	Slave River Delta
Bernadette Unka	Little Buffalo River
Billy Lockhart	Taltson River
Denise McKay	Taltson River; Slave River Delta
Don Balsillie	Taltson River
Doris Beck	Taltson River
Eddie Lafferty	Little Buffalo River
Fred Mandeville	Little Buffalo River, Slave River Delta
Gabe Yelle	Taltson River
Gabriel Lafferty	Slave River Delta, Little Buffalo River
George Giroux	Taltson River, Simpson Islands
Harvey Mandeville	Little Buffalo River
Henry Beaulieu	Little Buffalo River, Slave River Delta
Henry King	Taltson River
Henry McKay	Slave River Delta
Henry Yelle	Taltson River
John Cree	Taltson River
Johnny Simon	Taltson River
Kenneth Delorme	Little Buffalo River
Kevin Boucher	Taltson River
Lawrence Fabian	Little Buffalo River, Slave River Delta
Lena McKay	Slave River Delta
Lester McKay	Slave River Delta
Margaret Sayine	Taltson River; Slave River Delta
Mary Pierrot	Little Buffalo River
Maurice Boucher	Taltson River
Paul Smith	Taltson River
Pete King	Slave River Delta, Simpson Islands
Robert Sayine Jr.	Slave River Delta
Rocky Lafferty	Slave River Delta
Solomon King	Taltson River
Tom Unka	Little Buffalo River, Slave River Delta

APPENDIX B: List of resource manager interviewees

Name (N=19)	**Affiliation (at time of interview)**
Annie Boucher	Executive Director, Akaitcho Territory
Diane Giroux	Coordinator, Aboriginal Aquatic Resources and Ocean Management (AAROM) program, Fort Resolution
Don Balsillie	Former Chief, Deninu Kue First Nation, Fort Resolution
Doug Ritchie	Director, Ecology North, Yellowknife
François Rossouw	Fur Marketing/Traditional Economy, Environment and Natural Resources, Government of the Northwest Territories, Yellowknife
Irvin Norn	Band Manager, Deninu Kue First Nation, Fort Resolution
Lloyd Cardinal	President, Métis Local, Fort Resolution
Lorne Napier	Lands Manager, Dene Nation, Yellowknife
Moh Odeen	Principal, Deninu School, Fort Resolution
Pat Simon	Environment Manager, Deninu Kue First Nation, Fort Resolution
Paul Boucher	Community Negotiator, Treaty 8, Fort Resolution
Pete Ewins	Director, Arctic Conservation Program, WWF-Canada, Toronto
Raymond Simon	Band Councilor, Deninu Kue First Nation, Fort Resolution
Richard Simon	Former Mayor, Fort Resolution
Robert Sayine	Chief, Deninu Kue First Nation, Fort Resolution
Ronald Boucher	Lands Researcher, Deninu Kue First Nation, Fort Resolution
Shannon Ward	Acting Manager, Environment and Conservation, Renewable Resources and Environment, Indian and Northern Affairs Canada, Yellowknife
Tom Unka	Environmental Consultant, Deninu Kue First Nation, Fort Resolution
Wilfrid Simon	Community Wellness Counselor, Fort Resolution

APPENDIX C: Questionnaire: Social dimensions of adaptive capacity in Fort Resolution, NWT

Respondent:	**Code: FR-2006-**
Interviewer:	**Date:**
Location:	**Time:**

These questions are meant to tell us something about this community. Please remember that your answers will be kept completely confidential.

** If the respondent does not choose an available answer, please indicate the following: Don't know=DK, Not applicable=NA, Prefers not to respond=PR*

Section I: INDIVIDUAL INFORMATION

1. Gender	Male Female
2. Age group (25-35, 35-45, 45-55, 55-65, 65+)	
3. Birthplace	
4. Years in Fort Resolution (total)	
5. Main occupation and sources of income	
6. Number of people living in household	
7. Cultural group	Dene Métis Other
8. Highest level of formal education	
9. Additional training in past 5 years? What training? How long?	

SECTION II: OUR COMMUNITY

1. Overall, the current condition of the land and water in and around this community is:

1. Very good
2. Good
3. Average
4. Poor
5. Very poor

2. In the last ten (10) years, the condition of the land and water in and around this community has:

1. Gotten better
2. Stayed the same
3. Gotten worse

3. What are the two main actions that could be taken to improve the environmental conditions in and around this community?

1) _____

2) _____

4. In the past ten (10) years, the overall quality of life of individuals in this community has:

1. Gotten better
2. Stayed the same
3. Gotten worse

5. What are the two main reasons that the quality of life has gotten better, worse or stayed the same?

1) _____

2) _____

6. Does the future of this community depend more on what happens inside this community, on influences that come from outside the community, or both?

1. Inside
2. Both inside and outside
3. Outside

SECTION III: GROUPS, NETWORKS AND LINKAGES

7. How often do you visit each of the following communities?

	Every Week	Every Month	At Least Once A Year	Almost Never
Hay River				
Fort Smith				
Yellowknife				
Lutsel K'e				
High Level				
Peace River				
Edmonton				
Dettah				
Ndilo				
Other (specify)				

8. Please tell me if anyone in your household participates in the following groups or activities?

	Name of group or activity	Which household members involved - male/female -adult/youth MA / FY	Level of Activity in group 1= Leadership role 2= Very active 3= Somewhat active 4= Limited participation
Artistic, musical or hobby group (e.g. sewing club, music band)			
Business committee (e.g. economic development)			
Religious or spiritual group (e.g. church, bible study, healing circle)			
Cultural group (e.g. First Nations organizations)			
Educational group (e.g. Parent-Teacher Association, DEA)			
Environmental (e.g. FREWC, local action group)			
Health (e.g. Cancer Society)			
Political (e.g. Community/Band/Métis Council, Elder Justice Committee)			
Social club (e.g. card playing, bingo, book club)			
Sports or youth group (e.g. hockey)			
Work-related organization (e.g. union, professional organization)			
Service group (e.g. Rangers, Elders committee)			
Other group activities (specify)			

9. Of all the groups that members of your household belong to, which are the two most important to your household?

Group 1: _____ Group 2: _____

	Yes=1; No=2	
	Group 1	Group 2
10. How similar are members of (Group ____) in the following ways:		
a) Are members mostly of the same extended family?	a)	a)
b) Are members mostly of the same gender? (male/female)	b)	b)
c) Are members mostly of the same age group?	c)	c)
d) Do members mostly have a similar occupation?	d)	d)
e) Do members mostly have about the same level of education?	e)	e)
11. What is the main benefit for joining (Group ____)?	(Single response)	(Single response)
1) Improves access to money, resources or services		
2) Improves spiritual or social status		
3) Benefits the community		
4) Enjoyment or recreation		
5) Important in times of emergency		
6) Other (specify): _____		
12. When there is a decision to be made in (Group ____), how does it usually happen?	(Single response)	(Single response)
1) Decision is imposed from the outside		
2) Group leader decides		
3) Leader asks group members what they think and then decides		
4) Group members discuss and decide together		
5) Other (specify) _____		

13. Compared to ten (10) years ago, do members of your household participate in more, fewer, or the same number groups and activities?

1. More
2. Same number
3. Fewer

14. How often do these organizations provide you with information about issues that are important to you?

	Often	Sometimes	Never
The Band – DKFN			
Métis Local			
Akaitcho Territory Government			
Dene Cultural Institute			
Dene Nation			
Métis Nation			
Government of the Northwest Territories			
Government of Canada (Departments: Indian Affairs, etc.)			
Assembly of First Nations (AFN)			
Other (specify)			

SECTION IV: TRUST, SHARING AND SOCIAL COHESION

15. How strong is the feeling of togetherness or closeness in this community?

1. Very distant
2. Somewhat distant
3. Neither distant nor close
4. Somewhat close
5. Very close

16. Over the last ten (10) years, has the amount of sharing in the community gotten better, worse, or stayed about the same?

1. Gotten better
2. Stayed the same
3. Gotten worse

Why?

_____

17. How much do you trust people in the following categories?

1. Not at all
2. Not very much
3. Somewhat
4. Quite a lot
5. Very much

People from your cultural group (Dene, Métis, Other)	
People from other cultural groups in town	
Traditional land-users (trappers, hunters)	
Elders	
Youth	
RCMP	
Teachers	
Health workers	
Local government officials (DKFN, Métis Local, DCC)	
People from other towns	
Government of the Northwest Territories officials	
Federal government officials	

18. In general, how do you feel about the following statements?

1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly disagree

Fort Resolution is a safe place to live	
Fort Resolution is a good place to raise kids	
Most people who live in this community can be trusted	
Most people in this community are willing to help if you need it	
In this community, people trust each other to lend or borrow money or equipment	
Generally, I trust people who live in Fort Resolution more than I trust people who live elsewhere	

19. Over the last ten (10) years, has the level of trust in the community gotten better, worse, or stayed about the same?

1. Gotten better
2. Stayed the same
3. Gotten worse

☐

20. If the level of trust has changed over the past 10 years, what is the main reason?

1. Economic conditions
2. Political Leadership
3. Social conditions
4. Environmental conditions
5. Other (specify)

☐

_____

21. There are often differences in the characteristics of people living in the same community. For example, differences in income, social status, or cultural identity. How much tension or conflict is created by the following differences:	No tension	Some tension	A lot of tension
a) Differences in material possessions			
b) Differences in hunting and trapping activity and success			
c) Differences in access to paid jobs			
d) Differences in the way that people share resources (e.g. meat)			
e) Differences in education			
f) Differences in social status			
g) Differences between men and women			
h) Differences between younger and older generations			
i) Differences between long-term and newer residents			
j) Differences in religious beliefs (Christianity, aboriginal spirituality)			
k) Other important differences (specify)			

22. Which type of issues lead to serious conflict in the community?

_____

_____

23. Is the community generally peaceful or is there a lot of tension and conflict?

1. Very peaceful
2. Somewhat peaceful
3. Neither peaceful nor in conflict
4. Some level of tension or conflict
5. High level of tension or conflict

☐

24. Compared to ten (10) years ago, has the level of tension in the community changed?

1. Much more tension
2. Somewhat more
3. Stayed the same
4. Somewhat less
5. A lot less

☐

25. Thinking of the past ten (10) years, have there been any changes in this community in the following areas?

	More	No Change	Less
Use of traditional healers			
Presence of aboriginal spiritual teachings			
Amount of traditional ceremonies and events (sweats, bush camps, drum dances)			
Amount of culture camps and classes in school			
Amount of community programs (language classes, traditional activities)			
Other cultural changes (specify)			

26. How do cultural events affect life in the community?

1. Very positively
2. Positively
3. No impact
4. Negatively
5. Very negatively

☐

27. Did you vote in the last election for:

1. Yes
2. No

Chief and Council or Métis Local	
Government of the Northwest Territories	
Government of Canada	

SECTION V: COOPERATION AND COLLECTIVE ACTION

28. In the past year, have you worked with other people in Fort Resolution to do something for the benefit of the community?

1. Yes
2. No

☐

If yes, what did you work on?

_____

_____

29. What proportion of people in Fort Resolution volunteers time or money toward community projects or events (economic, environmental, cultural)?

1. Everyone
2. More than half
3. About half
4. Less than half
5. No one

☐

30. Compared to ten (10) years ago, how common is it for land users to help each other when hunting, trapping or fishing?

1. Much more common
2. Somewhat more common
3. About the same
4. Somewhat less common
5. Much less common

☐

31. If there was an environmental problem in the community (e.g. fewer animals), how likely is it that people would cooperate to try and solve the problem?

1. Very likely
2. Somewhat likely
3. Neither likely nor unlikely
4. Somewhat unlikely
5. Very unlikely

32. If there was an environmental problem in the community (e.g. fewer animals), who would come forward to deal with the situation?

1. People would deal with it individually
2. Land users would work together as a group
3. Main community leaders would deal with it separately
4. All community leaders would work together
5. The entire community would work together

33. Who in this community has historically looked after the land, water and animals?

1. No one does anything to protect the land
2. There are old customs that are followed
3. Leaders make decisions that everyone follows
4. A committee or group makes these decisions
5. Community members discuss and decide

*If 2., please give examples of old customs:

_____

_____

34. What is the most important reason why people in Fort Resolution protect the land, water and animals?

1. For food and the economy
2. For tourism
3. It is the right thing to do
4. It keeps the community working together
5. It is an important part of our culture

35. In general, how do you feel about the following statements?

1. Strongly agree
2. Agree
3. Neither agree nor disagree
4. Disagree
5. Strongly disagree

a) Overall, I have some influence in making my community a better place to live	
b) If people do not participate in community activities, they will be criticized	
c) People in the community mainly look after the welfare of their own families, rather than the welfare of the entire community	
d) In the past, people were more concerned with the welfare of the entire community	

APPENDIX D: List of scenario participants

Name (N=30)	**Affiliation**	**Activity**	**Date**
Alice Mandeville	Elder	Elder Women Focus Group	February 23, 2006
Arthur Beck	Métis Local Vice President, Land user	Métis Focus Group 2	May 11, 2006
Beatrice Dawson	Elder	Elder Women Focus Group	February 23, 2006
Carol Collins	District Community Council, Akaitcho Screening Board Member	Adaptation Leadership Workshop	March 20, 2007
Catherine Boucher	Chipewyan Language Working Group Coordinator, Land user	Rocher River Women Focus Group; Adaptation Leadership Workshop	April 18, 2006; March 20, 2007
Dawna Beaulieu	FREWC Representative	FREWC Focus Group	February 22, 2006
Diane Giroux	AAROM Coordinator	Interviewee	November 23, 2006
Donald Beaulieu	FREWC Representative, Land user	FREWC Focus Group	February 22, 2006
Eddy McKay	Akaitcho Territory Government Lands Researcher, former FREWC Representative	FREWC Focus Group; Adaptation Leadership Workshop	February 22, 2006; March 20, 2007
Gary Bailey	Métis Negotiator	Métis Focus Group 2; Adaptation Leadership Workshop	May 11, 2006; March 20, 2007
Henry McKay	FREWC Representative, Land user	FREWC Focus Group	February 22, 2006
Irvin Norn	DKFN Band Manager	Interviewee	May 10, 2006
James Sanderson	Métis Local Board Member, Land user	Métis Focus Group 1	May 10, 2006
Kenneth Delorme	Métis Local Board Member, Land user	Métis Focus Group 2	May 11, 2006
Lester McKay	Land User	Adaptation Leadership Workshop	March 20, 2007
Lloyd Cardinal	Métis Local President	Métis Focus Group 2	May 11, 2006
Mae Sayine	Elder	Rocher River Women Focus Group	April 18, 2006
Mary Pierrot	Elder	Elder Women Focus Group	February 23, 2006

Name (N=30)	**Affiliation**	**Activity**	**Date**
Patrick Simon	DKFN Environment Manager	Interviewee	May 10, 2006
Pete King	Métis Local Board Member, Elder	Métis Focus Group 1	May 10, 2006
Philip Beaulieu	DKFN Band Councilor, former FREWC Representative, Land User	Adaptation Leadership Workshop	March 20, 2007
Raymond Beck	Land User	Adaptation Leadership Workshop	March 20, 2007
Rocky Lafferty	FREWC Representative, Land user	FREWC Focus Group	February 22, 2006
Ronald Boucher	DKFN Lands Researcher, Land user	Adaptation Leadership Workshop	March 20, 2007
Rosy Bjornson	DKFN IMA Coordinator, former FREWC Representative	Adaptation Leadership Workshop	March 20, 2007
Terri Beaulieu	Métis Local Employee	Métis Focus Group 1	May 10, 2006
Tom Unka	DKFN Environment Coordinator, Land user	Adaptation Leadership Workshop	March 20, 2007
Verda Larocque	Chipewyan Language Working Group Member	Rocher River Women Focus Group; Adaptation Leadership Workshop	April 18, 2006; March 20, 2007
Violet Mandeville	Métis Local Field Researcher	Métis Focus Group 1	May 10, 2006
Warren Delorme	Métis Local Board Member, Land user	Métis Focus Group 2	May 11, 2006

APPENDIX E: Scenario narratives

SMALL TOWN: Moderate Climate Change with Moderate Socio-Economic Change

In the early to mid 2000s, the existing climatic and social trends continue in Fort Resolution. The town's population remains fairly constant, around 530 people, as some of the working-age residents leave to make a living elsewhere. There are few, if any, new economic development opportunities in town, so the town remains fairly quiet, with residents keeping to themselves. The level of employment remains stable, and trapping, hunting and fishing continue at similar levels to today. Food and fuel prices continue to rise moderately each year.

Summers are longer and winters are shorter by about two weeks, with all seasons experiencing slightly milder temperatures. In winter, the ice conditions become slightly less predictable due to more frequent freeze-thaw cycles, and people must take care when travelling on the land. In summer, lake, river and delta water levels remain stable, while sloughs continue to dry slightly. Residents may notice a slight increase in fish and wildlife deformities.

BOOM TOWN: Moderate Climate Change with Major Socio-Economic Change

In the early 2000s, a large mineral deposit is found in Akaitcho Territory, south of Great Slave Lake. Fort Resolution becomes the transit point for mine development, bringing better jobs and infrastructure to the town. Some localised environmental damage is caused in town and at the mine site (e.g. forest clearing, pollution, and deterioration of water quality in Resolution Bay and rivers near the mine).

With the resolution of Treaty 8 negotiations, Akaitcho communities gained significant control over land use and resource management decisions. The DKFN and Métis Local

have collaborated to form a joint indigenous company to invest money from the mining enterprise, from which financial capital and community services can be developed.

The joint DKFN-Métis leadership devises a 20-year community development plan. The community works together to help rebuild local cultural identity, with a specific focus on teaching youth about traditional knowledge and skills (hunting, trapping, fishing, spiritual development – sweat lodges, drumming & Chipewyan language). Youth are taught to fish, hunt and trap, but these are done mostly as weekend or recreational activities. All community members attend local healing workshops, which help to mend old wounds, increase sobriety in the community, and reduce conflict among individuals and family groups. Focusing on traditional social relationships, residents bond together and learn to depend on and support one another.

As residents recognize the importance of education and technical training in Fort Resolution, young adults are motivated to learn and develop skills for jobs with the mine. Several workers and families move to town from the south, and a number of young people return to Fort Resolution for work. The town's population increases to 800 people, and becomes more diverse. To accommodate the increase, food, accommodation, and entertainment services are developed in Fort Resolution, and the town experiences a construction boom. The community experiences reductions in the cost of food and goods, but housing prices increase with demand.

Some profits from the mine are distributed to local residents, and both working-age individuals and households increase their expendable income. Many residents spend money on new recreational vehicles – snowmobiles, speedboats, jet skis etc.

At the same time, the climatic trends of the late 1900s continue. Summers are longer and winters are shorter by about two weeks, with all seasons experiencing slightly milder temperatures. In winter, the ice conditions become slightly less predictable due to more frequent freeze-thaw cycles, and people must take care when travelling on the land. In summer, lake, river and delta water levels remain stable, while sloughs continue to dry

slightly. Residents may notice a slight increase in fish and wildlife deformities, and fish populations in Resolution Bay may decrease.

SHIFTING SEASONS: Extreme Climate Change with Moderate Socio-Economic Development

In the early to mid 2000s, the Akaitcho Territory experiences major seasonal changes. Summers extend for an extra month, with increased winds and more frequent storm events. Summer temperatures are several degrees warmer, although they often fluctuate, resulting in both warm and cool spells. Water levels in the rivers, delta, sloughs and lake go down significantly, so that only the main river channels are accessible in summer.

Winters are about one month shorter and generally milder, with increased frequency of storms and temperature fluctuations. The ice freezes about two weeks later in the fall and thaws about 2 weeks earlier in spring. In winter, the thickness and safety of lake and river ice becomes increasingly unpredictable.

With a lack of economic development, the population size in Fort Resolution declines slowly to about 300 people by 2030. Most young people aged 18-35 leave town to seek work and education elsewhere; the number of young families and children declines substantially. Existing services in Fort Resolution decline as the working-age people leave or retire, resulting in higher priced goods, especially food and fuel.

These conditions result in reduced income for most individuals and families, which forces people to reduce their use of snowmobiles, boats and vehicles. Residents experience more accidents on thin ice. Trapping is limited to the local area along the highway and near town by lack of ice and by increased travel costs, meaning that younger trappers increasingly seek employment elsewhere.

AKAITCHO MINES: Extreme Climate Change with Extreme Socio-Economic Development

In the early to mid 2000s, the Akaitcho Territory experiences major seasonal changes. Summers extend for an extra month, with increased winds and more frequent storm events. Summer temperatures are several degrees warmer, although they often fluctuate, resulting in both warm and cool spells. Water levels in the rivers, delta, sloughs and lake go down significantly, so that only the main river channels are accessible in summer. Muskrat numbers continue to decline.

Winters are about one month shorter and generally milder, with increased frequency of storms and temperature fluctuations. The ice freezes about two weeks later in the fall and thaws about two weeks earlier in spring. In winter, the thickness and safety of lake and river ice becomes increasingly unpredictable.

The general warming trend, combined with increased contaminant transport through the river system, causes the water quality to decline in Resolution Bay. Fish numbers decline in the Bay and around Mission Island, so residents must travel further to fish. Residents notice an increase in deformities and disease in both fish and wildlife.

During the early 2000s, a large diamond/uranium/oil deposit is found in Akaitcho Territory, south of Great Slave Lake, and an outside company gains permission to exploit these resources. Fort Resolution settles an IBA with the company, and while investments are not made at a community level, moderate funds are provided to community members with treaty status only. This income distribution scheme increases the tension between treaty and non-treaty residents in town.

The area around the mine is cleared, causing animal migration patterns to change. Nearby rivers show increases in pollutants from the mine. Young adults in Fort Resolution do not take advantage of the training provided, so workers fly in from Hay River or Yellowknife. Fort Resolution maintains its current level of services, but experiences

increased costs of goods, especially food and fuel. Most of the IBA money is used to offset these costs, so residents do not realize any significant profit from the mine.

Trapping is limited to the local area along the highway and near town due to bad ice, lack of snow, increased summer winds, reduced animal health and population numbers, and increased travel costs. This causes younger trappers to seek employment elsewhere. Very few people continue to hunt and trap except along the roadways.

The shifting weather conditions and increase in pollutants in the local system causes increases in various human diseases, including: diabetes, strokes, asthma, cancer, respiratory disease, heat-related illness, food poisoning, and skin cancer (UV radiation). Residents also experience increased stress levels due to the rapidly changing environmental and social conditions.

APPENDIX F: Research progress pamphlets

June 2005

November 2006

March 2007 (collaborative report with paleoecology/hydrology researchers)

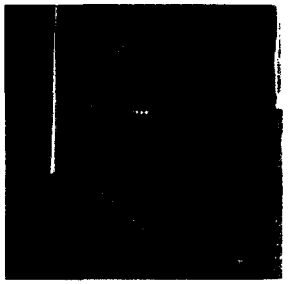
November 2008

A Study of Traditional Knowledge About Environmental Change
Deninu Ku'e, NT

June 2005

Hello, my name is Sonia Wesche and I am a university student from Waterloo, Ontario.

I am in Deninu Ku'e carrying out a study of traditional knowledge. I am interested in learning from elders and land users how the environment and climate are changing and how these changes affect people in the community. I will also explore how to build capacity in the community to help adapt to future changes.



The information collected will be used to create a community database of documented traditional knowledge and it will form the basis of a university thesis project. I will also create a video for the community to help better communicate your perspectives on environmental change with researchers, policy-makers and members of other communities.

I will be in Deninu Ku'e during the summer of 2005 carrying out interviews, and will return during the winter to continue the project. Please contact me if you would like to participate or if you have any questions.

Marsi Cho for hosting me in your community and to the Environmental Committee for its support!

Contact Information:
Sonia Wesche
c/o Dollie Lafferty & Raymond Simon
Fort Resolution, NT
Tel: 867-394-5131
Email: wesc3156@wlu.ca

Interview Topics

Familiarity with the Land
- Which area of the land are you most familiar with?
- When have you spent time on the land?
- Why is the land important to you?
- How did you gain your knowledge of the land?

Weather
- What was the weather like during each season (past and current)?
- What changes have you observed?
- How does the weather affect activities on the land?

Water and Ice
- Tell me about ice freeze-up in the fall (past and current).
- Tell me about ice break-up in the spring (past and current).
- Tell me about when floods have occurred in the delta.

Resources
- What activities did you and your family do on the land (past and current)?
- Have some resources changed in abundance?
- Have some resources changed in quality or health?

Deninu Ku'e

Slave Delta

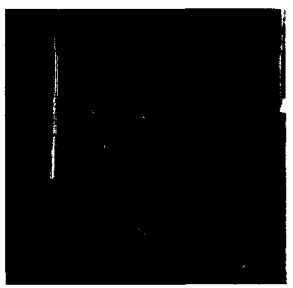
Adapting to Environmental Change in Akaitcho Territory

Research Project Summary:

November 2006 (ongoing)

Project Purpose

Sonia Wesche and Derek Armitage from Wilfrid Laurier University in Waterloo, Ontario have been participating in a collaborative research project about climate change in Fort Resolution since May 2004. We are interested in learning from elders and land users how the environment and climate are changing and how these changes affect people in the community. We are also exploring how best to build capacity in the community to help adapt to future changes



Deninu Ku'e

Slave Delta

Project Activities

Interviews

We have interviewed approximately 30 land users and elders to understand how changes in climate and on the land are affecting people.

Focus Groups

We have organized small focus group sessions to explore strategies for responding to current and future environmental change.

Questionnaire

With the help of local research assistants, a questionnaire was administered to households in Fort Resolution to understand some of the barriers and opportunities that affect how people work together for group benefits.

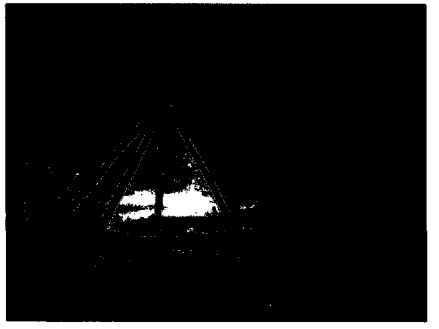
Workshops

Following the 'Climate Days' workshop in July 2005, we are hosting another workshop in Fort Resolution in November 2006 called 'Adapting to Climate Change in Akaitcho Territory: An Integrated Perspective'. We will discuss the effects of environmental change on people in Fort Resolution, and some strategies to better plan for and adapt to change.

Project Outcomes

The information collected will be used to a) create a community database of documented traditional knowledge about environmental change, b) stimulate discussion about the vulnerability of people and the environment in Akaitcho Territory to climate change, and c) provide recommendations about strategies for adapting to climate change. This research will also form the basis of a university thesis project.

Marsi Cho for hosting us in your community!



Contact Information:
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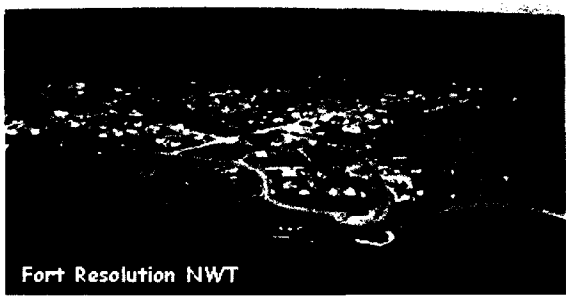
Environmental Change, Impacts and Adaptations in Fort Resolution and the Slave River Delta

Research Project Summary

March 2007



Fort Resolution NWT

Project Goals

- improve understanding of the hydrology and ecology of the Slave River Delta
- address concerns about the impacts of changes in climate and river flow
- assist the community of Fort Resolution with managing the ecosystem and adapting to environmental change

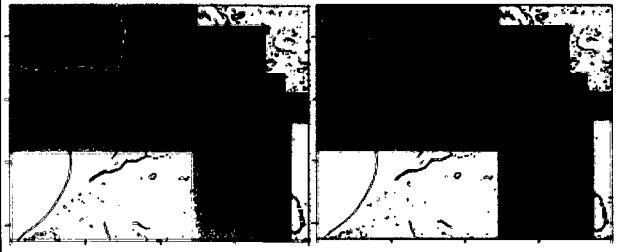
Our research began in 2002 and this pamphlet highlights some of our research findings.

Research Findings

Recent Floods from the Slave River

Flooding from the Slave River provides an important source of water to the delta. The blue areas in the maps below were flooded in the spring by the Slave River in 2003, 2004 and 2005. This information tells us which areas of the delta are most sensitive to changes in the river (areas in blue) and which areas are most sensitive to changes in climate (areas in red).

2003 2004

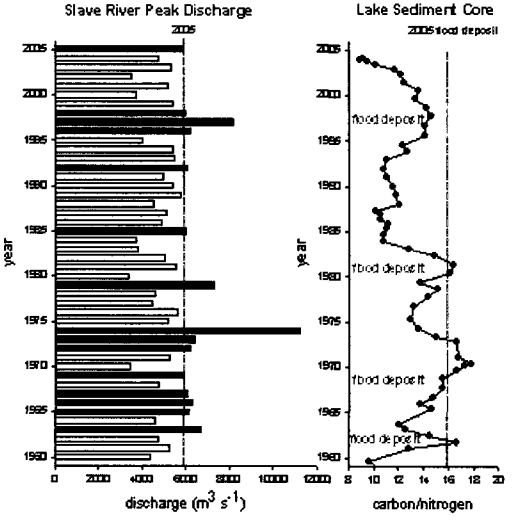


2005

Past Floods from the Slave River

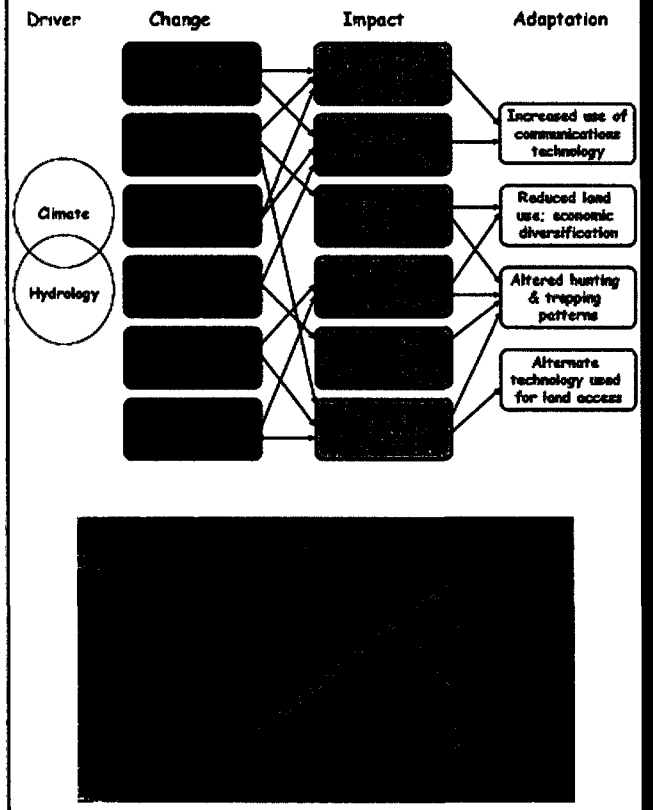
The large flood of 2005 occurred because the spring flow in the Slave River was very high that year. Years in the past with high flow rates (discharge) also likely resulted in large floods. These flood events are recorded in the layers of sediment in the delta's lakes.

We are now collecting longer sediment cores from the lakes to reconstruct flood history over the past several hundred years. This information will tell us how frequently large floods occur in the delta and how this may change with climate.



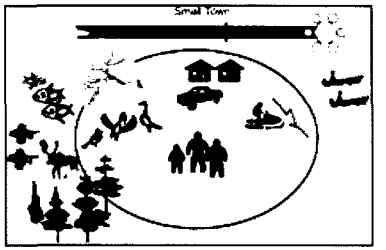
Environmental change, impacts and adaptations

The flow chart below shows some of the relationships among environmental change, impacts and adaptations. The chart is based on interviews with residents of Fort Resolution.



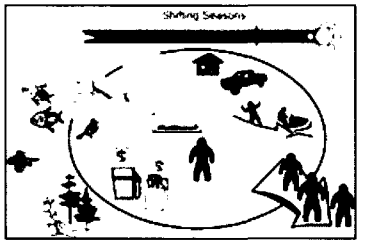
Scenarios of possible change

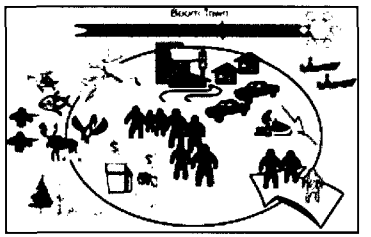
Climate change and resource development are impacting the community of Fort Resolution. Scenarios of possible change were discussed with residents, including students at Deninu school. This information is helpful to understand community vulnerability and to develop adaptation strategies.



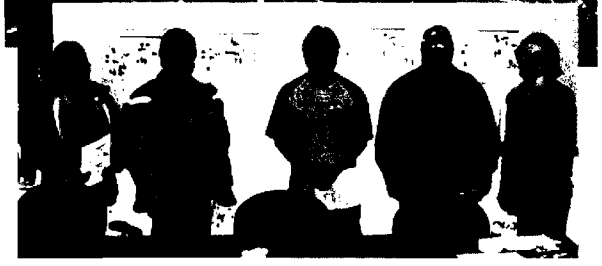
Limited change in climate and development

Major climate change





Major resource development



This project could not have been undertaken without the ongoing support and contributions of the community of Fort Resolution. Special thanks to DKFN, FREWC and Deninu School. Marsi Cho for hosting us in your community!

Contact Information:
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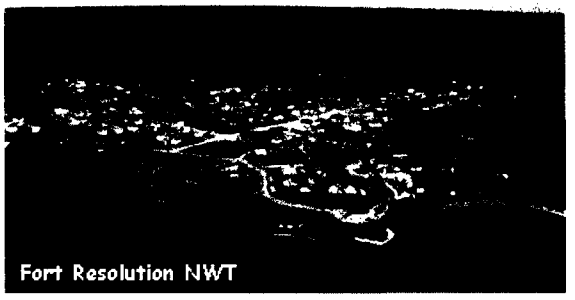
University of Waterloo

Maggie Adam
Bronwyn Brock
Ken Clogg-Wright
Tom Edwards
Roland Hall
Paige Harms
John Johnston
Mike Sokal

Environmental Change, Impacts and Adaptations in Fort Resolution and the Slave River Delta

Research Project Summary

November 2008

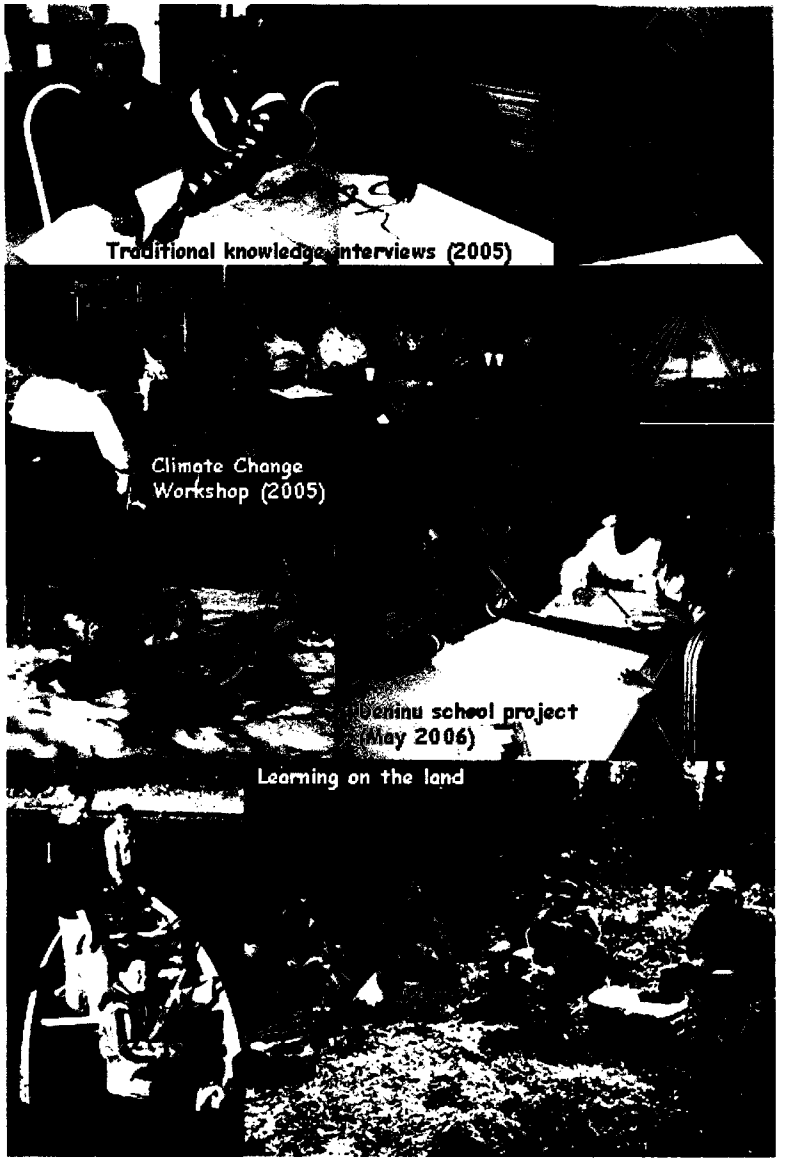


Cold Regions Research Centre

Project Goals

- Improve understanding of ongoing environmental changes and impacts in Fort Resolution and the Slave River Delta
- Assess the capacity of residents in the community to adapt to environmental change
- Provide recommendations for managing the ecosystem and adapting to change

Our research began in 2004 and this pamphlet highlights some of our research findings.



Methods

Climate change workshop (organized by GEWEX scientists)
- 2-day public workshop

Semi-structured interviews
- 33 land-users and elders

Social dimensions questionnaire
- 104 heads of household in Fort Resolution

Scenario-based focus groups and interviews
- 5 focus groups (20 participants)
- 1 adaptation workshop (11 community leaders)
- 3 interviews (3 community leaders)

Semi-structured interviews
- 19 individuals involved in environmental governance at multiple levels

Participant observation
- 15 field visits with local guides
- Daily life with my 'adoptive' local family

Examples of observed environmental changes

[In the 1950s] one old man told us, "Boys" he said, "the world is changing". How? Said you'll never see 60 below weather, you'll never see 50 below weather - it left a long time ago.
-P. King, 2005

Even in the winter we got rain a couple of times. *-L. McKay, 2005*

It's getting extremes. You still have short little patterns on the extreme ends, like when you get a storm like a couple of years ago [when we got] a real extreme summer storm [with very] high winds. ... In the winter you get the real high blizzard or something like that, a whiteout. *-B. Lockhart, 2005*

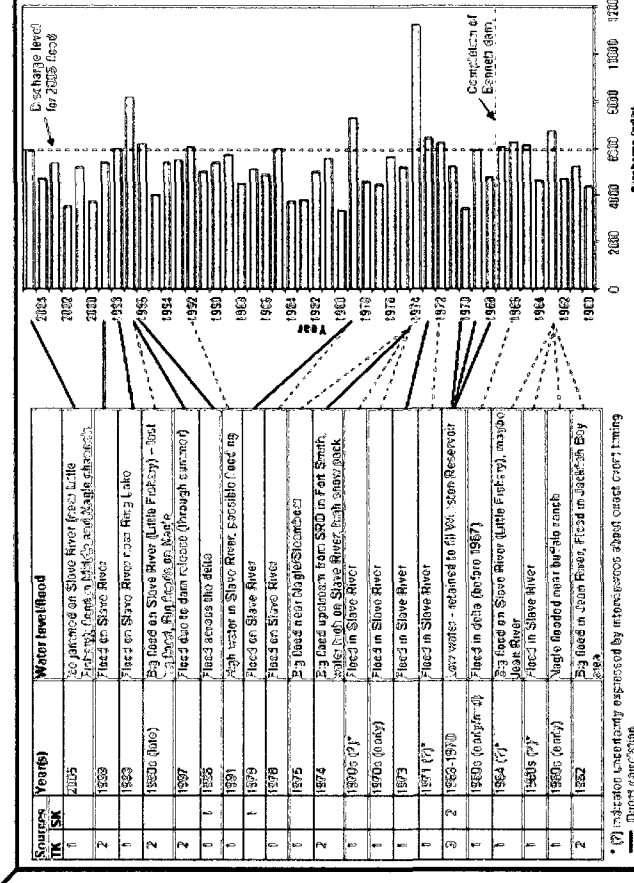
When the fall in the olden days gets cold, it gets cold right now [instantaneously], everything freezes. But now, you'd be one month before it would even get cold enough to get out on a skidoo. ... It's getting worse and worse every year, like two or three days later.
-G. Lafferty, 2005

Not that much fish now, not like before. Used to be lot of fish everywhere.
-S. King, 2005

I've seen quite a change in the last 30 years. There aren't as many muskrat as there used to be. Their habitat is starting to get choked out. *-D. Balsillie*

Past Floods from the Slave River

The large flood of 2005 occurred because of high spring flow in the Slave River. Years with high flow rates (discharge) correspond to traditional knowledge about flood timing.



Many observed environmental changes correspond to results from different types of natural science investigation. For example, delta flood events described through traditional knowledge match up well with elevated discharge records in the Slave River. Drawing on different types of information can help create a more holistic picture of what is occurring in the environment and strengthen the certainty of our interpretations. It can also help to pinpoint areas (e.g. anomalies in the record) that may require more detailed analysis.

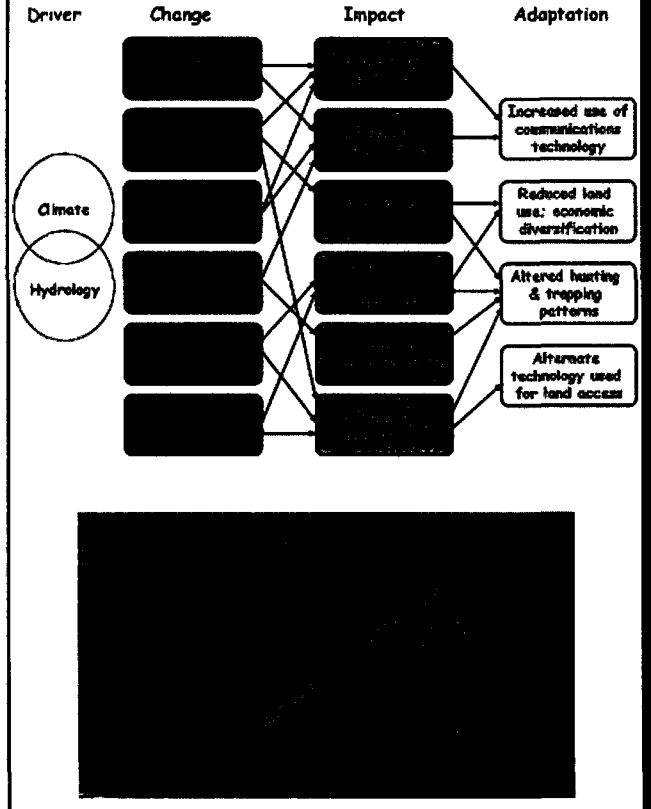
Periodic flooding is important for maintaining habitat and replenishing delta channels which maintains boat travel routes. This figure reflects the overall perceived dry period during the past three decades.

About 15, 20 years ago ...the ice was thicker and then when the ice starts coming down the Slave River [it] dams up at the mouth. ... Finally it plugs up the whole channel on the river and the whole delta will flood. ... But I noticed in the last couple of years the Slave River is not like that anymore, the ice is not as thick and the break ups are different now. -Anonymous, 2005

River ice used to flow for about five days during break up. Sometimes it'd start moving, then stop for a day or two. From the time it was frozen until it flowed out would take about five days. Now it's about two days - the ice is thinner, so it breaks up faster. -A. Beaulieu, 2005

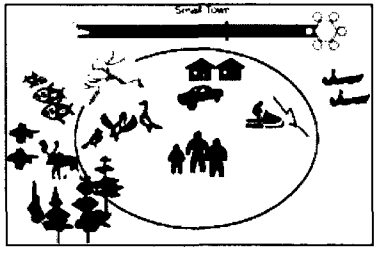
Environmental change, impacts and adaptations

The flow chart below shows some of the relationships among environmental change, impacts and adaptations. The chart is based on interviews with residents of Fort Resolution.



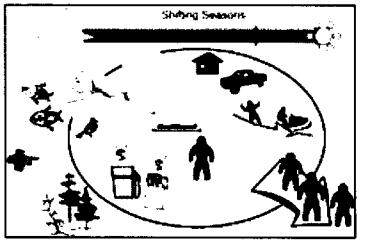
Scenarios of possible change

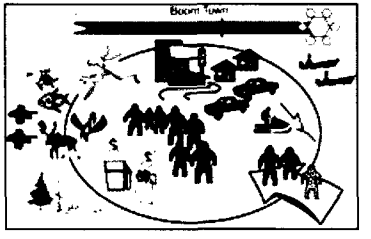
Climate change and resource development are impacting the community of Fort Resolution. Scenarios of possible change were discussed with residents, including students at Deninu school. This information is helpful to understand community vulnerability and to develop adaptation strategies.



Limited change in climate and development

Major climate change





Major resource development

Suggested adaptation options

Environment and natural resources
- Modification of harvesting practices
- Environmental monitoring program
- Environmental health research

Economy
- Economic diversification
- Investment in community development

Community management and development
- Community planning
- Emergency planning
- Improve community consultation
- Industry partnerships and agreements

Infrastructure and services
- Assessment of climate change impacts on community infrastructure
- Infrastructure planning for population change
- Improve health infrastructure and services
- Improve social services support and programs
- Develop youth club and programming

Information and training
- Build awareness of environmental change
- Cultural education and development
- Land use safety training
- Employment training

Participant Recommendations

Improve environmental quality around town
- Clean up the town: garbage, abandoned buildings, recycling of hazardous waste
- Water monitoring and filtering
- Improve infrastructure: dump, roads, lagoon



We're all the same people here, and we gotta work together. ... Whatever comes up into this community, [we should] work on it as one group of people. We could succeed at more programs ... there'd be more opportunities for the whole community, rather [than] the community being split and [some of us] being [close to the] poverty line. ... I don't like discrimination. I'd like to get rid of it from this community, and you'll see the people as one. One voice, one people.
-K. Delorme, 2005

You see a lot of kids that are finishing high school, which is a good thing. Hopefully with our [treaty] negotiations we get more help from the government, and people in place and jobs in place and ... we could govern ourselves. ... Maybe not my generation, maybe my kids' generation or my grandkids' generation. *-M. Boucher, 2005*

Recommendations

Promote community vision, adaptation planning and implementation

- Build on existing community assets; e.g. culture, knowledge and skills, social networks
- Cooperation among local organizations; e.g. joint environmental change working committee
- Community visioning; build on future scenarios
- Collaborative and participatory development of community adaptation plan
- Prioritize objectives for resource allocation
- Identify and implement no-regrets options that provide a net benefit regardless of social-ecological change outcomes; e.g. environmental monitoring, community planning, improved community consultation, environmental education, cultural development
- Incorporate climate change considerations into all local decision-making and programming

Improve governance and coordination between local and regional levels

- Engagement with other Akaitcho communities to share knowledge and best practices
- Centralized environmental information database
- Partner with local organizations for systematic environmental monitoring
- Work with higher level governments to gain support and funding for adaptation plan

Researchers

Sonia Wesche

Derek Armitage

This project could not have been undertaken without the ongoing support and contributions of the community of Fort Resolution. Special thanks to DKFN, the Environment Committee and Deninu School. Mahsi Cho for hosting us in your community!

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APPENDIX G: Trip reports

Environmental Change, Impacts and Adaptations in Fort Resolution and the Slave River Delta

Research Trip Report (June 7 – July 30, 2004)

Summary of Sonia Wesche's preliminary research visit to Deninu Kue (Fort Resolution)

Purpose of the trip: To meet community members and local groups to discuss and lay the groundwork for continued collaboration on a traditional knowledge study of environmental change in the Slave Delta, based on interest expressed by the Fort Resolution Environmental Working Committee (FREWC).

Purpose of this report: To update the community members of Deninu Kue (Fort Resolution) on: a) my trip activities; b) concerns raised by community members; c) environmental observations shared by community members; d) research recommendations made by community members; and, e) my future research plans.

Trip Activities

- Presented the research project idea at the Deninu Kue Community Hall
- Met with FREWC; designated a Project Steering Committee
- Met with the Project Steering Committee
- Met with the Deninu Kue Chief
- Met with members of Métis Local
- Met with the Deninoo School principal and some teachers
- Met with the Director of the Adult Learning Centre
- Met with the RWED Wildlife Officer
- Met with members of the Chipewyan Language Working Centre
- Gave an interview for a News North newspaper article
- Talked with many community members
- Visited the delta

Community Concerns

- Traditional knowledge is a very sensitive subject that must be treated with respect and not misused
- Research results must be verified and reported back to the community

Community Observations about Environmental Change

Weather

- Winter temperatures used to be colder
- Winters used to be longer; now later freeze-up and earlier break-up of ice
- Weather patterns are more variable than in the past

Water Levels

- Water levels are lower than in the past
- High water events are less significant; flooding is now a rare event

Ice Conditions

- 'Good' ice break-ups have declined; sediment accumulation has increased in the delta
- The quality of river and lake ice is less predictable

Wildlife

- Wildlife cycles are changing
- Muskrat populations have generally declined, although 2004 was a good year
- Caribou used to come near town, but have not done so in many years
- The moose population has declined
- There is an increased incidence of ticks in the delta area

Plants

- Berries have declined in abundance and quality
- Willows are encroaching and changing delta habitats

Community Member Recommendations

- Active land users and elders hold the most knowledge about the land; a number of names were identified as particularly valuable people to talk to
- The project should engage community members wherever possible (e.g. research assistance, language interpretation, student projects)
- Researchers should come into the community with an open mind and be ready to collaborate with local members

Future Research Plans (2004-2005)

- September 2005 onwards: Sonia and Derek will solicit more funding to ensure sufficient resources to carry out this project
- Winter 2004-2005: Sonia will visit Deninu Kue during the winter (timing to be determined) to participate in the Integrated Resource and Land Use Planning Workshop, begin preliminary interviews and visit the land with an active land user
- April – October 2005: Sonia will stay in Deninu Kue to carry out interviews and focus groups, and spend time on the land

Thank you to everyone in Deninu Kue who took time to spend with me and who helped make me feel welcome. I enjoyed my time in your community and look forward to returning! Please feel free to contact me with any thoughts, questions, ideas, or comments.

Sincerely, Sonia

Environmental Change, Impacts and Adaptations in Fort Resolution and the Slave River Delta

Research Project Summary: May 2006 (ongoing)

Project Purpose

Sonia Wesche and Derek Armitage from Wilfrid Laurier University in Waterloo, Ontario have been participating in a collaborative research project about climate change in Fort Resolution since May 2004. We are interested in learning from elders and land users how the environment and climate are changing and how these changes affect people in the community. We are also exploring how best to build capacity in the community to help adapt to future changes.

Project Activities

Interviews
We are interviewing approximately 30 land users and elders to understand the impacts of climate change.

Focus Groups
We are currently running small focus groups to explore strategies for responding to current and future climate change.

Questionnaire
With the help of several local research assistants, a questionnaire is being administered to all households in Fort Resolution to understand how the community's strengths and weaknesses affect its capacity to generate collective benefits.

Project Outcomes

The information collected will be used to a) create a community database of documented traditional knowledge about environmental change, b) stimulate discussion about the vulnerability of people and the environment in Akaitcho Territory to climate change, and c) provide recommendations about strategies for adapting to climate change. This research will also form the basis of a university thesis project.

If you have any questions or are interested in participating, please contact Sonia Wesche, Irvin Norn or Patrick Simon.

Environmental Change, Impacts and Adaptations in Fort Resolution and the Slave River Delta

Sonia Wesche's Research Trip Report (March 14 - 26, 2007)

Purpose of the trip

- To continue on with environmental change research that I have been conducting in the community since 2004, and to participate in a community open house with fellow researchers who have been conducting hydrological studies in the Slave River Delta since 2002.

Purpose of this report

- To update Fort Resolution community members on my trip activities and future research plans.

Trip Activities

- I facilitated the workshop *Adapting to Climate Change and Development in Akaitcho Territory* with 11 interested community members, several of which are involved in local and regional environmental decision-making. We discussed scenarios of possible future changes in both climate and resource development, identified some potential impacts on community members, and determined various response strategies for dealing with change.
- As a group, my seven hydrological research partners and I held a community open house at Antoine Beaulieu Memorial Hall. All community members were invited. The session was meant to communicate the status of our broader collaborative project (including studies of environmental change from both environmental and human perspectives) and to discuss some of our research results. The open house included a slideshow, research presentations, equipment demonstration, research posters, and Deninu School student scenario posters. Copies of research publications (a journal article and a book chapter) and research brochures were also made available.
- Three environmental leaders in the community joined us for a day of sediment sampling out on the delta (with the hydrological research team). They participated and learned first hand about the type of research that is being done to understand environmental change in the region.

Future Research Plans (2004-2005)

- Fall 2007 (September): Sonia will return to Fort Resolution to provide final reports on her project and discuss results with community members.

Thank you to everyone in Fort Resolution who has taken time to spend with me and who has helped make me feel welcome. I have enjoyed my time in your community and look forward to returning! Please feel free to contact me with any thoughts, questions, ideas, or comments.

Sincerely, Sonia

APPENDIX H: Consent form

Wilfrid Laurier University
Informed Consent Statement

Exploring Indigenous Understandings of Environmental Change and Adaptation in the Slave River Delta, Northwest Territories

Dear Participant,

You are invited to participate in a collaborative research study to examine community perspectives on environmental change around the Slave Delta and its impact on community members in Fort Resolution. A participatory methodology will be used to develop and implement a traditional knowledge study. The results of this research will benefit groups responsible for developing integrated ecosystem management strategies to address increased water resource demands in the region and respond to the potential implications of future climate change and variability. This research project is being undertaken by Prof. Derek Armitage and his graduate student, Sonia Wesche, from the Department of Geography and Environmental Studies, Wilfrid Laurier University.

During the course of this study, approximately 20-30 land users and elders will be asked to participate in interviews, focus groups and/or field excursions. The purpose of these activities is to generate information about the types of changes that have been occurring in the delta, and the importance of such changes for local community members. Honoraria will be provided for these activities at a rate determined by the Fort Resolution Environmental Working Committee (FREWC).

Your responses will be written down and, if you approve, may be documented either by audio or video recorder. Please note that your participation is completely voluntary, that you may refuse to answer any question, and that you are free to terminate any research-related activity at any time. All participant comments will be regarded as completely confidential unless individual consent is given to use personal identifiers. Research notes will be accessible only to the two researchers involved and to community research assistants or interpreters who agree to maintain confidentiality. (The confidentiality of other focus group participants cannot, however, be guaranteed.) Records of all research notes will be maintained in a locked cabinet when not in use. Copies of research data will be archived with the FREWC and/or the Chipewyan Language Working Group (CLWG). Responses attributable to participants in this study will not be used without prior consent.

Results from this study will be disseminated at community meetings, conferences, and through a PhD thesis, journal articles and book chapters. A synthesis of the results will also be prepared and made available to any interested participant. This synthesis will be prepared toward the end of this particular research project (likely in 2006). The results of this study should be of particular interest to community members in Fort Resolution, to those who use and know the Slave Delta, and to those participating in collaborative management activities at the local or regional scale.

If you have questions at any time about this study or the procedures, you may contact either researcher at the Department of Geography and Environmental Studies, Wilfrid Laurier University (519-884-0710, ext. 2653 or 3872, darmitag@wlu.ca or wesc3156@wlu.ca). This project has been reviewed and approved by the University Research Ethics Board. If you feel you have not been treated according to descriptions in this form, or that your rights as a participant in research have been violated during the course of this project, you may contact Dr. Bill Marr, Chair, University Research Ethics Board, Wilfrid Laurier University, (519) 884-0710, ext. 2468.

► By signing below I CONSENT to the following (check appropriate boxes):

► I prefer to provide oral consent. By checking here ___ I CONSENT to the following (check appropriate boxes):

► Being identified in the information release: ☐Yes ☐ No

► Being: -audio taped ☐Yes ☐ No

-video taped ☐Yes ☐ No

-photographed ☐Yes ☐ No

► Allowing the release of:

-audio/video tapes ☐Yes ☐ No

-photographs ☐Yes ☐ No

Print name: _____ Sign name: _____

Date: _____

APPENDIX I: Differential interviewee focus on observed changes and impacts

Types of changes and impacts noted during land user interviews: number of sources and references as coded in NVivo®

Theme	Type of Change or Impact	# Sources	% Sources	# References
Environment	Animals (& Fur)	31	**91.2**	190
	Water Levels	25	73.5	68
	Ice & Snow	24	70.6	51
	Break-up (& Flooding)	23	67.6	74
	Vegetation	17	50.0	41
	Freeze-up & Seasons	17	50.0	25
	Water Quality	16	47.1	29
	Pollution - Contamination	15	44.1	37
	Fires	15	44.1	24
	Land forms	12	35.3	19
Land Use	Travel	29	**85.3**	86
	Trapping	25	73.5	80
	Hunting	19	55.9	35
	Fishing	14	41.2	17
Socio-economic	Social Relationships	25	**73.5**	51
	Food Security	19	55.9	40
	Attitudes & Values	16	47.1	39
	Health	14	41.2	40
	Culture	12	35.3	26
	Drugs & Alcohol	9	26.5	26
	Social Activities	5	14.7	5
	Delinquency & Violence	2	5.9	2
	Employment	1	2.9	1

Source numbers indicate how many times out of 34 total sources (33 interviews plus a transcript of community inputs to the Climate Days workshop) specific themes were mentioned. *Reference numbers* indicate the total number of text segments within the associated sources that were coded to these themes. These numbers are based on the coding of interview segments. Discussion around specific themes was likely influenced by the nature of the interview questions; although attempts were made to maintain open questioning and follow-up on themes that were of interest to the interviewee. As such, the data presented here provides a broad indication of the level of importance of each theme to community members, collectively.

APPENDIX J: Survey context and respondent characteristics

Survey context and respondents

Of the approximately 150 households in Fort Resolution, we conducted 104 surveys with heads-of-household in the community (APPENDIX C). Of these, nine were not completed (few or no questions answered), thus the data analysis is based on 95 surveys. The two-thirds survey response rate ensures that responses are representative of the views of the community as a whole, evidence that is corroborated by other information obtained while working with and living in the community.

Respondents are spread fairly evenly between the ages of 26 and 65, with slightly fewer younger and older respondents. A similar number of male and female heads of household responded to the survey (43 males, 52 females). The table below details the characteristics of survey respondents.

Characteristics of survey respondents

N = 95		Number	%
Gender	Male	43	45.3
	Female	52	54.7
Age group	<25	5	5.3
	26-35	24	25.3
	36-45	20	21.1
	46-55	19	20.0
	56-65	17	17.9
	66+	10	10.5
Birthplace	Fort Resolution	48	**50.5**
	Rocher River	10	10.5
	Hay River	9	9.5
	Yellowknife	6	6.3
	Edmonton	4	4.2
	Fort Smith	4	4.2
	Little Buffalo River	2	2.1
	Rat River	2	2.1
	Other	6	6.6
	Item non response	4	4.2
Years in Fort Resolution	0-5	3	3.2
	6-10	3	3.2
	11-20	8	8.4
	21-30	17	17.9
	>31	64	**67.4**

N = 95		Number	%
Number of people in household	1	27	**28.4**
	2	19	20.0
	3	15	15.8
	4	15	15.8
	5	13	13.7
	6	2	2.1
	7	2	2.1
	8	1	1.1
	Item non response	1	1.1
Cultural affiliation	Dene	73	**76.8**
	Métis	17	17.9
	Other	4	4.2
	Item non response	1	1.1
Level of formal education	0-5	11	11.6
	6-8	11	11.6
	9-11	43	**45.3**
	12	16	16.8
	Post-secondary	6	6.3
	Item non response	8	8.4
Supplementary training in past five years	Yes	30	31.6
	No	62	**65.3**
	Item non response	3	3.2
Source of income	Unemployed	18	**18.9**
	Pensioner	14	14.7
	Homemaker	11	11.6
	Manual labour	10	10.5
	Administration	7	7.4
	Disabled	6	6.3
	Student	5	5.3
	Education	5	5.3
	Community management	5	5.3
	Hunting and trapping	4	4.2
	Service industry	4	4.2
	Health and wellness	3	3.2
	Resource sector	1	1.1
	Self employed	1	1.1
	Item non response	1	1.1

Birthplace

Almost half of the survey respondents were born in Fort Resolution, with 10.5% from Rocher River, 9.5% from Hay River, and 6.3% from Yellowknife. In more recent years, it has become common for pregnant mothers to travel to Hay River, Yellowknife, and in

some cases Edmonton to give birth, so a large percentage of individuals born in these communities were likely raised in Fort Resolution.

Number of years in Fort Resolution

Over two thirds of responding heads-of-household have lived in Fort Resolution for more than 30 years. This trend of limited mobility is common among aboriginal communities. Residents have important and shared historical roots in this area, and tend to link their individual identity with the land. The population's stability also indicates that residents are a) fairly aware of the social and environmental history of the community, and b) that they are likely to have personal investment in its future.

Number of People in Household

Currently, almost half of the respondent households in Fort Resolution are made up of singles and couples. Less than 7% of households contain more than 5 people. This indicates a drastic shift from traditionally large aboriginal family structures where several generations live together. It is now common for elders live alone or with their partners.

Culturally, 78% of respondents self-identify as Dene, 18% are Métis, and the remaining 4% associated as 'Other'. These trends mirror the political power of each of these groups at the local level.

Education

The level of education in the community is very low. One quarter of respondents have finished high school, but less than 7% have gone on to post-secondary education (which requires leaving the community). Another quarter of respondents have had no high school level education.

This issue is partially addressed by the substantial breadth of training opportunities available to people of all ages in the community. One third of respondents have received such training during the past five years, predominantly to upgrade education levels through Adult Basic Education, which is offered locally through Aurora College.

Type and frequency of supplementary training noted by survey respondents

Supplementary training in past five years	Frequency	% Respondents
Education	10	10.5
Manual labour	6	6.3
Health and wellness	4	4.2
Management	3	3.2
Cooking and food provision	2	2.1
WMIS job safety	2	2.1
Technical skills	1	1.1
Environmental	1	1.1
Unspecified	3	3.2
TOTAL	32	33.7

Income

Several respondents indicate income from mixed sources (e.g. homemaker-cook, homemaker-student, forestry-trapping). Many labourers and office workers supplement their income and food supply through part-time work in the informal sector (e.g. hunting, trapping, food preparation, and participation on local committees for which they are paid honoraria). Three respondents are earning employment insurance, which is a common supplement to seasonal wage jobs (e.g. summer work as a forest fire fighter for the local GNWT Environment and Natural Resources office). Only four of 94 respondents indicated hunting and trapping as their primary income-earning activity.

APPENDIX K: DENE CH'ANIE (The path the people walk)

Since the beginning, the Creator has always provided for the Dene.

The Creator has provided the Dene with a TERRITORY from which all good things flow, enabling our POPULATION to survive as a nation.

Since time immemorial, the Dene have lived our own lives on our own land in our own way.

While inhabiting our TERRITORY, the Dene have developed and maintained freedoms, languages, culture and spiritual beliefs to live in balance with Mother Earth.

* * *

We the Dene are a GOVERNMENT which makes laws that define and assert sovereignty over our TERRITORY based on Dene beliefs and values.

We the Dene have always entered into agreements and covenants with other nations.

We the Dene entered into an international agreement with Great Britain in 1899 and 1900. TREATY #8 as negotiated and understood by our ancestors expresses our special relationship with the crown. This relationship is built on trust and co-existence as long as the sun shines, the river flows, and the grass grows.

We the Dene continue to assert our sovereignty and self-determination over our TERRITORY through Dene GOVERNMENTS and institutions as we define them.

We the Dene have no mandate to extinguish, alter, or change the Creator's laws as instructed by our ancestors.

We the Dene have the responsibility to ensure that all newcomers respect and honour the Creator's laws within our TERRITORY to live in peace, friendship, and harmony: to co-exist with our nation.

* * *

The Dene uphold these rights as long as the sun shines, the river flows, and the grass grows. This is the wisdom provided to us for generations yet to be born. This is DENE CH'ANIE.

Adopted unanimously in June 1994
In Ndilo, Denendeh
by the NWT Treaty #8 Tribal Council (Akaitcho Territory Government, 2008)

APPENDIX L: Environmental quality recommendations from Fort Resolution residents

Environmental Actions	Frequency (N=91)	% of Respondents
Clean up the town	44	48.4
Reduce garbage and pollution	8	8.8
Remove old abandoned buildings	7	7.7
Implement recycling for household and hazardous	7	7.7
Remove old unused vehicles	4	4.4
Upgrade motorized vehicles and equipment;	2	2.2
Move tied dogs away from town centre	2	2.2
Clean up the land and water	2	2.2
Increase attractiveness of the community	2	2.2
Clean up Pine Point mine	1	1.1
Environmental Research and Management		
Improve water monitoring and filtering	20	22.0
More environmental research	5	5.5
Increase community input and control over land	2	2.2
Implement stringent environmental regulations	2	2.2
Re-establish natural hydrological patterns; remove	2	2.2
Monitor fish health and quality	1	1.1
Stop proposed mining projects	1	1.1
Social Issues		
Increase available jobs in the community	3	3.3
Increase community involvement through	3	3.3
Respect the land and water	3	3.3
Improve trust and sharing within the community	2	2.2
Deal with bootleggers and dope dealers	1	1.1
Increase level of hunting and fishing	1	1.1
Establish new community leadership	1	1.1
Infrastructure Issues		
Upgrade or move the garbage dump	10	11.0
Improve the roads; pave them or keep the dust	9	9.9
Upgrade or move the sewage lagoon	7	7.7
Rehabilitate the bison ranch	4	4.4
Build a piped water system	3	3.3
Move the water treatment plant out of town	2	2.2
Move the Power Corporation building out of town	1	1.1
Build a piped sewage system	1	1.1
Replace town culverts to improve drainage	1	1.1
TOTAL number of responses	**164**	

**Many respondents noted more than one issue. The number indicated here is the total number of times a specific issue was mentioned. The percentage value indicates the proportion of total respondents (91) that noted each individual issue.*

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