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COLD, COLD GROUND: REQUIRED INFRASTRUCTURE DEVELOPMENT IN THE ARCTIC IN THE FACE OF CLIMATE CHANGE

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ABSTRACT

In general, the Government of Canada has dealt with the Canadian North in a dismissive manner. More often than not Canada has demonstrated insouciance towards the needs of Northerners, especially the Natives. When the North represented a frozen, sparsely inhabited wasteland, Canada displayed very little concern for the region demonstrating a systemic lack of involvement. However, the region's richness in natural resources, coupled with increased accessibility, has forced the Arctic to the forefront of Canadian national affairs. While the causes of global warming are debatable, there is no doubt that the World's Arctic region is undergoing a significant period of warming that represents the greatest climactic rate of change on the Earth . Climate change will have numerous positive and deleterious impacts upon a very vulnerable ecological and sociological region. Despite the emphasis of recent governments upon diplomatic and military means to exert sovereignty, the optimal method to govern the North would be through aggressive infrastructure development throughout the region. This action will not only improve the quality of life for northern inhabitants, but, more importantly, improve the economic viability and autonomy of the North conclusively demonstrating Canadian governance and sovereignty of the region.

The great sea
Has set me adrift,
It moves me as the weed in a great river
Earth and the great weather
Move me,
Have carried me away
And move my inward parts with joy.

- Iglulik[1]

CHAPTER 1: INTRODUCTION & OUTLINE

Throughout Canadian history, her people have been enamored with romantic illusions of the Arctic. Many of the nation's most talented and recognizable authors, such as Pierre Burton and Farley Mowat, have written lovingly of North's pristine beauty. Many Canadian children have imagined themselves as Mounties riding dog-sleds across the barren tundra – a "romantic and popular image in Canadian history" noted by James Delgado.[2] The challenges, triumphs and tragedies of Arctic explorers, such as John Ross, John Franklin, Roald Amundsen, and Vilhjalmur Stefansson, riveted European and North American audiences through exhaustive printed press coverage and public speaking tours. Today, the Native inhabitants of the North are looked upon by most Canadians with respect and pride for their proven ability to thrive for generations, despite living in an austere and unforgiving environment. The awe with which southern Canadians hold the resolute people of the northern frontier is readily apparent in proud displays of Inuit soap stone carvings, *ookpiks and inushuks* across the country. As Prime Minister Stephen

[1] John Colombo, *Songs of the Great Land* (Toronto, ON: Oberon Press, 1989), 27.

[2] James Delgado, *Arctic Workhorse: The RCMP Schooner St. Roch* (Victoria, BC: TouchWood Editions, 1992), 11.

Harper opined, the Arctic is "embedded in our history, our literature, our art, our music, and our Canadian soul.''[3]

Nevertheless, the North has been largely ignored by the federal government from a developmental perspective and it had not maximized its military presence in the region.[4] The few exceptions were periodic surges forced upon the Canadian government by external factors. For example, the Canadian government chose to deploy police forces of the North West Mounted Police to the Yukon Territory in the late 1890's, after it appeared that the United States would commit its own military forces to establish law and order during the Klondike Gold Rush.[5] In short, Canada's North has been likened to the United States' Wild West. While the Americans sought to actively develop and populate their hinterland, however, Canada chose to do as little as necessary and to act only when compelled by other actors.

Fortunately, for the sake of both the Northern peoples and the fragile Arctic, external factors are currently colluding and compounding to oblige an integrated northern policy from the Canadian Government. Specifically, global climate change and the international demand for natural resources are compelling the Canadian Federal Government to invest in its North in a substantial manner. Despite the high capital costs, the Government of Canada must invest financial resources to develop Arctic infrastructure in order to address the significant ecological and sociological changes

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[3] Mary Simon, ''Sovereignty from the North.'' *The Walrus* 4, no. 9 (November 2007): 34.

[4] Rob Huebert, ''The Great White North: Renaissance in Canadian Arctic Security?'' *Canadian Military Journal* Vol. 6, no.4 (Winter 2005-2006): 19; Available from http://www.ccc.nps.navy.mil/rsepResources/ArcticSecurityRenaissence-Huebert-04-North1_e.pdf; Internet; accessed 19 October 2008.

[5] Major Kenneth Eyre, Custos Borealis: The Military in the Canadian North. Thesis. (1981), 19-20.

forecasted through climate change. This will not only solidify Canadian sovereignty over the North, it will also improve the quality of life of Northerners. Despite the ‘‘enormous material and human resources’’ investment this will entail, Canada should well-consider the significant efforts made by Russia over the past twenty years to develop their Northern Sea Route (NSR) into a viable and economically feasible commercial transit route.[6] Many important lessons learned and best practice models can be discovered through in-depth analysis of the Russian NSR experience.

This treatise will focus on the infrastructure necessary to maintain sovereignty and to further develop the economic potential of the North. In broad terms this paper will follow three distinct themes. First, the history of the North will be discussed addressing developmental, sociological, and strategic resource issues. Second, the theory of Global Warming will be reviewed to identify the potential impacts on the Arctic, particularly in view of the clearly documented warming trend observed in the Canadian Arctic over the last three decades. Finally, possible courses of action will be proposed to develop infrastructure in a viable and sustainable manner, optimizing effective Canadian control of the region. Owing to the overwhelming scope of remote northern development that is well beyond the capabilities of the Canadian Forces alone, the proposed infrastructure development projects must reflect a Whole of Government Approach.

For the sake of clarity, the Arctic is considered to be the Earth’s regions above the Arctic Circle (approximately 66.5 degrees latitude north). In the Canadian context, all three Canadian territories have regions with the Arctic Circle, including most of Nunavut, a sizable proportion of the Northwest Territories, and a small portion of the Yukon. The

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[6] Michael Mifflin, ‘‘Arctic Sovereignty: A View from the North.’’ *Policy Options* (May 2007): 58; Available from http://www.irpp.org/po/archive/po0507.htm#mifflin; Internet; accessed 15 October 2008.

territorial regions south of the Arctic Circle are considered sub-arctic, along with the northern most portions of Québec and Labrador. As the arctic and sub-arctic regions of the three territories are inextricably linked economically and politically, this article will focus on infrastructure development of the entire territorial north. Collectively, Yukon, NWT and Nunavut will be referred to as the Canadian North (See Figure 1).

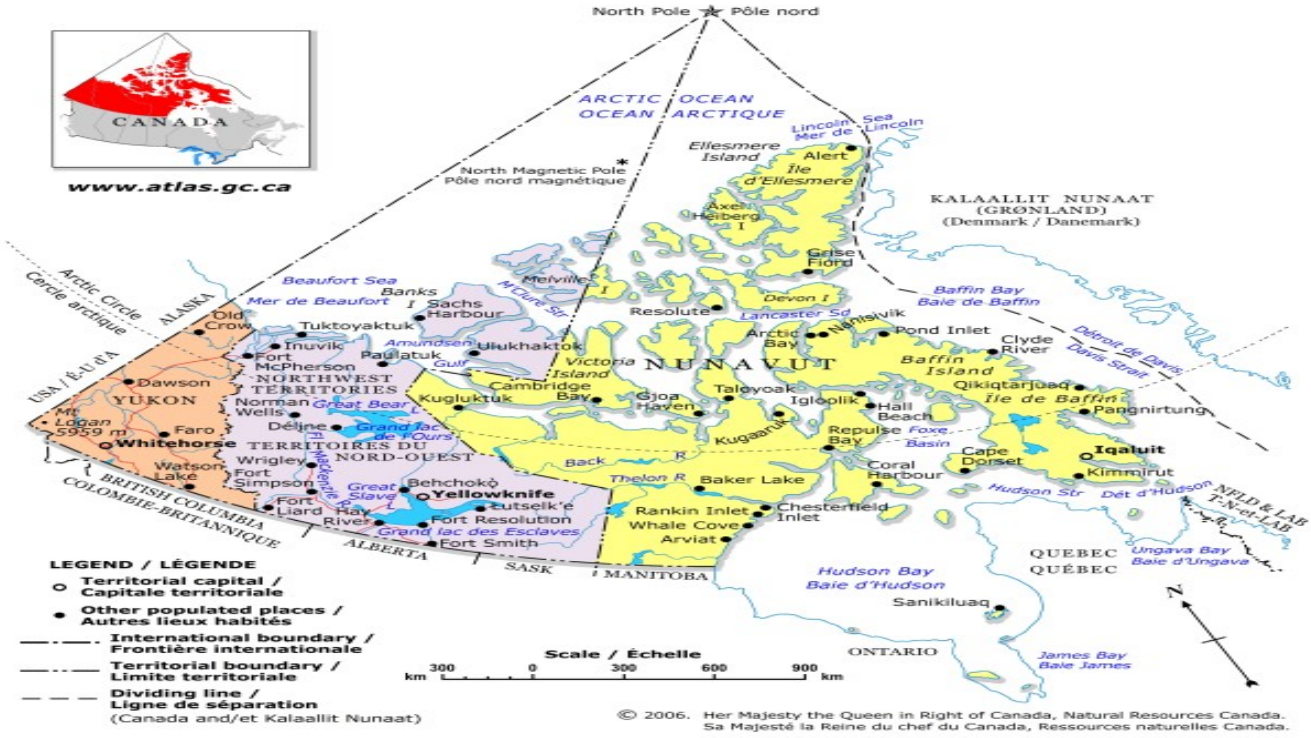

Figure 1: Canada's North

CHAPTER 2: NORTHERN HISTORY & PAST DEVELOPMENT

The Canadian Arctic region has been home to native peoples for thousands years. The region was first populated by nomadic Indians in search of new hunting grounds over seven thousand years ago. Ancestors of the present day Inuit arrived via the Bering Land Bridge between 3000 B.C. and 2200 B.C; they migrated further eastwards until 1000 B.C. when they reached northern Labrador.[7]

European explorers pushed north and west in search of an expeditious sea-route to the Orient, while commercial interests, most notably the Hudson's Bay Company (HBC) and the Christian churches, searched for natural resources, specifically fish, wood, fur, gold, and, most disturbingly, souls. Through the disjointed and uncoordinated invasion of North America, the country now known as Canada was explored, defined and charted, missionaries and traders by foot and canoe, as well as maritime explorers by sea. The rich fur-laden lands surrounding Hudson Bay were discovered by two disgruntled French explorers, Grosseilliers and Radisson. Salaried by English commercial interests, this region was claimed on behalf of the British Crown. Hudson Bay turned out to be a far more efficient transit route for furs destined for European consumption than Montreal and Québec. Consequently, the various trading posts on the shores of Hudson Bay quickly overtook the major St. Lawrence River settlements as the preferred, high-speed distribution centres.[8] The vastness and undiscovered riches of the Arctic lands of British North America (BNA) were unfathomable, and the British Crown gave virtually the entire Hudson Bay drainage system - nearly four million square kilometers - to the

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[7] Melanie McGrath, *The Long Exile: A True Story of Deception and Survival* (London: HarperCollins (2006), 9.

[8] James Raffan, Emperor of the North: Sir George Simpson and the Remarkable Story of the Hudson's Bay Company (Toronto, ON: HarperCollins, 2007), 59.

Hudson's Bay Company (HBC) in 1670. This area represented over one third of present day Canada.[9]

HBC and its principal competitor, the Northwest Company (NWC), grew thriving businesses to supply the fur obsessed European markets. Although the beaver remained the most sought after fur, ''North America teemed with riches – including valuable pelts of otter, ermine, muskrat, mink, and Arctic fox, the most luxurious to be found in the world.''[10] The competition for furs between HBC and NWC was fierce and often bloody resulting in many "unnecessary deaths."[11] Eventually, the over-zealous and unsustainable harvesting of various fur-bearing animals left many northern regions uneconomical for continued, profitable trapping operations. This over-hunting forced traders and *voyageurs* further inland from Hudson Bay to develop new fur-harvesting regions. These logical business decisions, based on very sound economic assessments, ultimately lead to increased exploration of the country. Intrepid company men and adventurers, such as Anthony Henday, Alexander Mackenzie, David Thompson, and John Rae, followed the vanguard of Indian trappers and *voyageurs* to better define the economic potential, geography and ecology of northern BNA.[12] Through the vision, courage and scientific technical competence of these men, the great unknown regions of British North America were explored, charted and claimed on behalf of Great Britain.

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[9] *Ibid*., 60.

[10] Michael Golay, and John Brown. *North American Exploration* (Edison, NJ: Castle Books, 2006), 346.

[11] Raffan, James. *Emperor of the North: Sir George Simpson and the Remarkable Story of the Hudson's Bay Company*. Toronto, ON: HarperCollins, 2007, 73.

[12] Michael Golay, and John Brown. *North American Exploration* (Edison, NJ: Castle Books, 2006), 343.

Co-operation between the European traders and the indigenous North American peoples was crucial to the sustainment of the fledgling Canadian economy. A symbiotic relationship developed: the Europeans gained traditional knowledge and a ready supply of fine furs, and the natives gained the benefit of technological advances and industrial goods. Friction between the Europeans and Indian over fair-trade, liquor and criminality was commonplace, but for the most part, their relationship was mutually beneficial so long as each side remained dependent upon the other. [13] Consequently, many Native communities developed within or adjacent to newly established trading posts that were distributed along western Canadian waterways. This co-localization allowed for easier trade and economies of scale against both enemies and the harsh winters; the traders had firearms and ample dry goods while the natives possessed superior local knowledge with respect to the environment, living-off of the land and homeopathic medicine. Invariably, trading posts were constructed at key points along the traders' major lines of communication, namely rivers and navigable tributaries. Owing to unsustainable over-harvesting of animals, the fur trade moved steadily both west and north from the HBC collection node of York Factory on the western coast of Hudson Bay.[14]

For decades, relative harmony was maintained within these diverse communities, owing principally to the knowledge that cooperation benefited both the traders and the natives. Contentious issues were relatively minor and could be resolved without comprising the underlying symbiotic relationship. The number of mixed families between European and natives was indicative of the mutual respect shared between the

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[13] Robert Bone, *The Regional Geography of Canada* (Don Mills, ON: Oxford University Press 2000), 449-450.

[14] Morris Zaslow, *The Northward Expansion of Canada 1914-1967* (Toronto, ON: McCelland and Stewart, 1988), 272.

two groups. The descendants of these mixed European-Native unions are known today as Métis, and remain a significant demographic group within modern Canada. The relative calm of the western prairies was shattered when American whiskey traders began preying on overly-dependant Native communities, precipitating a state of virtual lawlessness. In response to both general unrest between natives and settlers and illegal American activities at both Fort Whoop-Up and the Cypress Hills Massacre, the Dominion of Canada government created the North West Mounted Police (NWMP) in 1873.[15] This small paramilitary force was quickly formed, trained, and deployed to the Canadian prairies to re-establish law and order in the region. The Mounties accounted themselves well, and even the natives were satisfied with the government's intervention. Sir Cecil Denny, a NWMP captain involved in the imposition of law on the West who was very sympathetic to native concerns, wrote in his memoirs that ''the Indians welcomed our residence among them, and looked upon us as their friends and delivers from the many evils they had suffered at the hands of unprincipled white men.''[16] The NWMP, and its eventual successor the Royal Canadian Mounted Police (RCMP), proved crucial in the future development and the establishment of a government presence in the Canadian North. In many remote Native communities, the local RCMP detachments were the sole representatives and symbols of a distant federal government based thousands of kilometers away.

As the rich trapping areas along the Mackenzie River Delta became evident in the late nineteenth century, fur traders began moving northwards towards the Arctic Ocean and established trading posts along the river well-north of Great Bear Lake. They also

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[15] Major Kenneth Eyre, Custos Borealis: The Military in the Canadian North. (Thesis/1981), 12-14.

[16] Sir Cecil Denny, *The Law Marches West* (Toronto, ON: Dent & Sons 1939), 72.

diversified their fur inventory by actively pursuing the coveted white pelts of arctic fox which brought them into contact with the Inuit. This change in trade areas, coupled with the associated unrest of the Yukon Gold Rush at the turn of the twentieth century, compelled elements of the NWMP to deploy further northwards to ensure the rule of law and Canadian sovereignty in the sparely populated, poorly administered northern territories. By 1903, the NWMP had established outposts on both Herschel Island in the Beaufort Sea and on the northernmost portion of Hudson Bay at Fort Fullerton.[17] In addition, Roman Catholic and Anglican missionaries migrated north to spread their gospel through congregations and schools.

EARLY DEVELOPMENT

The establishment of police stations, trading posts and Christian missions in the most remote regions of the Arctic were examples of nascent Canadian development of its northern regions. Slowly but surely, the influences of southern Canadians began to extend across the arctic. Minor trading between the Natives and traders continued while the NWMP imposed their interpretation of the rule of law on the inhabitants of the North. Furthermore, the federal government established administrative control of the region through commission governments under the North West Territorial Council beginning in 1921.[18] Little Arctic development ensued for many years other than a few government facilities, trading posts and missionary infrastructure, such as churches, hospitals and

[17] William Morrison, *Showing the Flag: The Mounted Police and Canadian Sovereignty in the North, 1894-1925* (Vancouver, BC: University of British Columbia 1985), 81 and 91-92.

[18] Canada. Royal Commission on Aboriginal Peoples. *The High Arctic Relocation: A Report on the 1953-55 Relocation* (Ottawa, ON: Canada Communications Group 1994), 117.

schools. This lack of development did not change until the United States became actively involved in the Second World War.

WORLD WAR TWO DEVELOPMENT

The war caused serious concern in North America as both Canada and the United States feared invasion from Axis forces over the large and undefended northern frontier of the continent. After Japanese forces seized two remote Alaskan islands in 1942, there was genuine concern over the possibility of a Japanese attack on mainland North America originating from these staging bases.[19] Accordingly, great efforts were made to improve the defensibility of this region through additional military infrastructure. A line of communication route was built, predominantly by American engineers, from Edmonton, Alberta to Fairbanks, Alaska. This route, eventually known as the Alaska Highway, ensured that American and Canadian forces had a secure, high-speed land route to the north to block invading forces from moving southward into the continental heartland. This project was expensive and overcame significant technical difficulties in traversing mountain ranges and constructing military capable roads atop the unstable muskeg, rock and frozen ground. In addition, a series of military airfields with cached fuel depots, known as the Northwest Staging Route, was constructed in parallel with the Alaska Highway. This air line of communication was constructed to allow for convenient replenishment and to provide protective aircraft over-flight of the vulnerable

[19] Rob Huebert, ‘‘The Great White North: Renaissance in Canadian Arctic Security?’’ *Canadian Military Journal* Vol. 6, no.4 (Winter 2005-2006): 18; Available from http://www.ccc.nps.navy.mil/rsepResources/ArcticSecurityRenaissence-Huebert-04-North1_e.pdf; Internet; accessed 19 October 2008.

land route.[20] A sister route, the Northeast Staging Route or Crimson Route, was built through northeastern Canada and the then-British colony of Newfoundland during this period to create an air-link to the United Kingdom. In addition, an over-land pipeline was constructed to bring petroleum from Norman Wells, North West Territories to Alaska, allowing Allied Forces a readily accessible fuel source for anticipated military operations. Finally, numerous weather stations and communication facilities were constructed on the perimeter of the continent. Though these projects were strictly bilateral in nature, Canada provided siting approval and rights of way for stations located in her territory. The vast majority of construction was paid for by the American government and constructed by either US military personnel or private American construction companies. Sensing a potential loss of control which could prejudice sovereignty in the future, the federal government under Prime Minister William Lyon Mackenzie King ensured that the legal ownership of the facilities would revert to Canadian ownership upon the conclusion of the war.[21] This foresight was essential in avoiding anticipated American commercial designs on specific locations within northern Canada that were focused principally upon civilian aviation interests.

COLD WAR ERA DEVELOPMENT

Despite Canadian government success at expelling large numbers of American servicemen from bi-national installations immediately after the war, the requirement for bilateral co-operation continued at war's end. In 1946, Canada and the United States

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[20] Kenneth Eyre,''Forty years of Military Activity in the Canadian North, 1947-1987,'' Arctic Vol.40, no. 4 (December 1987): 294; Available from http://pubs.aina.ucalgary.ca/arctic/Arctic40-4-292.pdf; Internet; accessed 18 February 2009.

[21] Sheagh Grant, *Sovereignty or Security? Government Policy in the Canadian North, 1936-1950* (Vancouver, BC: University of British Columbia, 1988), 131.

negotiated the Joint Arctic Weather Stations (JAWS) to develop a series of mutually useful weather research facilities in the North. Again, the lack of resources and trained personnel forced Canada to accept American aid in operating the stations.[22] Once the celebrations finally ended after the Second World War, a more ominous threat arose, namely the expansionist intentions of the Union of Soviet Socialist Republics (USSR). Tensions between the USSR and her former Western allies, especially the US, quickly escalated causing fears of another global war. This led to the creation of the North Atlantic Treaty Organization (NATO) in 1949 and the North American Air Defense Command (NORAD) between the US and Canada in 1958. Soviet military capabilities, particularly long range bombers, caused a redoubling of joint American and Canadian efforts to secure the continent from possible Soviet attack. As John Honderich commented in *Arctic Imperative,* there were reasonably justified concerns ''that black clouds of Soviet bombers would surge over the Pole and drop their payload of nuclear horror on both Canada and the United States.''[23]

In terms of geography, the shortest avenue of approach between Soviet attackers and the major population centres of North America was directly over the Canadian arctic. Additional military installations were constructed throughout the north for both surveillance and air defense contingency roles. The most ambitious and costly project was the Distant Early Warning (DEW) Line that was constructed along the entire breadth of northern North America from Alaska to Newfoundland. Once again the Americans

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[22] Elizabeth Elliot-Meisel, ''Still Unresolved after Fifty Years: The Northwest Passage in Canadian-American Relations, 1946-1998.'' *The American Review of Canadian Studies* 29, no.3 (Fall 1999): 412; Available from http://findarticles.com/p/articles/mi_hb009/is_3_29/ai_n28725141?tag=content;col1; Internet; accessed 10 January 2009.

[23] John Honderich, *Arctic Imperative: Is Canada Losing the North?* (Toronto, ON: University of Toronto Press, 1987), 98.

bore the financial brunt of the capital expenditures.[24] Each DEW station had overlapping arcs of surveillance thus providing a complete and early warning of any missile or plane attempting to attack North America from the North. The majority of these sites were constructed along the mainland of Canada's Arctic coast.

One of the most significant attempts at northern development occurred in 1953, when the Canadian Federal government chose to relocate several Inuit families from Port Harrison (now known as Inukjuak) in the Ungava region of northern Québec to unpopulated islands of the high Arctic Archipelago. This federal government decision was made in order to address the over-population of northern Québec and, perhaps, to enhance Canadian sovereignty claims in the High Arctic. Common bureaucratic wisdom of the day believed that the permanent occupation of the northern islands (Ellesmere and Cornwallis) would demonstrate absolute Canadian ownership of these remote lands. With promises of excellent hunting and an improved quality of life, several southern Inuit families were relocated to remote camps at Resolute and Craig Harbour (now Grise Fiord). A third selected camp, Alexandra Fiord, was rejected owing to the impassibility of the ice during the transit. The settlements were poorly planned and basic winter survival essentials were not readied for the newcomers. The conditions were extremely harsh and the proposed settlements were remote. One new settler remarked ''when we finally landed there, it was as if we had landed on the moon, it was so bare and desolate. There was no food and there was no shelter.''[25]

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[24] Rob Huebert, ''The Great White North: Renaissance in Canadian Arctic Security?'' *Canadian Military Journal* Vol. 6, no.4 (Winter 2005-2006): 19; Available from http://www.ccc.nps.navy.mil/rsepResources/ArcticSecurityRenaissence-Huebert-04-North1_e.pdf; Internet; accessed 19 October 2008.

[25] Nunavut Department of Education. ''High Arctic Relocation,'' *Grade10: English Language Arts* (Draft 2002): 13; Available from http://www.gov.nu.ca/education/eng/css/curr/10-

The relocations, undertaken in the name of sovereignty, had dramatic consequences for the people themselves. As southern Inuit, these families were not well suited for such as drastic change in lifestyles. Despite hollow promises of return voyages to their ancestral lands in northern Québec, these people were forced to endure severe hardship, especially during the early years of occupation. With time, the Inuit were able to adjust their hunting techniques and dietary preferences to take advantage of whale migration routes. Though these remote communities never thrived, the migrant Inuit were able to survive the harsh conditions of their environment. Nevertheless, this social experiment was a failure from the outset. The Federal Government acknowledged this reality in 1996, when it reached a financial agreement of more than $10M dollars to compensate the affected families for their hardship and relocation. The government, however, has never formally apologized to the Inuit victims of the government's failed attempt to colonize the North through social engineering and forced migration.[26]

12/English/En102030/Relocation%20Modules/gr%2010/H_Arctic/H_ARCTIC.pdf; Internet; accessed 20 January 2009.

[26] Melanie McGrath, *The Long Exile: A Tale of Inuit Betrayal and Survival in the High Arctic* (Toronto: Alfred Knopf, 2006).

CHAPTER 3: NORTHERN RICHES & STRATEGIC IMPORTANCE

The Canadian north is rich in resources: some known, others awaiting discovery. The territorial waters of the Canadian Arctic and the numerous islands of the Archipelago remain one of the least explored regions of the Earth owing to their remoteness and climactic harshness. In an overpopulated world with dwindling natural resources, the Canadian Arctic remains a source of hope, a final untapped frontier to be exploited. With a favourable geological profile, the potential for undiscovered natural resources remains high.

WILDLIFE

Despite the forbidding and severe environment, many animals thrive in the northern reaches of Canada both on land and in the Arctic waters. There are significant population of musk-ox, caribou and polar bear throughout the region. In addition, smaller fur bearing animals, such as, arctic fox, rabbit and marten populate wide areas of the region. Many species of migratory birds, such as snow geese and Canada geese, use the high arctic as their summer feeding and nesting grounds. The majority of land animals and birds are hunted only by subsistence hunters. However, a large and lucrative market for sport hunting activities continues to emerge. Many Northerners now supplement their incomes through the provision of guiding and outfitting services to provide wealthy hunters the opportunity to harvest exotic game.

In the arctic regions the game of choice is invariably the polar bear followed by caribou and musk-ox. In the sub-arctic, many locals provide guiding services for moose, caribou, grizzly bear and freshwater sport fish. Respect for wildlife is a key tenet of the people of the North. No where is this more evident than the exulted polar bear, which is

atop the northern food chain. The Inuit often demonstrate their reverence for wildlife through oral history, including poetry.

I spied a bear
One the drifting floe
Like a harmless dog
It came running and wagging its tail towards me
But so eager to eat me up
That it swung round snarling
When I leaped aside.
And now came a game of catch-me-who-can
That lasted from morning till late in the day.
But at last it was wearied
And could play no more,
So I thrust my spear into its side.

- Aua[27]

The Arctic Ocean is also a diverse ecosystem with many exotic creatures, such as, walrus and various species of seal and whale. In addition, there are numerous species of commercially viable fish, for example, turbot, arctic char and shrimp. The potential of this area has been largely untapped; as the territorial Minister of Sustainable Development remarked, ‘‘the world’s most exciting fishery lies at the top of North America in the pristine, ice-cold waters of Northern Canada.’’[28] The commercial fishery industry is quite young in its development having only begun in earnest in the 1980’s. Modern fish processing plants now operate in three Arctic communities: Cambridge Bay, Rankin Inlet and Pangnirutung. Prior to the development of a fishing industry, the majority of sea-harvest was dedicated to personal use; however, the prospects of a

[27] Neil Philip, Editor. *Songs Are Thoughts: Poems of the Inuit* (Toronto, ON: Doubleday, 1995), 14.

[28] Nunavut. Department of the Environment. *Sedna’s Bounty: Spirit, Soul and Sustenance*, (n.d.): 3; Available from http://www.gov.nu.ca/env/fishindustry.pdf; Internet; accessed 20 February 2009.

sustainable, cash-based industry within Nunavut has compelled the Territorial government to pursue more aggressively the economic benefits of an expanded commercial fishery. This includes desired exports and, specifically a stable long-term employment environment. Currently, arctic char, shrimp and, especially turbot, are the principal commercial fish marketed from the Canadian Arctic. Other fish species and perhaps sea-creatures, such as, clams, scallops, crabs and snails may also be identified as viable target species.[29] The present commercial fishery in the North, especially in Nunavut, has not optimized the potential for local development and improvement; currently Northern owned concerns account for less than 10% of the allocated quota.[30] The territorial governments, specifically Nunavut are attempting to maximize the benefit of these renewable resources in order to provide financial stability to its citizens and economic autonomy to the region.

MINERALS

Canada's north has a long history in mining. Metals such as zinc, iron and lead have been commercially mined for many years in Northern Canada.[31] The use of metal implements is so ingrained in the history of the Arctic peoples that an entire sub-demographic of the Inuit people in the region of Victoria Island has been identified as the Copper Inuit owing to their historical working of the metal into weapons, implements and jewelry. The newly formed Canadian Territory of Nunavut has been described as ''one

[29] Canada. Fisheries and Oceans Canada. *Nunavut Small Craft Harbours* (November 2005), 26.

[30] Nunavut. Department of the Environment. *Sedna's Bounty: Spirit, Soul and Sustenance*, (n.d.): 5; Available from http://www.gov.nu.ca/env/fishindustry.pdf; Internet; accessed 20 February 2009.

[31] Frédéric Lasserre, ''Source d'énergie renouvelable,'' *Options Politiques* (May 2007): 39.

of the most attractive places for gold, diamond, and other mining investment in the world.''[32]

Despite the presence of viable, and potentially lucrative, mining operations, the challenging conditions of the region and difficulty in travel means that only small proportion of the land mass and the adjacent sea-bed has been explored by geologists. As such, the region is likely to contain other undiscovered mineral deposits. Initial geological analyses indicate that the principal mineral deposits prevalent in the North are ''diamonds, gold, tungsten, silver, lead, iron, copper, zinc, nickel, coal, tantalum, niobium, lithium, cobalt, bismuth, uranium, beryllium and barium.''[33]

Diamonds have attracted particular attention and investment to the region over the last two decades. Canada's first commercial diamond discovery was made at Lac de Gras, Northwest Territories, in 1991. With four producing diamond mines in NWT and Nunavut, Canada is currently the third largest exporter of gem and near-gem diamonds in the world.[34] Diamondiferous kimberlitic formations which are the geologic formations most likely to contain diamonds have been identified throughout the north of Canada especially in the sub-arctic eastern portion of the eastern NWT and southern Nunavut.[35] In 2008, Nunavut Premier Paul Okalik wrote that ''Nunavut is experiencing an

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[32] Michael Mifflin, ''Arctic Sovereignty: A View from the North.'' *Policy Options* (May 2007): 56; Available from http://www.irpp.org/po/archive/po0507.htm#mifflin; Internet; accessed 15 October 2008.

[33] Canada. Natural Resources Canada. *From Impacts to Adaptation: Canada in a Changing Climate*. Chapter 3: Northern Canada, (2007), 80.

[34] CBC News. ''Canada's Diamond Rush'' (20 September 2007); Available from http://www.cbc.ca/news/background/diamonds/; Internet; accessed 20 February 2009.

[35] Jamieson Findlay, ''Blue Ground,'' *Canadian Geographic* (February/March 1998), 52-53.

unprecedented boom in mineral exploration and mine development'' involving over fifty companies and over $200M in exploration investment.[36]

HYDROCARBONS

The Canadian North has been known to be rich in hydrocarbons since the discovery of oil at Norman Wells, NWT in the1920s. Despite the favourable geology of the region, however, comparatively modest oil and gas exploration has been conducted in the Arctic or sub-arctic regions of the country. With world-wide levels of proven fossil fuel reserves diminishing, oil and gas exploration under the Arctic has recently begun in earnest. Samples of ancient ice cores have proven that the Arctic region once contained large quantities of organic material that were eventually compressed and converted into large deposits of fossil fuels, such as oil and natural gas.[37] The Beaufort Sea has operational drilling facilities and scientists estimate that at least fifty percent of the world's undiscovered oil and gas reserves lay beneath the islands and the waters of the Arctic Ocean.[38] The potential production of this region are so significant that two friendly neighbours, Canada and the United States, are engaged in a protracted dispute over a significant slice of the Beaufort Sea.[39]

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[36] Premier Paul Okalik, ''Nunavut Poised to Become a Major Player,'' The *Hill Times* (10 March 2008), 29.

[37] Scott Borgerson, ''Arctic Meltdown: The Economic and Security Implications of Global Warming.'' *Foreign Affairs* 87, iss.2 (March/April 2008): 65.

[38] Oran Young, ''Arctic Shipping: An American Perspective,'' in Franklyn Griffiths, ed., *Politics of the Northwest Passage* (Kingston, ON: McGill-Queen's University Press,(1987), 116.

[39] Lieutenant-Commander Guy Killaby, ''The Great Game in a Cold Climate: Canada's Arctic Sovereignty in Question.'' *Canadian Military Journal* 6, no.4 (Winter 2005-2006): 36-37; Available from http://www.journal.forces.gc.ca/vo6/no4/north-nord-01-eng.asp Internet; accessed 15 October 2008.

As more countries become industrialized, the demands for various fossil fuels will continue to climb, thus causing the depletion of known oil and gas reserves. This trend will continue until either new technologies are developed or significant additional global fossil fuel reserves are discovered and extracted for commercial consumption. Owing to technical challenges, the harsh environment, and ice cover, little of the ocean floor in the Arctic basin has been charted or scientifically investigated. Canada and the other circumpolar nations are in the process of geologically delimiting the extent of their extended continental shelves beyond two hundred nautical miles. Of note is the significant cooperation between nations with competing claims to jointly define the ocean floor. Nevertheless, science will not be enough. Canada's inability to encourage effective exploitation of hydrocarbon resources is directly tied to the lack of infrastructure in the region and is the ''major impediment to development.'' [40]

GEOGRAPHY

Canada's Arctic is highly desirable to other nations in terms of both its location and geography. Not only is it a buffer between two of the world's most powerful military rivals, the US and Russia, it contains the Northwest Passage (NWP). European and American adventurers have sought this potential maritime route between Asia and Europe, coined the 'Arctic Grail'[41] by historian Pierre Berton, for nearly four hundred years. The epic struggles of men with sub-standard ships and equipment to confirm or

[40] Frédéric Beauregard-Tellier, *The Arctic: Hydrocarbon Resources* (Ottawa, ON: Library of Parliament, 24 October 2008), 4: Available from http://www.parl.gc.ca/information/library/PRBpubs/prb0807-e.htm; Internet; accessed 15 February 2009.

[41] Pierre Berton, *The Arctic Grail: The Quest for the Northwest Passage and the North Pole 1818-1909* (New York, NY: McCelland and Stewart, 1988).

refute the fabled passage's existence led to suffering and legend.[42] For example, ''In the nineteenth century, an Arctic seaway represented the Holy Grail of Victorian exploration, and the seafaring British Empire spared no expense in pursuing a shortcut to rich Asian markets.''[43] Over time, the discovery of the Northwest Passage became more important than the passage's potential maritime utility. Golay and Bowman wrote that "the quest was at first fueled by greed and commercial interest; but long after the motive was no longer feasible, the search continued – intensified, based on motives that could not be called rational."[44] See Figure 2.

The fabled route was finally traversed and charted by Roald Amundsen in 1905 after a three year voyage. Theoretically, the Northwest Passage offered a significant potential reduction in maritime travel distance between the great trading nations of Europe and markets in Asia. Unfortunately, the Northwest Passage was typically impassable for the majority of the year owing to ice. In fact, the first return voyage through the Northwest Passage did not occur until 1940-1942, when the RCMP auxiliary schooner *St. Roch*, an ice-reinforced former Canadian Coast Guard Ship, was able to force its way through the ice flows and complete the round-trip.

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[43] Scott Borgerson, ''Arctic Meltdown: The Economic and Security Implications of Global Warming.'' *Foreign Affairs* 87, iss.2 (March/April 2008): 66.

[44] Michael Golay and John Brown, *North American Exploration* (Edison, NJ: Castle Books, 2006), 465.

Figure 2: Principle Northwest Passage Routes

Contemporary logic holds that the NWP route significantly decreases the distance to ship goods between Asia and Europe by more than 5000 kilometers. This would reduce both shipping times and fuel consumption - the two most significant cost factors in maritime shipping. The narrow straights, shoals and numerous small islands in the waterways around Victoria Island area, however, would likely preclude the use of the southern NWP to large transport ships. These geographic realities, coupled with the dynamic changes of ice cover throughout the region (including both sea-ice and fast ice within the Archipelago and icebergs in the Baffin Bay and Davis Straight areas), present enormous challenges to viable commercial use by large transport vessels. In addition, the

insurance costs and the legislated increased strengthening of ships in accordance with accepted international environmental protection guidelines would likely be prohibitive.[45]

In addition to the potential use of Arctic waterways as a commercial route for maritime cargo transport, a burgeoning market for eco-tourism has emerged in recent years. The largely unspoiled North with a rich abundance of unique wildlife and fantastic landscapes has become a prime destination for well-heeled travelers searching for a unique adventure. Owing to more favourable ice conditions than the western Arctic and greater wildlife sightings, the eastern Canadian Arctic is the preferred location for Arctic eco-tours: in fact, tour to the Baffin Island region increased by 50% in 2006 for a total of 22 cruise-ships.[46] Not surprisingly, shore visits by the passengers could have significant economic impacts upon the local businesses of visited communities.

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[45] Franklyn Griffiths, "The Shipping News: Canada's Arctic Sovereignty Not on Thinning Ice," *International Journal*, Vol. 58, Iss. 2 (Spring 2003): 265.

[46] E.J. Stewart, et al. ''Sea-Ice in Canada's Arctic: Implications for Cruise Tourism,'' Arctic Vol. 60, no. 4 (December 2007): 370 and 372; Available from http://pubs.aina.ucalgary.ca/arctic/Arctic60-4-370.pdf; Internet; accessed 19 February 2009.

CHAPTER 4: CLIMATE CHANGE AND NORTHERN WARMING

It is rare today to have a week pass without the local newspaper or national television newscast discussing a story of pending doom for the earth owing to Global Warming. Global Warming has been one of the most topical and ever-present issues for the past ten years. As Fred Singer, a prominent global warming skeptic, has observed:

> … man-made ‘‘global warming’’ is in the public mind, backed by the powerful combination of NGOs, government-financed research, and politicians eager to pander to a misinformed public… Most mainstream journalists have long since committed themselves to the environmental cause. It appeals to their sense of superiority, and it gives them an unending source of scary news for the front pages and TV sound bites.[47]

The prevailing attitude of the popular media and the general layman is that the entire earth is in the midst of an irreversible warming trend caused predominantly through the industrialization of the world's economies. The World Meteorological Organization states unequivocally that:

> The clearest example of an anthropogenic impact on the global climate is the change caused by the emission of radioactively active gases from human activities. Most attention has been devoted to the rise in carbon dioxide (CO_2) from the burning of fossil fuels, but a number of other emissions are also of potential importance. [48]

The Green House Gas (GHG) theory claims that the carbon dioxide waste emissions created through the combustion of fossil fuels from human activities, such as transportation, industrial manufacturing and coal power-generation, forms an insulating

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[47] Fred Singer and Dennis Avery. *Unstoppable Global Warming: Every 1,500 Years* (Lanham, MD: Rowan & Littlefield, 2008), 255.

[48] World Meteorological Organization. *Climate: into the 21st Century* (Cambridge, UK: University of Cambridge 2004), 94.

layer around that planet. This traps the heat within the atmosphere, leading to a gradual increase in ambient temperature throughout the world. This is the prevailing majority opinion amongst scientists, journalists and elected officials. Former United States Vice President Al Gore is celebrated as the international spokesperson for the Man-Made Global Warming Crisis, and he was the awarded the 2007 Nobel Peace Prize accordingly. He and the co-recipient, the International Panel on Climate Change (IPCC), were cited 'for their efforts to build-up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change.''[49] Mr. Gore has been hugely influential in rallying support for the Global Warming Crisis through his speaking-tours and his best-selling book and documentary film, *An Inconvenient Truth.* Many people have taken his theories at face value, especially with respect to the inevitable catastrophes, such as sea-level rises, increased storm activity and massive drought. "The Earth's atmosphere is so thin that we are capable of dramatically changing its composition," he wrote. "Indeed, we have already dangerously increased the amount of greenhouse gases in the atmosphere.''[50]

The countervailing opinion, held by some climate scientists and GHG skeptics, claims that the apparent recent temperature increases is the result of periodic natural fluctuations with no or minimal attribution to human activities. Many skeptics do not even accept the assertion that the increased warming is global in its effect, and they tend to downplay the consequences of forecasted impacts. Bjorn Lomberg, a noted environmentalist and statistician, has debunked many of the environmental lobby's more

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[49] Nobel Institute, http://nobelprize.org/nobel_prizes/peace/laureates/2007/; Internet; accessed 28 January 2009.

[50] Al Gore, *An Inconvenient Truth: The Crisis of Global Warming* (New York, NY: Viking, 2006), 21.

extreme positions in his painstakingly researched and well-referenced book, *The Skeptical Environmentalist: Measuring the Real State of the World*. Despite the scientific strength of many of his conclusions, even this noted scientist is being overwhelmed by the environmental lobby. He writes:

> We have been told for a long time the story of the Litany, that doomsday is nigh…an entire army of environmental organizations, pundits and politicians have warned us of the impending debacle. This message has had enormous social and political impact.[51]

The main contention of Global Warming skeptics is that the recently observed warming trend is restricted to the northern hemisphere and periodic fluctuations from the norm over short spans of time are not exceptionally unique or significantly noteworthy for concern. Furthermore, many benefits of a warmer planet are identified by the skeptics. For example, longer agricultural growing seasons are often touted as a net benefit to human kind, despite the fact that many second and third order effects of global warming, such as, decreased precipitation for irrigation, are often ignored. As the former British cabinet minister Nigel Lawson wrote, ‘‘it is far from clear that the inhabitants of the planet as a whole would suffer a significant net cost, or indeed any net cost at all.’’[52] Various reasons and theories have been offered to explain these periodic warming and cooling cycles.

One of the more prevalent explanations of the earth's recently observed warming ties back to our system's major source of energy: the sun. This rather intuitive area of

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[51] Bjorn Lomborg, *The Skeptical Environmentalist*. Translated by Hugh Matthews. (New York, NY: Cambridge University Press, 2001), 327.

[52] Nigel Lawson, *An Appeal to Reason: A Cool Look at Global Warming* (New York, NY: Overlook Duckwoth, 2008), 92.

research has been largely discounted or ignored by the proponents of the GHG theory. The star's energy output fluctuates in a variety of manners depending upon magnetic activity of the sun influencing such metrics as solar irradiance, ultraviolet light radiation and the flux of cosmic rays.[53] Interestingly enough, magnetic activity correlates very strongly with sun-spot activity. Specifically, the greater number of sun spots indicates a more active star producing more energy. The influence of sun-spots on the earth's resultant temperature has been studied and rationalized directly against known earth temperatures in a statistically significant manner for 400 years. Furthermore, recorded sun-spot activity corresponded well with well-documented weather, such as the Medieval Warming Period and the Little Ice Age. [54]

In 1983, Dansgaard and Oeschger began analyzing deep ice-cores from Greenland spanning over 250,000 years. By calculating the ratios of various isotopes within the seasonal layers of the ice core, they were able to a temperature timeline for Greenland for over twenty-five centuries.[55] After some refinement, they were able to conclusively identify a periodic warming/cycle with a 1,500 year frequency that transcended the entire period of analysis for the Greenland region. The temperature timeline proposed by Dansgaard and Oeschger was confirmed as being global in nature when European glacial sediments and Antarctic ice cores were similarly analyzed through isotope temperature proxies. In fact, the much deeper ice cores from Antarctica were able to confirm the

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[53] I.G. Usoskin, et al. ''Solar Activity over the Last 1150 Years: Does it Correlate With Climate?'' *13th Cool Stars Workshop* (Hamburg, 5-9 July 2004): 19; Available from http://www.mps.mpg.de/dokumente/publikationen/solanki/c153.pdf; Internet; accessed 19 February 2009.

[54] Fred Singer and Dennis Avery. *Unstoppable Global Warming: Every 1,500 Years* (Lanham, MD: Rowan & Littlefield 2008.), 31 and 90.

[55] *Ibid.*, 16

1,500 years cycle over a 400,000 year period.[56] Of importance with respect to the causes or contributing factors of climate change is the observation that the sun is undergoing an unprecedented level of activity. Solanki et al have ascertained through radiocarbon analysis that the sun has been more active over the past seventy years than 90% of the previous 11,400 years.[57] Additionally, this recent increase in solar activity has persisted over an atypically lengthy amount of time. Solanki has been reluctant to associate this increased solar activity exclusively to recent warming trends. He did state his belief that "we are coming to a point where we acknowledge that both solar activity and greenhouse gases are important factors in the change in the Earth's temperature."[58] His qualifying comments are indicative of just how committed either side of the debate are to their respective agendas.

Although each side of the debate has valid and supportable points, this study cannot draw any firm conclusions on the underlying cause of recently observed climate change. Regardless of their differences in opinion and analysis, both sides of the Global Warming debate agree that the northern hemisphere, particularly the Arctic region, is in the midst of a general warming trend that has been ongoing since the 1980's. For the sake of identifying the infrastructure required to support Canadian government operations in

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[56] National Centre for Policy Analysis. ''The Physical Evidence of Earth' Unstoppable 1,500-Year Climate Cycle: Study #279, The Ice Cores: 3; Available from http://www.ncpa.org/pub/st/st279/st279b.html; Internet; accessed 19 February 2009.

[57] Sami Solanki,et al. ''Unusual Activity of the Sun During Recent Decades Compared to the Previous 11,000 Years,'' *Nature* Vol 431 (28 October 2008): 1.

[58] Elizabeth Meen, ''Sunspot Activity Hits 1,000-Year High,'' *Swissinfo.ch* (12 July 2004). Available from http://www.swissinfo.org/eng/search/Result.html?siteSect=882&ty=st&sid=5080155; Internet; accessed 20 February 2009.

the Arctic, this warming trend will be acknowledged and anticipated to continue for the next several years.[59]

[59] Despite the clear warming trend of the general Arctic region there are some areas that are undergoing a prolonged period of cooling; the Davis Straight region of the eastern arctic has cooled more than 0.5 degrees Celsius since the 1960s. Climate Change Digest *Impacts of Global Climate Warming for Canadian East Coast Sea-Ice and Iceberg Regimes Over the Next 50-100 Years.*

CHAPTER 5: IMPACTS OF ARCTIC WARMING

The Arctic appears to be most responsive region of the earth with respect to the immediate impacts of climate change. The United Nations' International Panel on Climate Change (IPCC) reported that "Climate change in the polar regions is expected to be among the largest and most rapid of any region on Earth, and will cause major physical, ecological, sociological, and economic impacts, especially in the Arctic."[60] Even former United States President, George W. Bush, who is widely considered by the Global Warming community as the arch foe of the environmental movement in view of his continued support for oil exploration and heavy American industry, has commented that ''climate change and other factors are significantly affecting the lives of Arctic inhabitants, particularly indigenous communities.''[61] Indeed, the Canadian Arctic is warming and the local inhabitants are quite aware of the imminent changes to their known world:

> The ice down here though I walked on it,
> The ice down here though I walked on it,
> It did not seem like real ice.
> The land down here though I walked on it,
> The land down here though I walked on it,
> It did not seem like real land.
> The lake down here though I visited it,
> The ice down here though I visited it,
> It did not seem like a real lake.
>
> Copper Eskimo[62]

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[60] United Nations. International Panel on Climate Change. ''Climate Change 2001: Impacts, Adaptation, and Vulnerability,'' *Summary for Policymakers*: 16; Available from http://www.ipcc.ch/pdf/climate-changes-2001/impact-adaptation-vulnerability/impact-spm-en.pdf; Internet; accessed 10 December 2008.

[61] United States. President George W. Bush. *National Security Presidential Directive/NSPD—66*. Washington, DC: Office of the Press Secretary (12 January 2009), n.p.

[62] John Colombo, *Songs of the Great Land* (Toronto, ON: Oberon Press, 1989), 80.

The continued warming of the Canadian Arctic will result in many changes, some potentially advantageous and others decidedly problematic. Empirical data, collected over the past several decades by various scientific research teams, clearly indicates that the Arctic region is undergoing a statistically significant warming trend. In fact, local temperatures have risen approximately 2.5 degrees Celsius per decade since 1979.[63] This observed rise in temperatures was seen as ‘‘recovery from an anomalously cold conditions (prior to 1970).’’[64] Today's average Arctic temperatures appear to be the highest in over 400 years. This highlights that, despite climactic variability, the Arctic is certainly warmer today than in any period since the Middle Ages. The various anticipated environmental changes on the Canadian North will be discussed within this chapter, focusing predominantly on the expected impacts upon the traditional Inuit way of life.

ICE & MARITIME TRAVEL

Several types of arctic ice need to be addressed to ascertain the impacts of climate change. Sea-ice is mobile and is affected by both currents and winds causing it to be propelled throughout the arctic region. The formation of sea-ice is dependent upon both temperature and ocean water salinity. Typically, the upper layer undergoes a greater dilution of salinity owing to fresh water melt-off, precipitation and fresh-water discharge from rivers emptying into the ocean. The vertical gradient of salinity is known as the

[63] Office of Naval Research, Naval Ice Center, Oceanographer of the Navy, and the Arctic Research Commission, ‘‘Naval Operations in an Ice-Free Arctic,’’ Symposium, April 2001: Annex 1-7; Available from http://www.natice.noaa.gov/icefree/FinalArcticReport.pdf; Internet; accessed 4 January 2009.

[64] *Ibid*., 6.

halocline and is crucial for the formation of ice at higher latitudes.[65] Water with a lower salt concentration will freeze at relatively higher (warmer) temperatures than water with greater salinity. Fast-ice is salt-water ice that forms adjacent to arctic landmasses, such as, islands, reefs or coastlines. Both sea-ice and fast-ice are similar inasmuch as they consist of a large surface area and a relatively thinner but uniform depth. Unlike fast-ice and sea-ice, ice-bergs are not ice formed in the ocean waters. As such, ice-bergs are somewhat ‘‘foreign’’ to the waters that hold them - they originate from land. Over thousands of years, in very cold climates and high altitude regions, fresh-water glaciers form when snowfall is gradually compressed to form a very dense ice. Warming temperatures, faults and gravitational forces will cause changes in a glacier’s balance of mass; consequently smaller portions of the glacier to break off periodically. This process is known as calving and results in fresh-water ice to enter the oceans as icebergs. More importantly, glaciers calving or melting into the oceans represent the only substantial net increase of water volumes to the global oceans.

A warmer North will certainly have less ice. Sea-ice is multi-year ice that has survived at least one summer melting season; however, much sea-ice is ancient. Ice that does not completely melt into water during the course of a summer becomes thicker as progressive moisture layers accumulate during subsequent years. The permanent polar ice cap has reduced significantly over the past thirty years, most notably in the area between the North Pole and Russia (See Figure 3). Although the extent of sea-ice ebbs with the onset on the warmer summer and autumn, warmer temperatures will result in less sea-ice cover of the arctic waterways and a net reduction in the mass of free-floating ice.

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[65] Cynthia Tynan, ‘‘Observations and Predictions of Arctic Climate Change: Potential Effects on Marine Mammals,’’ *Arctic* Vol. 50, Iss. 4 (December 1997): 313.

General estimates indicate that by 2050, there will be a 15% reduction in the total surface of sea-ice, coupled with up to a 40% reduction in total sea-ice volume.[66] The sensitivity of sea-ice with respect to regional warming indicates an ‘‘approximate 1 degree latitude retreat in the southern ice boundary off eastern Canada for every degree Celsius of warming.’’[67]

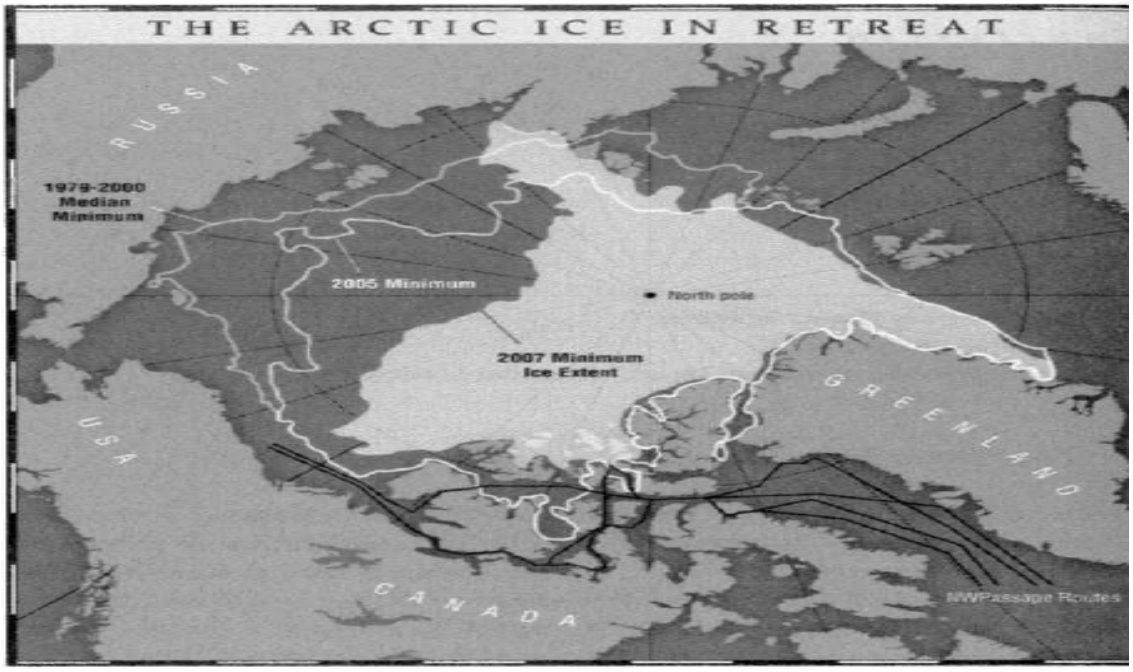

Figure 3: Polar Ice Cap Extent

Owing to the decreasing ice cover, the Northwest Passage will likely have a longer shipping season. With the exception of a few small recreational craft, the vast majority of ships that have transited the Northwest Passage since 1942 (*St. Roch)* have

[66] Garrett Brass, Ed. *The Arctic Ocean and Climate Change: A Scenario for the US Navy*. (Arlington, VA: US Arctic Research Commission, 2002), 6.

[67] Canada. Environment Canada. *Climate Change Digest: Impacts of Global Climate Warming for Canadian East Coast Sea-Ice and Iceberg Regimes Over the next 50-100 Years* (Downview, ON: Canadian Climate Centre, 1993) 11.

been either icebreakers or specially-designed ice-strengthened ships.[68] In view of the retreating ice, however, the United States Navy (USN) has estimated that 'the Northwest Passage will be opened to non-ice-strengthened vessels for at least one month each summer'' by 2011.[69] This greater availability of the Northwest Passage to seasonal traffic would certainly enhance the potential of this route as a viable commercial maritime route between Europe and Asia. More importantly, a navigable Northwest Passage could offer an alternate method of natural resource transport to markets, thus reducing the necessity for costly pipelines. In 2005, the Canadian Government conservatively acknowledged that ''the effects of climate change are expected to open up our Arctic Waters to commercial traffic by as early as 2015.''[70]

A more ominous impact of decreased sea-ice cover is the significant impact on the indigenous peoples' historic way of life. Throughout their history, Northern Native populations, especially the Inuit, have used the ice covered Arctic to expand their reach to non-contiguous hunting grounds. These seasonal ice corridors allowed hunting and fishing parties to harvest the wildlife resources of nearby islands throughout the Canadian Archipelago. Essentially, the ice-cover straights became the defacto winter highway for Inuit travelers and hunters. Furthermore, the Inuit extensively used these ice flow edges to hunt marine animals such as seal and whale. Climate change has affected the predictability of ice strength and formation times. As in past periods of environmental

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[68] Institute of the North, U.S. Arctic Research Commission and International Arctic Science Committee, *Arctic Marine Transport Workshop* (28-30 September 2004), Appendix F.

[69] Office of Naval Research, Naval Ice Center, Oceanographer of the Navy, and the Arctic Research Commission, ''Naval Operations in an Ice-Free Arctic,'' (Symposium, April 2001): 12; Available from http://www.natice.noaa.gov/icefree/FinalArcticReport.pdf; Internet; accessed 4 January 2009.

[70] Government of Canada. *Canada's International Policy Statement: A Role of Pride and Influence in the World Overview (*Ottawa, ON: 2005) 7.

uncertainty, such as, general warming, the lack of reliable ice conditions has forced Inuit hunters and harvesters ‘‘to seek more predictable terrestrial locations.’’[71] This change in hunting venues will certainly induce a change in prey species from marine wildlife to land mammals. The reduction of the traditional source of food from the sea will likely cause significant sociological changes to their known way of life and could potentially increase their dependency on food imported from southern regions in the event that terrestrial land species are over-harvested or deemed inadequate for the nutritional needs of a relatively concentrated coastal population. The loss of this traditional source of food will likely cause significant sociological changes to their known way of life and increase their dependency on food imported from southern regions.

The trafficability of the Northwest Passage, with respect to navigational limitations based on excessive ice coverage, has trended upwards for more than two decades. This can be attributed to a general increase in temperatures and a strong positive feed-back effect that compounds its effects over time. The Albedo Feedback Loop is a process whereby a reduction in snow and ice coverage allows darker exposed land and open water to absorb solar energy as opposed to reflecting it away from the earth.[72] While snow and ice tend to reflect the vast majority of solar radiation away from the earth’s surface, the darker coloured water and land absorb more solar energy during the summer season. Water has remarkable heat transfer capabilities and is able to retain thermal energy much longer than most materials; consequently, the waters that have been

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[71] Duerden, Frank. ‘‘Translating Climate Change Impacts at the Community Level,’’ Arctic Vol.57, Iss. 2 (June 2004): 213; Available from http://proquest.umi.com/pqdlink?index=0&did=665705431&SrchMode=1&sid=2&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1235326329&clientId=23; Internet; accessed 10 February 2009, 10.

[72] Chad Kister, *Arctic Melting: How Climate Change is Destroying One of the World’s Largest Wilderness Areas* (Monroe, ME: Common Courage Press, 2005), 94-96.

previously warmed by the sun cool at a much slower rate than the land and atmosphere surrounding them. In addition, warmer waters will tend to degrade ice from below via direct heat transfer because of the higher than normal temperature of water relative to the exposed ice.

Although higher temperatures in the Arctic will lead to less total ice mass, this does not necessarily imply that there will be fewer icebergs. The Beaufort Gyre is the anti-cyclonic (clockwise) Arctic Ocean current that forces both sea-ice and icebergs in to the Canadian Archipelago and down Baffin Bay into the North Atlantic. Thus, the direction of ice travel is generally from northwest to southeast. Higher temperatures may well lead to greater iceberg production for many years even if the warming trend reverses. Until all of the ice-berg producing glaciers are completely exhausted due to climate change, there could potentially be a greater iceberg threat to shipping to both within the Northwest Passage and the more widely used north Atlantic shipping lanes. Thus, despite a reduction in the overall quantity of ice, the anticipated rise in temperature could well contribute to more hazardous maritime conditions. For example, ‘‘Multi-year ice, particularly in low concentrations, will present a major hazard to shipping’’ because it will often be camouflaged within floes of relatively weaker annual seasonal ice.[73] More dangerous ice-berg conditions could cause uncertainty leading to an avoidance of the Northwest Passage by risk adverse commercial interests.

[73] Institute of the North, U.S. Arctic Research Commission and International Arctic Science Committee, *Arctic Marine Transport Workshop* (28-30 September 2004), A-5.

FIGURE 1. LE PASSAGE DU NORD-OUEST

Source : Lasserre, Frédéric. « Le passage du Nord-Ouest : une route maritime en devenir ? », *Revue Internationale et Stratégique* (Paris), n° 42, p. 143-160, 2001.

Figure 3: The Principle Route of the Northwest Passage

The Manitoba port of Churchill could bring an increased volume of maritime traffic in Canadian Arctic waters. As Canada's only mainland Arctic deep-sea port, Churchill is also served by rail link to Canada's agricultural heartland of the western prairies and the remainder of North America. The current shipping season is only three months long; however, less sea-ice due to arctic warming could easily extend this season. Any lengthening of the port's season will influence shipping activities in the Arctic Archipelago, especially with respect to monitoring and ice-breaking duties of the Canadian Coast Guard.

Churchill, as a rail terminus connected to the entire North American industrial base, is extremely well-suited for the transport and receipt of bulk cargo, such as, grain and liquefied natural gas (LNG). The economic potential of this port is so lucrative that in 2007 the Russians, eager to facilitate greater transpolar trade via the 'Arctic Bridge'

between Churchill and Murmansk, offered the use of Russian icebreakers to facilitate greater transshipment through the port. Although Canada rejected this offer, the federal government has allocated substantial funds (over $40 million) to improve the port and transportation infrastructure in order to capitalize on this new opportunity.[74]

The vast river systems of the North are also used extensively to transport goods during the summer and autumn seasons. The rail terminus of Hay River, NWT, is used as a collection point for material from southern Canada including fuel, non-perishable food stuffs and construction material. From this central distribution point, low-draft river and lake barges are driven northward along the Mackenzie River by the Northern Transportation Company (NTC) supplying various settlements throughout the region. At Tuktoyaktuk, on the Arctic Ocean, the goods are then sent to other coastal communities by ocean-going tugboats. Although climate change will allow for a longer river transport season owing to decreasing ice jams, the forecast for future riverboat replenishment is not uniformly Decreased snowfall causing lower flow rates and increased sedimentation from erosion could cause draft concerns even for the shallow-bottomed river barges; consequently, the continued or even increased use of the historic river transport system in the North remains uncertain.[75] The navigability of northern rivers remains largely unknown in face of climate change. With both decreasing ice and water levels it is uncertain which factor will be prove to be more crucial in the continuation of the river barge industry.

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[74] Canada. Western Economic Diversification Canada. ''Establishing Manitoba as a Global Transportation Gateway,'' (n.d.): 1; Available from http://www.wd.gc.ca/eng/10310.asp; Internet, accessed 22 February 2009.

[75] Canada. Natural Resources Canada. *From Impacts to Adaptation: Canada in a Changing Climate*. Chapter 3: Northern Canada, (2007), 85.

Decreased snowfall causing lower flow rates and increased sedimentation from erosion could cause draft concerns even for the shallow-bottomed river barges. Consequently, the continued or even increased use of the historic river transport system in the North remains uncertain.[76]

COASTAL EROSION AND RISING SEA-LEVELS

A common cry from the Environmental Global Warming lobby is the imminent threat of rising sea-levels due to both melting land-based ice, namely glaciers and ice-caps, and warmer water (greater volume per molecule due to expansion). In *An Inconvenient Truth,* Al Gore predicts a twenty foot sea-level rise if either the Greenland Ice shield or the West Antarctic Ice Shelf were to melt.[77] More reasonable, yet still significant, are the GCM predictions which indicate a net sea-level increase of between 9 centimeters and 88 centimeters during the course of this century.[78] Although this may be an issue in other low-lying coastal regions of the world, sea-level increase is not the major concern in northern coastal communities. Unlike more temperate, low-lying coastal communities, the resultant water will still be very cold thus reducing the impact of water molecule expansion. There are, however, a handful of northern communities that appear more susceptible to some moderate effects of rising sea-level, including

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[76] *Ibid.,* 85.

[77] Gore, Al. *An Inconvenient Truth: The Crisis of Global Warming.* New York, NY: Viking, (2006) 104 and 109.

[78] World Meteorological Organization. *Climate: into the 21st Century* (Cambridge, UK: University of Cambridge, 2004), 211. The wide variance is due to the use of different computer models predictive of climate change.

Tuktoyaktuk, Cambridge Bay, Hall Beach, Iqaluit, Pond Inlet and Arctic Bay.[79] Some of these communities have already been affected by wave and wind action along their coasts. For example, in 2003 significant repairs were required at Hall Beach in order to reconstruct the erosion control structures which had been severely damaged by excessive wave action caused by high winds.[80]

Numerous Canadian Arctic communities are discovering that the absence of fast-ice along their coasts is contributing to greater rates of coastal erosion. It appears that ice has a protective effect on the sensitive sand and gravel beaches of the arctic. The decrease of ice has allowed wave and wind action to accelerate the natural erosion of many sensitive beaches.[81] To date, the towns most adversely affected by the loss of coastline due to storm and wave erosion have been identified as Tuktoyaktuk and Sachs Harbour in the NWT.[82] This is mainly due to the prevailing winds and the large expanses of obstacle-free ocean adjacent to their coasts. The continued loss of low-lying beach areas takes natural boat landing sites and seafood preparation areas, such as fish drying racks, away from the maritime dependent inhabitants who historically have gained the

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[79] Canada. Department of Indian and Northern Affairs. *Nunavut*, (30 November 2008), 2; Available from http://www.ainc-inac.gc.ca/enr/clc/adp/ia/nnv-eng.asp; Internet, accessed 18 February 2009.

[80] Jamal Shirley, *C-CIARN North -Nunavut Community Research Needs Survey* Iqaluit, NU: Nunavut Research Institute (2006): 9; Available from http://www.nri.nu.ca/pdf/C-CIARN%20Research%20Needs%20survey.pdf; Internet; accessed 22 February 2009.

[81] Susan Hassol, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (New York, NY: Cambridge University Press, 2004), 78-79.

[82] G.K.Manson, et al. ‘‘Spatial Variability of Factors Influencing Coastal Change in the Western Canadian Arctic,’’ *Geological Survey of Canada* Vol. 25 (7 November 2003): 138; Available from http://www.springerlink.com/content/efqttbtv58xpfgq8/fulltext.pdf; Internet; accessed 22 February 2009.

vast majority of their caloric intake and traditional foods from the sea.[83] This could have significant sociological impact on the historical Inuit way of life.

PERMAFROST DEGRADATION, ROAD TRANSPORTATION & FLOODING

The structural integrity of permafrost is vital to past and future construction projects throughout the Arctic region. Permafrost is the thick layer of sub-surface soil that remains frozen throughout the year despite the warmth of the summer season. In the past there was no concern for the stability of structures or infrastructures constructed immediately atop the permafrost; this soil had similar properties to the concrete or wooden footings frequently used throughout the world to support vertical above grade construction. With permanently frozen ground, there was no anticipated requirement for supportive footings as perpetually frozen ground had similar load characteristics to solid bed rock:

> Although ice-bonded frozen ground can provide a strong foundation for infrastructure, thawing of the ground leads to loss of strength, as well as to settlement and instability…concerns include differential settlement due to spatial variations in soil characteristics and ice content, and slope instability resulting from permafrost melting.[84]

Permafrost temperatures were very consistent until the late 1980's when they began increasing. Empirical data indicates the thaw rate of permafrost has increased by

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[83] Eleanor Wein, et al. ''Use and Preference for Traditional Foods among Belcher Island Inuit,'' Arctic Vol.49, No.3 (September 1996): 261. Available from http://pubs.aina.ucalgary.ca/arctic/Arctic49-3-256.pdf; Internet; accessed 18 February 2009.

[84] Canada. Natural Resources Canada. *From Impacts to Adaptation: Canada in a Changing Climate*. Chapter 3: Northern Canada, (2007), 80.

half a degree Celsius resulting in a net loss of permafrost depth of 0.1 metres per year.[85] The recent warming trend observed in the arctic has begun to degrade the supporting properties. The sub-soil permafrost layer in the southern arctic regions has begun to thaw seasonally, leading to structural failures as the earth beneath buildings can no longer bear the standing weight load of the building materials. Although recent changes to engineering protocols and construction standards have addressed the potential impacts of degrading permafrost, this has not always been the case. [86] Any consistent loss of structural integrity will lead to failure or significant maintenance issues with all manner of horizontal infrastructures, as portions of previously solid roadways collapse beneath the load of materiel used for construction including, roads, airfields and pipelines.

In many cases the qualities of permafrost have been utilized to ensure the segregation of waste materials from the surrounding environment. Specifically, sewage lagoons and mining retention or tailing ponds have been reliant upon the impermeability of permafrost containment barriers. As climate change alters the extent of permafrost range and depth, the structural integrity of these barriers will likely begin to fail causing harmful waste products to escape their protective containment. The impacts of leakage could be catastrophic resulting in ‘‘contaminants being released into the surrounding environment, with subsequent impacts on ecosystems and human health.’’[87] The

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[85] James Morrison, et al. ‘‘Recent Environmental Changes in the Arctic,’’ *Arctic* Vol.53, Iss. 4 (December 2000): 370; Available from http://pubs.aina.ucalgary.ca/arctic/Arctic53-4-359.pdf; Internet; accessed 29 January 2009.

[86] Canada. Natural Resources Canada. *From Impacts to Adaptation: Canada in a Changing Climate*. Chapter 3: Northern Canada, (2007), 80.

[87] *Ibid., 82.*

contamination of potable water sources with pathogens, such as, *E Coli*, would cause significant health and safety issues for remote northern communities.

Finally, the reduction of the extent of permafrost within the Mackenzie River Valley will likely lead to greater occurrence of landslide activity and increased erosion. This will result in a larger river valley and increased turbidity of the river itself which could adversely affect the oxygen quality of the waterway and its ability to support a thriving fish habitat. The areas most impacted by landslides and erosion are severely sloped regions and the Beaufort Sea coastal area.[88]

Historically, the winter months have required the construction of ice bridges and ice roads in order to allow the flow of goods to and from the north. In view of the cost of air freight and the current impracticality of replenishment by sea, these logistical lines of communication are critical to the health and livelihood of many northern communities. Although supplies, such as dry goods, can be stockpiled, items such as fresh fruit and dairy products that are crucial to a healthy diet must be delivered throughout the year. Longer summers and less harsh winters have recently led to a much shorter ice-road transportation season, thus reducing the quantities of goods that can be delivered relatively inexpensively (compared to air lift) to or from some northern communities. Ice road construction usually commences in late November or December with the routes being navigable for a short two month season (February and March) when the routes are under continuous use depending upon the strength of the ice.

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[88] Stewart Cohen, ‘‘What If and So What in Northwest Canada: Could Climate Change Make a Difference to the Future of the Mackenzie Basin?’’ *Arctic* Vol. 50, Iss.4 (December 1997): 299; Available from http://proquest.umi.com/pqdlink?index=5&did=391992391&SrchMode=1&sid=3&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1235326697&clientId=23; Internet; accessed 10 February 2009.

The importance of ice-roads cannot be understated for the sustainment of the more remote and ice-locked portions of NWT and, to a lesser degree, mainland Nunavut; in fact, the public road system of NWT almost doubles in length during the winter road season.[89] Despite the uncertainty and danger of ice-road transport, the financial costs are far less than airfreight sustainment, especially in bulk materials, such as fuel, large machinery, and construction materials.

The construction of ice roads is not only important for the sustainment of inhabitants, but they are absolutely essential for the delivery of heavy equipment and material required to develop the region's natural resource sector. The weight of the required equipment requires strong roads that are only achieved with sustained cold weather. In Alaska, climate change has reduced the number of days available for oil exploration and extraction by 50% in the past 30 years[90] The ability to access the North and to further define its integral natural resource deposits will be crucial to the continued economic improvement of a relatively poor region within Canada. The eventual development of natural resources will contribute to greater employment and a net improvement of quality of life for northern peoples.

A further example can be found in the case of the Jericho diamond mine owned and operated by Tahera (TSX:TAH). Bulk supplies and heavy equipment are typically transported via a 400 kilometer ice road between Yellowknife and the mine over a two month period. In 2006, however, ‘‘unseasonably warm weather…played havoc with a seasonal ice road;’’ as such, the route was only navigable for 42 days and the mine

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[89] Canada. Natural Resources Canada. *From Impacts to Adaptation: Canada in a Changing Climate*. Chapter 3: Northern Canada, 2007: 86.

[90] Susan Hassol, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (New York, NY: Cambridge University Press, 2004), 86.

received only 60% of its intended freight.[91] In order to continue operations the company was forced to use air lift at much higher cost. Tahera estimated that each additional kilogram of material would cost 0.75 cents, equating to a $3 million dollar unforecasted cost. This was a substantial sum for a mine just commencing operations.[92] Uncertainty for small Canadian corporations attempting to develop the North will preclude them from making significant investment in the region, thus retarding the resource based growth required to provide employment and financial stability for Northerners.

In the event that winter ice-roads become impractical in future years due to climate change, other methods of transport will have to be considered. As air freight will continue to be too costly, the option remaining for non-river accessible communities will be the construction of all-weather roads. Modern engineering design techniques can overcome the challenges of unstable permafrost via avoidance of thaw-sensitive soils and minimization of settling effects; however, the costs will be significant. For example, gravel all-weather road construction costs in Northern Ontario are estimated at $85,000 per kilometer of road.[93] Although the decision to construct all-season weather roads would only directly impact the sub-arctic regions of the North (specifically Yukon and Mackenzie Valley), the high cost of construction would certainly indirectly affect all Northerners, as finite territorial financial resources would have to be committed to the sub-arctic region rather than being focused upon arctic development.

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[91] MWC. ‘‘Early Ice Road Closures Could Cool Diamond Operations,’’ http://lists.miningwatch.ca/pipermail/news/2006-April/000481.html; Internet; accessed 20 February 2009.

[92] Tahera Diamond Corporation. ‘‘Winter Road Update,’’ http://www.tahera.com/News/PressReleases/2006/Winterroadupdate1304/default.aspx; Internet; accessed 20 February 2009.

[93] Canada. Natural Resources Canada. *From Impacts to Adaptation: Canada in a Changing Climate*. Chapter 3: Northern Canada, (2007), 87.

The impermeability of permafrost has created waterways, such as lakes and ponds, on high features that defy the hydraulic principle of gravitational flow (that water should seek lower elevation). Permafrost has created higher elevation lakes that are contained by the frozen earth known as *thermokarst* lakes. As the structural integrity of permafrost dams begins to fail, lower elevations will be at risk of inundation. In several cases, Native communities are down-slope from lakes that have been contained by permafrost. Some communities might be threatened as the permafrost melts, and could potentially require relocation. The arctic communities of the NWT north of Great Bear Lake appear to be the most susceptible to possible flooding as permafrost dams continue to degrade, allowing the water of previously contained lakes at elevation to flow into the lower elevations of the Mackenzie River drainage and to form ‘‘extensive wetlands and peatlands in areas of low relief.’’ [94]

ECOLOGY & WILDLIFE

Plankton are tiny organisms, incapable of propulsion, that are transported around the oceans of the world via currents. They are the basic nutrient in the aquatic food-chain and are crucial to the nutritional health of the fish and mammals of the Arctic. Plankton populations are highly dependent upon light, temperature and ice cover. The warming of the Arctic and the associated loss of ice cover will likely cause a growth in plankton reproduction. The greater volume of the ocean’s most significant food-source would most likely result in an increase in the overall arctic fish population. There is an accompanying threat that existent species may be forced from their natural habit by

[94] *Ibid.,* 63.

foreign, warmer-water species searching for more productive feeding grounds and compatible habitats.

In a similar vein, insects are far less adaptable to cold climates relative to warmer environs. Increasing temperatures in the summer and early autumn can lead to an increase in insect activity. Cold temperatures are essential in keeping insect populations in check. When extraordinarily early spring or late autumn occurs there can be drastic impacts on a variety of ecosystems. For example, Cameron et al demonstrated during their long-term studies of the Alaska caribou herd that calving probability was directly correlated to body weight and percentage body fat which confirmed that the ability to successfully reproduce required energy reserves both during the period of conception and during rearing.[95] They observed a convergence between the period of peak births and the summer insect season which caused cow and calf pairs to search insect-relief habitat vice inland feeding areas thus depressing the mother's energy balance.[96] The resultant nutritional deficit will have an adverse affect on the mother's ability to nourish her off-spring, leading to stressors on both.

A further example of the impacts of climate change on the Northern ecosystem can be seen in the recent infestation by the pine beetle, which has destroyed hundreds of thousands of hectares of sub-arctic boreal forests in the past several years, seriously damaging the Canadian forestry industry. In the past, harsh winters killed off the insect larvae thus and prevented their spread; however, failure of winter temperatures in the early 2000s to remain below -30 degrees Celsius for thirty or more days allowed many

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[95] Raymond Cameron, et al. ''Central Arctic Caribou and Petroleum Development: Distributional, Nutritional, and Reproductive Implications.'' *Arctic* Vol. 58 (March 2005): 5.

[96] *Ibid.*, 7-8.

larvae to survive, generating a positive feed-back loop.[97] Fortunately, more typical winters in the last few years have destroyed this pest. The damage already inflicted upon boreal forests has made a significant negative impact on the Canadian timber industry, however, and will likely leave a greater risk of large forest fires. Climate change could also resume the trend of more extensive pine beetle infestation.

Rising temperatures will also have a significant impact on the wildlife currently found in the Arctic. As temperatures become less extreme, southern wildlife may well expand their natural ranges northward, potentially squeezing out incumbent wildlife for habitat. Inuit oral history, spanning generations, suggests that this is already happening. In some cases, animals and birds, previously unknown to local peoples, have migrated into northern region. The former chief of Old Crow, Yukon, remarked ''We started to see a lot of animals and plants they've never seen.''[98] Warming waters would also likely encourage the migration of southern-more fish species. More dominant fish like Atlantic cod are used to more moderate North Atlantic waters could potentially displace the less dominant native fish of the North, such as turbot. Seals, walruses and other fish-dependent species, such as whale and polar bears, would be forced to change their traditional diet sources and potentially alter their feeding habits significantly.

The polar bear is revered as the representative species of the Arctic. Atop the food-chain, this massive carnivore is the epitome of northern wildlife. The stability of polar bear populations is a contentious issue between global warming alarmists and skeptics, as well as northern peoples. Polar bears are dependent upon ice edges in order

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[97] Susan Hassol, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (New York, NY: Cambridge University Press, 2004), 54.

[98] Chad Kister, *Arctic Melting: How Climate Change is Destroying One of the World's Largest Wilderness Areas* (Monroe, ME: Common Courage Press, 2005), 17.

to access seal hunting grounds. Despite their impressive strength as swimmers, polar bears cannot effectively hunt in the water. They need to stalk or ambush seals and walrus' either resting atop the ice or loitering at breathing holes.[99] In addition, polar bear sows use ice-flows for breeding and rearing their young.

There are concerns that a reduction in sea-ice around polar bear habitat will adversely affect polar bear populations. The World Wildlife Fund (WWF) has studied polar bear populations in Hudson and James Bay, where the reduction in sea-ice has been the most dramatic. Their studies reveal that polar bear weights and reproduction rates have both decreased by over 15% over the past twenty-five years.[100] Despite this empirical data, many Inuit practitioners of traditional ecological knowledge, *Inuit Qaujimajatuqangit* (IQ), claim that polar bear population clusters outside Hudson Bay are stable, if not increasing.[101] The differing perspectives on the relative health of polar bear populations have led to pronounced friction between native northerners, especially Inuit hunters, and southern-based scientific community.

This misunderstanding culminated in late 2008 when the United States government declared that the Polar Bear was an endangered species, thus causing a collapse of the Arctic guiding/outfitting industry which had traditionally catered to rich American clients. This declaration, along with a similar stance from the European Union,

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[99] Richard, Bryan. *A Field Guide to the Wildlife of North America* (Bath, UK: Atlantic, 2006), 63.

[100] Chad Kister, *Arctic Melting: How Climate Change is Destroying One of the World's Largest Wilderness Areas* (Monroe, ME: Common Courage Press, 2005), 57.

[101] Martha Dowsley, ''Inuit Perspectives on Polar Bears (Ursus maritimus) and Climate Change in Baffin Bay, Nunavut, Canada,'' *Research and Practice in Social Sciences* Vol. 2, No. 2 (February 2007): 60-61; Available from http://www.researchandpractice.com/articles/2-2/dowsley-1.pdf; Internet; accessed 10 January 2009.

will have adverse affects on a $3M per year industry that typically charges up to $40, 000 per hunt.[102]

Figure 5: Polar Bears, Threatened or Thriving?

VEGETATION & AGRICULTURE

A potential positive effect of Arctic warming relates to agriculture. A longer farming season, coupled with more heat and sunshine may well stimulate additional farming opportunities in sub-arctic regions. The only agriculture currently conducted in the Territories is within the southern-most portion of the Mackenzie River basin; however, the continued warming trend could allow for the farming of grain in an

[102] CanWest News Service. ''N.W.T. Minister Wants Polar Bear Hunt Ban Reversed,'' (23 June 2008): 3; Available from http://www.canada.com/topics/news/story.html?id=6c588f46-da6e-4816-a4be-789a4836b478; Internet; accessed 10 March 2009.

additional 10 million hectares of land within the sub-arctic.[103] It is important to note that, the lack of sufficient past vegetation to enrich the soil with nutrients and the general rocky nature of the Arctic may limit widespread and economic feasibility of farming opportunities. Conversely, the increased farming opportunities in neighboring Greenland indicate that hearty food and forage staples such as broccoli, potatoes and hay can be produced in similarly harsh environments.[104] Furthermore, the arctic tree-line will likely migrate north as the discontinuous tundra regions thaw and the climate becomes less severe.

[103] Stewart Cohen, ‘‘What If and So What in Northwest Canada: Could Climate Change Make a Difference to the Future of the Mackenzie Basin?’’ *Arctic* Vol. 50, Iss.4 (December 1997): 301; Available from http://proquest.umi.com/pqdlink?index=5&did=391992391&SrchMode=1&sid=3&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1235326697&clientId=23; Internet; accessed 10 February 2009.

[104] Scott Borgerson, ‘‘Arctic Meltdown: The Economic and Security Implications of Global Warming.’’ *Foreign Affairs* 87, iss.2 (March/April 2008): 66.

CHAPTER 6: PROPOSED FUTURE INFRASTRUCTURE DEVELOPMENT

In face of the significant changes presently occurring in northern Canada due to the unquestionable warming of the region, there are compelling reasons and obligations on the part of the federal government to revisit the investments in development necessary to maintain and enhance Canadian influence in this region. The obligation of the federal government to demonstrate greater influence, vis à vis development, is an emerging aspect of reaffirming arctic sovereignty. Specifically, ''this includes a state's exercise of control and authority over its territory, and the perception of this control and authority by other states.''[105] The Canadian government can once and for all finally seize the initiative and execute a true northern strategy that will both assure the northern way of life in face of climate change and demonstrate, conclusively, Canadian sovereignty over the North. To date Canada has a very poor track record with respect to fulfilling the responsibilities of governance in the North. As the authors of *Arctic Front: Defending Canada in the Far North* observed, ''Of all the polar countries, Canada has been the weakest in developing the potential of its Arctic regions and in responding to its full range of responsibilities.''[106]

The territorial leadership of the North is well aware of the requirement for increased capital investment in the Arctic. Mary Simon, the President of *Inuit Tapirlit Kanatami*, the principal Inuit advocacy organization, remarked during an address to the Empire Club of Canada: ''The Arctic also needs investment in infrastructure. Lack of adequate infrastructure capital currently impedes development of viable small business

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[105] Matthew Carnaghan and Allison Goody. *Canadian Arctic Sovereignty* (Ottawa, ON: Library of Parliament, 26 January 2006). 2; Available from http://www.parl.gc.ca/information/library/PRBpubs/prb0561-e.htm; Internet; accessed 29 November 2008.

[106] Ken Coates, Whitney Lackenbauer, Bill Morrison, and Greg Poelzer, *Arctic Front: Defending Canada in the Far North* (Toronto: Thomas Allen, 2008), 191.

enterprises that are so necessary for a strong and diversified economy.''[107] As noted in *Building Inuit Nunaat: The Inuit Action Plan*, economic development is the key to success as ''many Inuit communities in *Inuit Nunaat* lack economic infrastructure, training and skills development, resource development and business development.''[108]

Although the federal government often speaks of security as the main method of demonstrating sovereignty, the primordial focus should be on demonstrating control of the region through initiatives that promote ''environmental, social and economic aspects'' vice military installations or deployed forces.[109] Only through the establishment of a viable and sustainable economy, which optimizes the localized economic gain from natural resources, can the region become self-sufficient and economically self-reliant. Through close co-operation with our polar neighbours and judicious investment in key infrastructures that support both the economic growth and address the social aspects of northern life within these three territories, Canada can best demonstrate its sovereignty. More critically, Canada will substantially improve the quality of life of its northern citizen. As a highly-fragile ecosystem, it is crucial that sustainable development be closely monitored and that environment and social sensitivities are respected throughout the planning and implementation processes of development.

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[107] Mary Simon, ''Inuit Unveil Action Plan to Develop Next Chapter of Inuit Development with Canada,'' *Address to The Empire Club of Canada*, Toronto, ON (15 February 2007), 3.

[108] Inuit Tapiriit Kanatami and Inuit Circumpolar Council (Canada). *Building Inuit Nunaat: The Action Plan*. Ottawa, ON (5 February 2007), 39; Available from http://www.itk.ca/sites/default/files/Inuit-Action-Plan.pdf; Internet; accessed 31 January 2009.

[109] Whitney Lackenbauer, ''From Polar Race to Polar Saga: An Integrated Strategy for Canada and the Circumpolar World,'' *Preliminary Draft* (1 December 2008): 23.

Despite the high costs of living, the majority of the sub-arctic regions of the Yukon and Northwest Territories are economically sound. The arctic portions of these two territories and all of Nunavut, however, are under significant financial duress based on their inability to transition from a subsistence economy to a sustainable wage-based economy. With concerted effort and compassion, the Government of Canada must attempt to provide for consistent wage-earning jobs in the North while still maintaining the native peoples' way of life with respect to culture and traditional lifestyle. Significant financial resources and the will of the federal government will be essential to further protect our interests in the North and to unequivocally demonstrate our total control of the region to other nations. The reasoning is three-fold. First, the Government of Canada has a moral and legal obligation to protect the way of life for the people of the North, especially the natives who, by treaty and tradition, have earned special federal protection. This important aspect was reinforced by the government in *The Northern Dimension of Canada's Foreign Policy*, namely ''to promote the human security of northerners and the sustainable development of the Arctic.''[110] Second, without a concerted effort (with substantial front-end costs), the economic potential of the region will not be optimized, resulting in a less prosperous nation. Third, from a geopolitical perspective, a more effective and encompassing level of federal government development will reinforce Canada's arctic sovereignty claims to other polar nations. A northern development programme must be well-thought out and cognizant of environmental risk mitigation as ''increased human activity is expected to bring additional stressors to the Arctic

[110] Foreign Affairs Canada. *The Northern Dimension of Canada's Foreign Policy* (2000), 2; Available from http://www.international.gc.ca/polar-polaire/ndfp-vnpe1.aspx?lang=en; Internet; accessed 22 February 2009.

environment, with potentially serious consequences for Arctic communities and ecosystems.''[111]

The current Conservative government has made several commitments to further develop Northern Canada. In 2007 Prime Minister Stephen Harper announced several high-cost projects envisioned for the Arctic over the next few years, demonstrating the Canadian's Government's renewed commitment to the North and her people.[112] Once again, a commitment has been undertaken to finally purchase Arctic offshore patrol vessels and an arctic-capable icebreaker. The availability of these vessels to either the Canadian Coast Guard or the Canadian Forces will allow for ships to travel within the Canadian Archipelago with greater freedom of movement than is presently available.

AIDS TO SEA NAVIGATION

In the event that the waters of the Canadian Archipelago, especially the NWP, become desired maritime routes to domestic and international shipping industries, Canada will be obligated to provide safe passage through her territorial waters. One of the reasons it took so many years and failures to define the NWP is the geographic complexity of the region. Impassible fjords, narrow straights, dangerously shallow depths, ice and unpredictable weather make the Northwest Passage a challenging route to navigate successfully even under excellent conditions. Transport Canada, via the Coast Guard, will be required to dedicate significant resources to the proper marking of the sea-

[111] United States. President George W. Bush. *National Security Presidential Directive/NSPD—66*. Washington, DC: Office of the Press Secretary (12 January 2009), n.p.

[112] Canada. Office of the Prime Minister. ''Backgrounder - 26 International Polar Year Projects and Funding Churchill Announcement'' *PMO* (5 October 2007). 1-3; Available from http://pm.gc.ca/eng/media.asp?id=1841; Internet, accessed 22 February 2009.

way in order to assure ‘‘safer and more efficient navigation’’ to protect vessels, their crews and the environment.[113] Owing to the severe climactic conditions, the Canadian Coast Guard will also have to conduct an aggressive maintenance programme to ensure that storms or ice have not damaged or moved critical buoys. Canada has been crucial in legislating environmental protection measures for the world's ocean, especially within sensitive Arctic waters; in fact, it was Canadian leadership and diplomacy that resulted in the UNCLOS article reinforcing the rights of coastal nations to impose environmental restrictions upon ships operating in environmentally sensitive regions. Furthermore, in addition to strict ship-construction standards that comply with Canadian environmental guidelines, the Canadian government must ensure that suitable charts are surveyed and made available to commercial maritime traffic.[114] Based on an evaluation of the ice conditions and navigational complexities, the Canadian Coast Guard (CCG) may have to assign ice masters and pilots to navigate vessels transiting the NWP. If this is the case, then transportation nodes will have to be established at either entrance to the NWP in order to accommodate the necessary CCG personnel.

As the Arctic fisheries expand there is the added risk of more frequent and potentially more catastrophic maritime emergencies. Maritime Search and Rescue is the purview of the Canadian Coast Guard, often supported by Canadian Forces assets. Depending upon the extent of the developing fisheries within the North, additional Coast Guard resources may have to be dedicated to arctic operations. Any necessary expansion of CCG centres will require facilities and accommodations to house its personnel. This

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[113] Whitney Lackenbauer, ‘‘From Polar Race to Polar Saga: An Integrated Strategy for Canada and the Circumpolar World,’’ *Preliminary Draft* (1 December 2008), 102 and 104.

[114] Franklyn Griffiths, "The Shipping News: Canada's Arctic Sovereignty Not on Thinning Ice," *International Journal*, Vol. 58, Iss. 2 (Spring 2003), 263.

will add economic benefits to implicated communities and also allow a symbol of the Federal Government commitment to be evident to a larger number of remote communities.

NWP TRANS-SHIPMENT NODES

In the event that the NWP is deemed a commercially viable route based on world trading patterns and anticipated ice reduction, the straights and shallows of the desired route may prove too challenging for the largest of ocean-going vessels. The dangerously narrow straights, navigational hazards, and ice threat will likely preclude the use of super tankers or large transport ships. In addition, the requirement for strengthened vessels with reinforced hulls, additional insurance premiums, and experienced ice masters and pilots may well make the use of the NWP prohibitively expensive. A Canadian solution to this issue might emulate the Russian experience along the Northern Sea Route, whereby Canadian masters and ships would transit the NWP in smaller, more nimble ships. Bulk cargo could be delivered to transit terminals located adjacent to the Beaufort Sea and Baffin Bay by large ocean going vessels. These facilities would allow for cargo or bulk materiel to be cross-loaded from larger ships to more appropriately sized vessels with greater maneuverability. During the open shipping season, smaller Canadian controlled vessels could then shuttle material through the NWP. This option would strengthen Canadian control of the passage; however, significant capital expenses would be necessary to provide docking space for large ships, maintenance facilities and cargo handling and storage facilities. In addition, suitable crews and purpose-built ship would have to be sourced.

DEEP SEA COMMERCIAL PORTS

In order to support greater maritime activity in the North, there is a requirement to provide for deep-water ports. The principal requirement for deep-water ports is to allow for delivery of supplies during the shipping season, irrespective of the tide status. Both Rankin Inlet and Iqaluit are major centres within their geographic regions; consequently, they are envisioned as the principal ports of entry for bulk material and supplies. From these centralized locations smaller vessels or aircraft can be used to distribute the goods to smaller, more remote locations. These proposed enhancements to the port facilities of these two towns will require immense investment. For example, the improvements to the Port of Iqaluit were estimated to be almost $50M based on 2005 values.[115] In addition, the proposed sites are intended to enhance the local economies of Nunavut through the ability to provide off-loading sites for larger commercial fishing vessels, namely those greater than 65 metres in length. Two specific fishery regions are forecasted as being capable of supporting larger commercial fishing enterprises, specifically Baffin Bay and Hudson Bay. In a report solicited by the City of Iqaluit, it was estimated that at least 50% of the non-Nunavut commercial fishing fleet would choose to use that port as a transshipment and maintenance node in order to minimize transit times to ports in Atlantic Canada and elsewhere. [116] This would certainly contribute significantly to the local economy. An additional advantage of large ship capable ports will be the ability to host cruise-chips throughout the shipping season thus maximizing the economic benefits of increased tourism to the region

[115] Aarluk Consulting and Gartner Lee Limited. ‘‘Strategic Plan for the Iqaluit Deepwater Port Project,’’ *City of Iqaluit* (August 2005), vi.

[116] *Ibid*., 10.

The seasonal village of Bathurst Inlet has also been tentatively identified for a deep-sea port capability. Unlike the other two sites, Bathurst Inlet has been chosen strictly as a material port designed to link-up via an all-weather road with seasonal ice-roads in order to service the fledgling mining industry both in NWT and Nunavut. A longer anticipated maritime shipping season will allow mine industry equipment and commodities to be more efficiently delivered to the mine sites. Moreover, maritime freight is far less expensive than air freight, and the connecting ice road will be more resilient than the more southern route that currently operates from Yellowknife. This project will be more challenging and expensive than other deep-sea ports because in addition, to the significant port requirements, other facilities(including an all-weather road) will have to be constructed from scratch in the uninhabited settlement. Infrastructure needs include accommodations, large bulk fuel storage, vehicle maintenance facilities and an airstrip. To date, this project rests within the private sector as a joint partnership between two Inuit corporations, Kitikmeot and Nuna Logistics.[117]

SMALL VESSEL COMMERCIAL PORTS

The viability and expansion of a commercial fishing industry appears to be more probable as both ice cover retreats and warmer water fish species migrate northward. Unfortunately, very few arctic communities have the small-port facilities to support a commercial fishery. The Department of Fisheries and Oceans, in conjunction with the Government of Nunavut, has a development plan for the construction or redesign of up to

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[117] Canada. Canadian Environmental Protection Agency. *Case Study: Bathurst Inlet Port and Road Project* (5 August 2005): 1; Available from http://www.ceaa-acee.gc.ca/015/001/032/sec3_e.htm; Internet, accessed 25 February 2009.

seven improved port facilities to further develop the region's nascent in-shore fish industry.[118] The aim is to eventually develop a commercial fishery capable of export to external markets either domestically within Canada or internationally. Currently most of the fish caught are either for subsistence or local consumption. A renewable and exportable product, such as turbot or arctic char, would have a positive effect on the economy and improve the quality of life of northern fishermen. Currently, there are only three small fish processing factories in Nunavut. Expanding these facilities or constructing fish plants elsewhere would bode well for the economic viability of communities, allowing Inuit to remain in their ancestral villages while earning a regular wage. Ultimately, fish processing facilities could be considered for local value added labour and more stable employment. Furthermore, a greater number of fishers would be able to continue living-off the maritime riches of the Arctic Ocean without forsaking their culture.

HOUSING INFRASTRUCTURE

The lack of suitable infrastructure is often cited as the principal issue facing Northerners in achieving a more equitable quality of life relative to their southern compatriots. This is a common plaint amongst organizations concerned with Canadian native rights; for example, the Conference Board of Canada remarked, with respect to Nunavut: ''Regardless of responsibility, the pervasive lack of infrastructure and other forms of physical capital are endangering the future economic success of the Territory.''[119] The lack of suitable domestic housing is likely the greatest infrastructure

[118] Canada. Fisheries and Oceans Canada. *Nunavut Small Craft Harbours* (November 2005), Annex A.

challenge to the North. Demographically, the North is far younger than the remainder of the nation with a rapidly growing population; as such, there are far more people than suitable residences especially in the Arctic. The Canadian Mortgage and Housing Corporation conducted a detailed analysis of prevalent real estate trends within Canada in 2001. During the course of this study, it was demonstrated that between 30% and 70% of all Inuit inhabiting the historical Inuit lands of Nunavut, Nunavik (northern Québec), Labrador and Inuvialuit (NWT) lived in crowded conditions. Furthermore, Inuit households were double the national average of core housing needs which consider factors such as, adequacy, suitability and affordability.[120] This study also indicated that Inuit were three times more likely than the general Canadian to inhabit dwellings requiring major structural repairs.[121] Unsuitable and crowded living conditions certainly contribute to greater social problems, such as, spousal abuse, substance abuse and suicide.[122]

TOWN SITE REMEDIATION

Owing to the warming of the Canadian Arctic, several potential major infrastructure projects should be undertaken to stabilize existent facilities in communities throughout the North, especially those in the non-contiguous permafrost regions of the

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[119] Canada. Conference Board of Canada Economic Services. ''Infrastructure Planning for Nunavut's Communities,'' *Interim Report for the Nunavut Association of Municipalities* (January 2004), 7.

[120] Inuit Tapiriit Kanatami and Inuit Circumpolar Council (Canada). *Building Inuit Nunaat: The Action Plan*. Ottawa, ON (5 February 2007): 86; Available from http://www.itk.ca/sites/default/files/Inuit-Action-Plan.pdf; Internet; accessed 31 January 2009.

[121] *Ibid*., 86

[122] Jamal Shirley, *C-CIARN North -Nunavut Community Research Needs Survey* Iqaluit, NU: Nunavut Research Institute (2006): 24; Available from http://www.nri.nu.ca/pdf/C-CIARN%20Research%20Needs%20survey.pdf; Internet; accessed 22 February 2009.

sub-arctic. Not surprisingly, thawing permafrost foundations will have a significant impact of the structural integrity of buildings. Studies indicate that ‘‘even small increases in air temperature substantially affect(s) building stability, and that the safety of building foundations decreases sharply with increasing temperature,’’ [123] thus decreasing the anticipated lifespan and safety of a given structure. Specifically, larger structures might require underpinning whereby concrete piles are driven into the more stable sub-soil ensuring that deteriorating permafrost does not adversely affect the structural stability of the building.

Another area for concern is the effect of failing permafrost on waste retention or sewage ponds. Historically, perpetually frozen earthen berms have been relied upon to contain sewage, mine tailings and leachates from municipal dumps. Continued warming will further degrade these infrastructures, resulting in potential contamination of the surrounding town sites. Significant engineering redesign or relocation of these municipal services might be required in order to ensure human health and safety and the protection of a fragile environment.

COASTAL PROTECTION

The shores of some coastal communities that are no longer sufficiently shielded with a protective band of fast-ice and sea-ice have been severely eroded through wave and storm action. Measures will have to be taken to stabilize the shores through the use of breakwaters or other geotechnical solutions. Otherwise, options for relocation of entire communities might need to be considered. Tuktoyaktuk, NWT, is the community

[123] Susan Hassol, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment* (New York, NY: Cambridge University Press, 2004), 89.

most immediately endangered by this lack of protection of sea-ice. Despite efforts to arrest the erosion with shoreline protection structures, the small community has been forced to abandon several important buildings including the elementary school.[124] In a similar situation, the Yukon Government was forced to relocate the old whaling station on Herschel Island to save the heritage buildings from the encroaching sea.[125] Of note, all of the identified locations for either small vessel or deep-water ports have included within their design specifications the requirement for significant earthwork break waters that will certainly mitigate or reduce the erosion effects of water against sensitive coastlines.[126]

ROAD REMEDIATION

Roads constructed atop the permafrost will likely slump and fail if the warming trend continues. Roads are technically simple to construct, maintain and repair; however, the remote nature of the North and lack of a substantial engineering industry in the region will likely make total reconstruction prohibitively costly. As such, there is little probability of a complete redesign and rebuild of the North's land route. Repairs will likely be limited to spot repairs at failure sites and preventative maintenance on those sections of road deemed high risk for future slumping. Similar remediation will also have to be made on sub-arctic airfields which provide a crucial link to the outside world. This

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[124] *Ibid*., 81.

[125] United Nations. Educational, Scientific and Cultural Organization. *Case Studies on Climate Change and World Heritage.* (April 2007): 58-59; Available from http://whc.unesco.org/uploads/activities/documents/activity-473-1.pdf; Internet, accessed 24 February 2009.

[126] Canada. Fisheries and Oceans Canada. *Nunavut Small Craft Harbours* (November 2005), Annex A.

is essential to provide emergency medical treatment and to serve as refueling stations for search and rescue aircraft.

Any newly constructed roads or airfields required to support new industries or settlements will be far more expensive to design and build, given requirements to correctly account for the likely future degradation of the sub-base. Furthermore, airlift may well become the preferred mode of transport to newly developed or remote sites, given the prohibitive expenses associated with linking overland to existent road networks. Similar remediation will also have to be made on sub-arctic airfields which will continue to provide a crucial link to the outside world during periods of difficult overland travel. This especially critical to provide emergency medical treatment and to provide refueling stations for search and rescue aircraft.

AIRFIELD EXPANSION

In order to allow the scope for quick deployment of personnel to the North via strategic airlift, the military and civilian airfields of Northern Canada will require lengthening. Most of the airstrips are capable of supporting fighter, tactical airlift and medium commercial aircraft; however, in order to deploy an effective number of personnel quickly the much larger C-17 Globemaster will be required. [127] As a substantially larger aircraft, this plane requires a wider, more robust airfield with greater maneuver room. The requirement for military personnel to deploy in order to face a security threat is low; however, there are many potential domestic emergency situations where a large number of quickly deployable personnel would be beneficial. For example,

[127] Whitney Lackenbauer, ‘‘From Polar Race to Polar Saga: An Integrated Strategy for Canada and the Circumpolar World,’’ *Preliminary Draft* (1 December 2008), 52.

incidents such as a major oil spill, maritime emergency or plane crash could all benefit from a prompt military presence based on the additional capabilities offered by the CF. In the event of a catastrophic occurrence, the Canadian Forces' ability to quickly deploy the medical and engineering assets of the Disaster Assistance Response Team (DART) would be undoubtedly advantageous in order to aid victims. Furthermore, Canada's ability to promptly deploy resources to a remote and harsh region would certainly demonstrate the nation's sovereignty in the Arctic.[128]

The same issues that arise with road construction atop permafrost are also evident in other horizontal constructions, such as airfields and retention walls. In 2003, a large sink-hole occurred beneath the paved surface of the Iqaluit airfield leading to serious concerns over the future sensitivity of the airport to further thaw/freeze cycles. [129] This type of horizontal structure failure will likely become more prevalent especially in the non-contiguous permafrost regions in the sub-arctic.

ARCTIC RESEARCH FACILITIES

As an Arctic nation, Canada possesses the complex arctic terrain and technical scientific knowledge to excel in research within this environment. Opportunities to improve human understanding of this complex ecosystem and environment should be seized. The potential for Canadian leadership within the realm of Arctic science is obvious, and a less confrontational approach with other circumpolar neighbours –

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[128] Even disregarding the military requirements, it must be noted that air transport is the principle method of travel for people and cargo in the coastal Arctic especially during the winter months. Any improvements in the efficiencies of the existing civilian air ports will improve the ease of transportation throughout the region.

[129] Jamal Shirley, *C-CIARN North -Nunavut Community Research Needs Survey* Iqaluit, NU: Nunavut Research Institute (2006): 16; Available from http://www.nri.nu.ca/pdf/C-CIARN%20Research%20Needs%20survey.pdf; Internet; accessed 22 February 2009.

through various international research organizations - would help to cement Canada's place as a constructive actor in the circumpolar world.

The Canadian government recently approved a bilateral agreement with the United Kingdom whereby British scientists would be able to use Canadian arctic research facilities in exchange for Canadian scientist use of British facilities in the Antarctic.[130] Similar bilateral agreements will foster international co-operation and advance scientific understanding of one of the earth's least understood or researched regions. Furthermore, the present Conservative government has committed to additional arctic research through the construction of an Arctic Research Station in Nunavut; the short-list includes the settlements of Cambridge Bay, Pond Inlet and Resolute.[131]

MACKENZIE PIPELINE

Although not a strictly governmental project, the oft-proposed Mackenzie River valley natural gas pipeline will require authorization and significant Federal Government involvement to become a reality. This project has been under consideration for nearly forty years; however, little progress has been made to date. At the very least this project would require federal government approval with respect to Native land claims and environmental protection. More likely, it will also demand significant governmental financial support of the project in terms of subsidies, royalty concessions, tax breaks and perhaps even direct investment into this significant financial undertaking which is

[130] CBC. ''New deal with U.K. boosts Canadian access to Antarctic research stations,'' (11 February 2009); Available from http://www.cbc.ca/technology/story/2009/02/11/tech-arctic-antarctic-deal.html; Internet; accessed on 11 February 2009, 1.

[131] Canadian Press. ''Strahl Announces Arctic Research Station to be Located in Nunavut,'' (20 February 2009): 1; Available from http://ca.news.yahoo.com/s/capress/090220/science/science_arctic_research_station; Internet; accessed on 24 February 2009.

estimated to exceed $15M.[132] If constructed, this pipeline would allow for the efficient transfer of natural gas from the Beaufort Sea and Mackenzie Delta extraction facilities to the energy-starved markets of the continental United States. Potentially insurmountable environmental and Native land claim concerns would require committed federal government action to resolve. Without a clear vision on the desired end-state of northern development an ill-considered decision may be made. A major project such as this will certainly afford the local population with the potential of lucrative jobs in construction and servicing; however, they will become further disassociated with their traditional subsistence lifestyle. Unfortunately, without higher technical trades training and a better level of basic education, the majority of high paying jobs will be filled by more qualified personnel form Southern Canada and thus most economic benefits will be lost to southern cousins. Unfortunately, Canadian Arctic history indicates that the permanent residents, mainly native, ‘‘will remain long after the newcomers flee, with Arctic wealth or impoverished dreams.’’[133]

MILITARY/COAST GUARD DEEP-SEA PORT

The federal government has recently stated its desire to construct a deep-water port in the High Arctic at the former lead-zinc mining settlement of Nanisivik on the northwestern side of Baffin Island. The site currently has a rudimentary docking system that had been used by commercial tankers for ore transport. The dockside depth of more than fifty feet is sufficient to accommodate the types of large-draft vessels anticipated for

[132] CBC News. ‘‘Federal support for Mackenzie pipeline backers a conflict, critics say,’’ (21 January 2009): 1; Available from http://www.cbc.ca/canada/north/story/2009/01/21/mgp-reax.html?ref=rss; Internet, accessed 22 March 2009.

[133] Ken Coates, P. Whitney Lackenbauer, Bill Morrison, and Greg Poelzer, *Arctic Front: Defending Canada in the Far North* (Toronto: Thomas Allen, 2008), 156.

deployment to the region. The Conservative government has pledged more than $100 million to develop the port which is estimated to be operational by 2015.[134]

Though this site would be ice-bound in the winter months, it offers excellent proximity to Lancaster Sound which is the only eastern entry of the Northwest Passage. Logistically, the proposed site is excellent as it is virtually in the centre of the Canadian Archipelago, thus affording optimal use to ships transiting the Northwest Passage. Cached fuel will allow greater mobility and flexibility to Canadian Navy and Canadian Coast Guard ships to operate in the Arctic independently of refueling ships. The port facilities of Nanisivik will also allow an accessible location for ships requiring repair or protection from adverse weather events. In addition, this project will provide significant financial benefits to an economically-repressed region of the country. The injection of more than one hundred million dollars will certainly benefit under-employed workers of Nunavut. Furthermore, once the port becomes operational there will be a greater requirement for local business enterprises to be developed or expanded in order to provide crew and passengers with essential services when disembarked at port.[135]

MILITARY ARCTIC TRAINING CENTRE

Additionally, the Canadian Forces has been directed to refurbish old federal buildings at Resolute Bay, Nunavut into an arctic warfare training centre. The availability of this training centre will allow soldiers, stationed at permanent southern

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[134] CBC News. ‘‘Harper announces northern deep-sea port, training site,’’ (11 August 2007): 1; Available from http://www.cbc.ca/canada/story/2007/08/10/port-north.html; Internet, access 22 February 2009.

[135] Although this port is principally to support the ships of the Canadian government, there is potential for commercial shipping firms to utilize the facilities of Nanisivik, especially those involved in the burgeoning eco-tourism market.

bases, to deploy to the Arctic for longer periods of time and at a more frequent rate.[136] Not only will soldiers gain invaluable survival experience, but crucial arctic warfare equipment and materiel will be cached for unforeseen contingencies. More importantly, a forward operating base for ground-based soldier will be available as a staging area for future operations whether they are for defensive measures or domestic operations. The already constructed airstrip will prove invaluable for replenishment and reinforcement.

[136] CBC News. ''Harper announces northern deep-sea port, training site,'' (11 August 2007): 1; Available from http://www.cbc.ca/canada/story/2007/08/10/port-north.html; Internet, access 22 February 2009.

CHAPTER 7: RECOMMENDATIONS AND CONCLUSION

For most of our history, Canada has carelessly neglected the North, choosing to act only when prompted by external factors, such as war or perceived threats to sovereignty. In view of this systemic, historical indifference and the unrealized economic potential of the natural resources found in the North, it is time for the Government of Canada to act resolutely in a concerted and well thought-out manner.[137] The allocation of substantial financial resources, government effort and technical and scientific expertise must be harnessed in order to address Northern development in a coherent manner. Despite recent governments' emphasis upon diplomatic and military means to exert sovereignty, the optimal method to govern the North would be through aggressive infrastructure development throughout the region, especially the Canadian Arctic. Tangible Northern development will clearly demonstrate Canadian national commitment to the region and aid many of the nation's most marginalized citizens, namely Natives.

A concerted development effort would further reinforce and solidify Canadian sovereignty claims in the Arctic. Ultimately, all investment in capital infrastructure projects should be directly related to the eventual exploitation of the region's untapped natural resources and the economic strengthening of the region. The three Canadian territories of the North need to become less dependent on federal aid in the way of transfer payments. In the end, the provision of infrastructure, enabling Northerners to thrive within their ancestral communities, will alleviate much of the current financial and social burdens currently prevalent in the North.

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[137] Ken Coates, P. Whitney Lackenbauer, Bill Morrison, and Greg Poelzer, *Arctic Front: Defending Canada in the Far North* (Toronto: Thomas Allen, 2008), 215-216.

First and foremost, infrastructure initiatives designed to improve the quality of life of Northerners must be swiftly undertaken in order that our northern compatriots can live in comparable comfort, safety and security to their southern cousins. Housing and municipal services such as, waste treatment plants, roads and airports require substantial improvement. Second, capital projects focused on development and regional economic autonomy need to be implemented so that a more-stable wage-based economy can be developed thus allowing Northerners to benefit from their vast natural resources. The construction of ports in support of the local fishery is the most obvious example. Last, the federal government must increase its effectiveness and presence in the North through the construction of federal facilities like: arctic research centres, coast guard facilities and military stations.

As a final point, climate change will certainly continue to affect the Northern way of life. Many traditional lifestyles and practices will have to be altered or entirely abandoned, while other exciting, new opportunities will emerge. Some changes will have a net positive effect on the quality of life for Northerners. Canada's Arctic peoples will continue to thrive irrespective of the changes ahead, much like they have for the past several thousand years. These are an indomitable, resourceful people and they will overcome whatever challenges climate change offers. The adaptability and realistic optimism of Northerners is often reflected through Native oral history and poetry:

> Who comes?
> Is it the hound of death approaching?
> Away!
> Or I will harness you to my team.
>
> - Copper Eskimo[138]

[138] John Colombo, *Songs of the Great Land* (Toronto, ON: Oberon Press, 1989), 97.

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