



SCIENCE FOR A **CHANGING** FAR NORTH

The Report of the Far North Science Advisory Panel
April 2010



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PREFACE

*For one group it is a frontier, for the other
a homeland.*

Thomas Berger, 1977



PREFACE

The Far North of Ontario is one of the world's largest, most intact ecological systems, reflecting a high level of ecological integrity and providing ecosystem services far beyond its borders. It stretches from Hudson Bay south to the boreal forests in Ontario's mid-latitudes, where the land is criss-crossed with roads and towns, and forestry, mines and farms (Fig.1). At 452,000 km², the Far North is 42% of the area of Ontario, larger than Newfoundland and Labrador, and 1.5 times the size of Italy, yet very few of Ontario's citizens have any familiarity with it. It is the homeland of citizens whose ancestors have occupied it continuously for millennia. Its 34 communities (Fig. 2) are remote, linked only by short-lived winter roads, air and water, and modern communications. Its residents know the land and they rely on it. They live as close to the land as anyone in North America, on landscapes that are unique and extraordinary (Fig. 3).

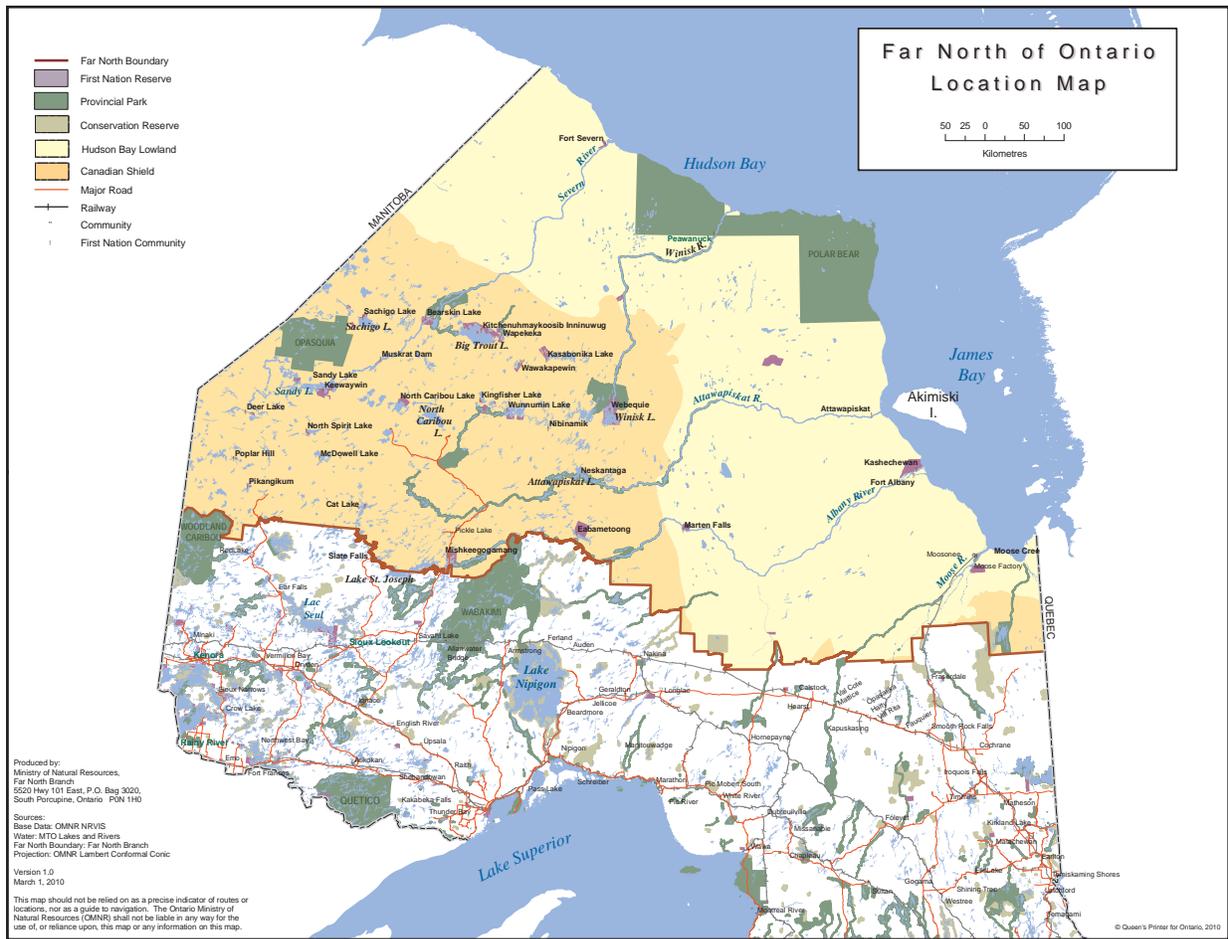


Figure 1. Far North Location Map. Source: OMNR, 2010.

In the next few years, the citizens of the Far North will face many choices, some of them involving large-scale developments that will change the region forever. Opportunity and pressure will grow to access and develop the region’s mineral, energy and forest resources. Whatever development takes place must improve the quality of life for its citizens and must occur with full respect for the cultural values, natural features and ecological functions that define the Far North. This is the stated intent of new draft provincial legislation regarding the Far North.

The current draft of Ontario’s Bill 191, *The Far North Act: An Act with Respect to Land Use Planning and Protection in the Far North*, has four objectives: a significant role for First Nations in land use planning; the protection of its cultural areas and ecological systems within an interconnected network of protected lands and waters; the maintenance of its biological diversity and ecological processes and functions, and the protection of its stored carbon; and sustainable economic development that benefits First Nations.

What is proposed in the legislation is a new kind of decision-making based on the adoption of community based land use plans developed by First Nations in partnership with government, before major development occurs. These plans are also required to take into account broader-scale considerations, including a Far



Figure 2. Far North Communities. Source: OMNR, 2010.

North Land Use Strategy. The Far North Science Advisory Panel was asked to provide advice on that broad-scale strategy. This report provides our advice, and describes the scope and scale of knowledge and awareness – both broad-scale and local – that will be needed if these ambitious objectives are to be met. The residents of the Far North have previous experience with planning, consultation and development proposals. In 1977, Ontario mandated the *Royal Commission on the Northern Environment* to inquire into “any beneficial and adverse effects on the environment...of any public or private enterprise” north of the 50° latitude. E.P. Hartt and J.E.J. Fahlgren were its Commissioners, and released an Issues Report (1978) and *An Atlas of Far Northern Ontario* (1985). The inquiry was in response to a proposal for large-scale timber harvest.

The Commissioners met with communities across northern Ontario, including three communities in the Far North, Moose Factory, Moosonee and Mishkeegogamang, as well as in Toronto. The majority of submissions were on social, economic and cultural matters, and Hartt recommended “the development of an orientation away from centralized forms of social control and decision-making into experimentation with ones that are decentralized and community oriented.” The focus of the Commission was the means by which engagement and mutual benefit could be achieved. “The process by which change can be introduced

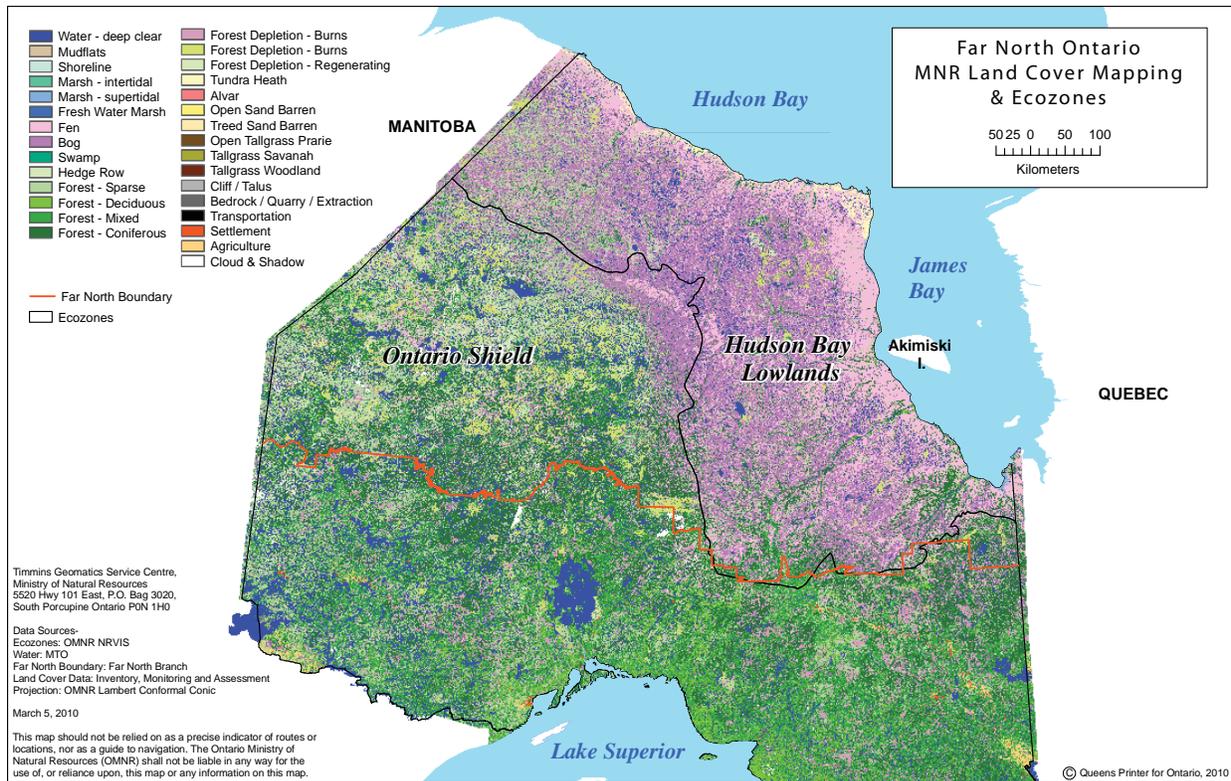


Figure 3. Far North Land Cover Mapping & Ecozones. Source: OMNR, 2010.

constructively on all social, economic and cultural questions is by involving northerners in the decisions which will affect their lives.”

Commissioner Fahlgren focused on the compilation of information that had been unavailable before. He emphasized the benefits of such information to environmental assessments of developments in the north. He wrote, *“The public is now increasingly insistent that decisions to allow any major proposed project to be implemented be withheld until the likely beneficial and adverse consequences of the project and alternatives to it have been evaluated from social, economic and natural environmental viewpoints.”*

As a result, timber was accessed north of 50° but the region north of about 51° remained largely roadless and without large-scale development. Plans by Ontario Hydro in 1989-92 included hydro development of the Abitibi, Mattagami and Moose rivers, but excluded large-scale sites on the Albany, Winisk and Attawapiskat, based on an environmental assessment of economic, social and ecological factors, and First Nation concerns about flooding. The Northern Rivers Commitment with First Nations now prohibits hydro-electric development exceeding 25MW on these rivers and the Severn River.

Broad-scale plans were developed by public agencies; for example, in the 1980s, the public lands of Ontario were the subject of land use planning that resulted in draft plans for the Far North. This was repeated in the 1990s for central Ontario, after which the 2002 Room to Grow report of the Ontario Forest Accord Advisory Board made a commitment that development in the Far North would be *“orderly development”*. The Report stated: *“First Nations [are interested] in commercial forestry potential north of the 51st parallel...”*

MNR is currently working with several First Nations under what is called the Northern Boreal Initiative. The preparation of land use direction and new environmental assessment coverage for forestry in the north will be significant tasks. A new approach called Community Based Land Use Planning is currently being developed. The First Nation communities will lead planning, with MNR's support and assistance."

The *Room to Grow* report also set out a goal of identifying appropriate conservation lands through community plans, before large-scale developments were initiated. On this basis, a community based land use plan by the Pikangikum First Nation for the Whitefeather Forest was completed in 2006, and other such plans are under consideration by other First Nations.

The Far North, with the exception of two active mines, has no major industrial development at present. The draft Ontario Power System Plan (2007), however, includes plans to generate and transmit significant new hydro-electricity from the Far North. Significant new mining, processing and shipping is being promoted in the Ring of Fire mineral field north of the Attawapiskat River. At the same time, however, Ontario has adopted a *Biodiversity Strategy* (2005), and new legislation in support of *Endangered Species* (2007). These documents, along with the *Northern Boreal Initiative*, require the Province and its residents to consider the environmental implications of development, including that in the Far North.

Our report focuses on the value and importance of the environmental features and ecological functions of the Far North, and on the critical science issues we believe deserve close attention in land use planning, environmental assessment, and adaptive management as the Far North changes.

We were not asked to look at the processes through which communities will be engaged in planning and decision-making. Instead we have attempted to answer questions such as: What is known of the global, national and provincial significance of this region? What is its special character that deserves particular attention and protection? What has been learned elsewhere that should guide planning in the Far North? What changes might be driven by a changing climate? We have made specific recommendations about the science-related aspects of land use planning, and the values, principles and adaptive processes the Panel believes should underlie that planning.

Members of the Panel have referred to many reports and studies included in the extensive "Endnotes". Our intention has been to integrate and provide a more general discussion of matters that are in some cases dealt with in more detail elsewhere. At the same time we recognize that the knowledge we have brought to our discussions has not included traditional aboriginal knowledge. We have emphasized that such knowledge should be included when decisions are made in the future.

We have attempted to organize our report and our recommendations in ways that are useful to all planning partners in the development of community based land use plans and also, if need be, in designing interim measures when development is proposed in advance of a community based plan.

In summary, we have focused on the "*beneficial and adverse effects*" of development on communities through the consequences for the environment. We believe our report complements the treatment of community well-being through the "*social, economic and cultural questions*" that were the focus of the *Royal Commission on the Northern Environment* more than thirty years ago.

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

This report describes the vast and largely intact ecological systems of the Far North, and recommends a conservation-matrix approach for land use planning. It recommends landscape-level planning, with “benchmark” areas and specific features of interest set aside from development, while other areas are designated for active management, and the landscape overall is planned for continuity and resilience of ecological function. Adaptive management provides a means of evaluating management strategies as climate change and economic development proceed. It will require sustained commitment to the collection and sharing of information about the Far North, including scientific and aboriginal traditional knowledge.

Overview

The Far North of Ontario is one of the world’s largest, most intact ecological systems, reflecting a high level of ecological integrity and providing ecosystem services far beyond its borders. It is the homeland of citizens whose ancestors have occupied it continuously for millennia. They know the land, and they rely on it. Their 34 communities are remote, linked by air, water, winter roads, and modern communications. The citizens of the Far North are already involved in making choices about large-scale developments that will change the region forever. This trend is already apparent in regions such as the Ring of Fire, and will only accelerate over the next few years. Change will come first in the form of intense interest in accessing and developing the region’s mineral, energy and forest resources. This can only occur with full respect for the cultural values, natural features and ecological functions that define the Far North, and in the context of enabling development that benefits First Nations. These are the stated objectives of new draft provincial legislation regarding the Far North.

A group of scientists, the *Far North Science Advisory Panel*, was asked by the Province of Ontario to consider the state of scientific knowledge about the Far North, and provide scientific advice relevant to land use planning decisions in that region in support of community based land use planning (see Terms of Reference, Appendix A). This report provides that advice.

The Biophysical Environment of the Far North

Large intact landscapes like the Far North are rare. In a global context, the Hudson Bay Lowland of the Far North contains one of the Earth's largest peatland complexes. In the "Boreal Shield"^{1*} region to the south and west lies the core of the largest single extant block of boreal forest free from large-scale anthropogenic disturbance anywhere in the world. These peatland and forest systems constitute globally important stores of carbon, mediate ecosystem hydrology, and modify local and regional climates. They are interconnected through the movement of water, air, and organisms, among them federally and provincially-listed endangered and threatened species, and other species of concern.

Most of the region's lakes and rivers are free from the effects of human activity, although some rivers have been developed for hydro-electric power and diversion of flows to the south and west. Water quality is thought to be unimpaired throughout the region, although the drinking water in some First Nations communities has been degraded by poor sanitation, with tragic consequences.

Diesel-based generation of electricity and traffic over winter roads create localized sources of air and water pollution from spilled fuels in First Nations communities. Generally speaking, however, pollution from industrial effluents is currently limited to a small number of mining and exploration sites. Long-range airborne transport and deposition of mercury and persistent organic pollutants such as polychlorinated biphenyls, brominated organic compounds including flame retardants, and pesticides to surface waters is, however, a growing concern, because of the toxic effects caused by accumulation of such substances in fish, wildlife and human tissues. Levels of some of these chemicals are already high in Far North fish – in some cases, at or above the level recommended for human consumption. There is very little margin of safety for additional pollutant inputs.

The region remains a stronghold for biodiversity, including mammals such as caribou, wolverine, Canada lynx, gray wolf, marten, and polar bear, that have suffered declines elsewhere in their ranges, including southern Ontario. Ten of Ontario's mammal species only occur in the Far North, most of them restricted to the Hudson Bay Lowland, and a suite of maritime mammals range along the coast and in river estuaries. The region is also of global importance for migratory birds. For many migrating shorebirds and waterfowl, the shores and associated mudflats of James Bay and Hudson Bay are the only tidal saltwater habitats that are located between the maritime arctic to the north and the Gulf of St. Lawrence, Atlantic Ocean and Gulf of Mexico to the south. In particular, the migratory corridor along the Hudson Bay and James Bay coasts is of global significance for waterfowl and shorebird breeding and migration. The funnelling effect of the coastlines of Hudson Bay and James Bay, which concentrates bird numbers spectacularly during fall migration, is one of North America's few remaining examples of its former faunal abundance. Alteration of these habitats therefore has implications for biodiversity, not only locally but also at the continental and global scale.

At least 50 species of fish are currently known in the Far North, making it a biodiversity "hot spot" for fish in Canada. Common species on the Shield are walleye, whitefish, sucker and northern pike, while species

¹ * The terms "Boreal Shield", "Canadian Shield", and "Ontario Shield" are often used interchangeably for the portions of the Shield that occur within Ontario. For the purposes of this report, we will use the term "Boreal Shield" or simply "Shield" to refer to the part of the Shield that lies within the Far North, and "Canadian Shield" more generally.

like brook trout and lake sturgeon (a species of special concern) are more common in the Hudson Bay Lowland. Three species or forms (sea-run brook trout, arctic char and fourhorn sculpin) are restricted in Ontario to the Far North. Non-native fish are almost absent; exceptions are smallmouth bass and rainbow smelt, which were brought into a few lakes and rivers in recent decades. Most of the fishing in the Far North is for subsistence, and is localized around communities. Tourism fishing is however the main focus of more than a dozen major base lodges and more than 150 fly-in camps, with very few of them operated by residents of the region.

The remoteness of the Far North and its low level of development also present challenges. Basic biophysical survey and inventory work has only just begun in most areas with, as yet, little understanding of fundamental relationships between species and ecosystems, and the potential for disturbance to alter those relationships. Traditional knowledge would help to address this need, but it is not yet expressed as a region-wide knowledge base. Future conditions are also uncertain, because of the dynamic nature of natural disturbance regimes like fire in the region, the looming spectre of climate change, and the manner and extent to which the region's globally-important mineral resources will be developed.

More Change is Coming

Climate change models and established trends indicate that by the middle of this century, the Far North will likely be considerably warmer and will receive slightly more precipitation than it does today. In spite of the slight rise in precipitation, these conditions will increase the potential for evapotranspiration, and in turn may lead to reductions in soil moisture, lake levels and river flow. Models indicate that some of the most dramatic changes will occur in the most northern extent of the Far North, near the coast of Hudson and James bays. A considerably shorter ice cover season on Hudson Bay and James Bay would lead to much warmer and longer duration summers, and warmer and shorter winters. This, in turn, would lead to the loss of permafrost, changing the surface hydrology and local topography.

The plants and animals of this region are well-adapted to its current extreme climate conditions, so as climate change progresses, it is likely that ecosystem structures will exhibit profound changes. Changes in the amount and seasonal distribution of precipitation will alter the winter versus summer regime of lakes, rivers, and streams, with potentially significant effects on a variety of species. Greater winter precipitation combined with earlier spring melt may lead to larger and earlier spring stream flows. The extent and duration of wildfires are predicted to increase, as air temperature rise and soils and peatlands dry. Changes in species composition should also be expected as species' ranges expand or contract in a warmer climate. Future assemblages of plants and animals may look quite different from current systems.

Even without significant changes in ecosystem structure, however, a warming climate may alter ecological processes in fundamental ways, for example through faster rates of photosynthesis, autotrophic respiration and changes in net primary production. This, in turn, could have a profound effect on ecosystem carbon biogeochemistry and carbon storage. Raising or lowering water levels, whether through climate warming or through human activities such as the building of dams or diversion structures, or carelessly designed road networks, can result in release of potentially harmful materials to downstream waters and to the air.

At present, the human footprint on these vast landscapes is very modest, limited to remote human

communities and a handful of industrial developments. Pressure to develop the energy, mineral, and natural resources of the region is growing, however, both from interests in the south and from the communities themselves; there is also great interest in improving access through a network of all-season roads. Community based land use planning, as recommended in the report of the 1977 *Royal Commission on the Northern Environment* and more recently in Bill 191, offers a means for communities to make simultaneous decisions about development and conservation. In particular, the Ring of Fire – McFauld's Lake area appears to have very significant mineral resources, which should have economic benefits for First Nations communities and all of Ontario. Increasing knowledge of the geology along with mineral exploration, especially in the Shield area, indicates the likelihood of new discoveries, possibly related to large scale patterns in the geological structure of the Far North.

Planning for development must be approached with great caution. Individual development projects such as mines, wind energy farms, hydro-electric power and tourism operations have the potential to affect local ecosystem integrity, through habitat alteration, changes in water levels, increased erosion, and release of pollutants to air and water. More significantly, as human activity begins to alter this ecologically intact land surface through development, there is increasing potential to affect ecosystem structure and function at a broad scale. In part, this is because individual projects must be linked by regional infrastructure, such as roads, airstrips, and transmission corridors. Transportation and transmission infrastructure has the potential to cause significant regional environmental impacts, including the creation of physical barriers to animal movement, habitat fragmentation, including stream habitats that are critical for spawning and movement, alteration of soil properties and surface water flows, and increased access through otherwise inhospitable terrain for invasive species, as well as predators, and hunters and anglers. These changes in turn alter interspecies dynamics and affect the abundance and distribution of species. Perhaps most important, however, the effects of roads are incremental and cascading. Once one road is built, to serve a single purpose or development project, it opens up the potential for further development, and creates pressure to build more road networks and power transmission lines. Well-planned and well-managed infrastructure is therefore a critical component of land use planning for the Far North.

Currently, the Far North has only two permanent inter-community gravel roads and one railroad to Moosonee; otherwise the region is served by airports and a network of winter roads. A major power corridor has been constructed from Otter Rapids on the Moose River through the James Bay communities to the Victor Mine, but no permanent road (if indeed one is necessary) has yet been built to service it. Several major corridor projects have, however, reached the feasibility or engineering stage at this time, including a high-voltage transmission line, a new 350-kilometre railroad link to the Ring of Fire chromite-nickel-copper-gold deposits near McFauld's Lake, and a year-round road to connect four First Nation communities and the Town of Moosonee on the west shore of James Bay to Highway 11.

First Nations communities are also discussing the possibility of an all-season road from Red Lake to Pikangikum and Sandy Lake, through the Whitefeather Forest areas. Even if new roads are unpaved and experience little traffic volume compared to southern Ontario, significant impacts on sensitive northern environments should be expected, particularly if the build-out of road networks is not carefully planned at a regional scale and cumulative effects are not carefully (re)assessed with each individual project.

The Path Forward

The future holds great uncertainty, not just in the location and nature of development, but in the influence of a changing climate on natural systems. The change that is projected could bring important socio-economic opportunities to Far North communities, but also change to the region's ecosystems.

In the short time the Science Advisory Panel has been convening, development interest in the Far North has dramatically heightened and at least 50 commitments and agreements are reported to be already moving ahead in the absence of formal land use planning. At the same time, global climate change, mobility and technology are accelerating the predicted trajectories of environmental and social change in the region. The Panel is deeply concerned about the potential for inadequately planned and monitored development to compromise ecological integrity in the region, and thus the ability of communities and governments to achieve all the objectives of the draft Far North legislation, including sustainable development for the benefit of First Nations.

Partners in planning for land use have a responsibility to advance Far North development in a manner responsive to community based planning, while meeting regional and international expectations and commitments. This requires careful attention to the maintenance of biological diversity and ecological functions, including carbon storage and sequestration, through the conservation of natural ecosystems. The Panel urges adherence to principles even, or perhaps especially, for interim development before community based plans are in place. To do otherwise is to risk inadvertent and irreversible environmental damage and erosion of the region's ecological resilience, even before the full effects of climate change and widespread human activity are known.

Planning across the entire region will of course be challenging. It will not be enough to consider resource sectors or protected areas singly and in isolation. Rather, it will be necessary to focus on the maintenance of ecological flows at multiple scales – the movements of organisms, water, and nutrients, and their interactions with different disturbances, both human and natural – across landscapes and planning units. This in turn requires comprehensive and coordinated planning and management of all landscape components and uses – planning, in other words, for conservation landscapes. This principle applies urgently and particularly to this region, at this time, because of the Far North's unique character, the changes that are predicted for it, and the needs of its communities. There is emerging but clear scientific evidence that the ecosystems of the Far North will be subjected to a magnitude and rate of climate change that exceeds historic levels. They may well be pushed beyond their natural, dynamic states, making them more vulnerable to negative impacts associated with development activities.

Conventional approaches to land use planning will not be sufficient to meet the purpose and objectives set out in the proposed Far North Act. They have been designed for landscapes that are already greatly altered from their original condition, where the goal is to protect the “best of what is left” for conservation purposes. In the Far North, it is necessary to reverse this approach, and consider how much development can be supported such that the natural and cultural values and integrity of the region are not compromised by development activities. This report recommends a regional-scale “conservation-matrix” model for land use planning, encompassing large core protected areas that serve as landscape-level benchmarks; site-specific protected areas, geared to protecting specific features; active management areas, where development and settlement are actively occurring; and the surrounding landscape, or “conservation matrix”, within which the other three elements are embedded, and which they support.

Careful planning can help to minimize unanticipated impacts, and protect the region's ecological resilience as the climate warms and the human footprint expands. But surprises are inevitable, and we must be prepared for economic development to result in unintended ecological consequences. Those risks can be minimized by adopting key planning principles, based on both scientific and traditional knowledge, to improve our understanding of the probable outcomes of different land use scenarios with respect to achieving planning objectives. For example, the Far North represents an ecologically intact situation where ecological connectivity can be assumed at the outset. A fundamental goal of conservation planning will therefore be to ensure the region does not lose this attribute as land use changes become more prevalent. Yet because our knowledge of these systems is still rudimentary, the systems themselves are dynamic, and the impacts of climate change are as yet uncertain, it is difficult to predict the outcomes of management strategies. This uncertainty also increases the risk of failure to achieve planning objectives at both community and regional scales. For that reason, this report emphasizes the need for adaptive management, a structured process of learning that recognizes that unknowns and uncertainty exist in the course of achieving any natural resource management goals. Adaptive management allows adjustment of management strategies as information about the system improves. It means designing and implementing resource development activities in an incremental fashion, carefully documenting effects at each stage, and making course adjustments when and where necessary in accordance with new information. The benefits of adaptive management are many and include significant reductions in risk, dramatic increases in the transparency of decision-making, and a solid knowledge platform on which to base the choice of sustainable activities. The implementation and monitoring of management options can also create economic and employment opportunities.

New development in the Far North, one of the world's most ecologically intact landscapes, must be planned and managed such that communities can achieve their planning objectives, including social and economic development, while protecting the integrity of broad-scale systems and processes even in a changing climate. The Panel believes that a conservation-matrix model for Far North land use planning, supported by adaptive management, should enable sustainable development that benefits the region and its communities. Such an approach will require sustained commitment to the collection and sharing of information, both aboriginal and scientific, about the Far North.

Recommendations (Refer to Chapter 5 for the full text of these recommendations)

1. Create a coordinated government-wide strategy for the management of interim and ongoing development

2. Immediately designate the 'Ring of Fire' as a priority management area with an interim sub-regional planning process

3. Immediately establish the Far North Land Use Strategy

- 3.1 Conduct land use planning to protect ecological integrity of the region as a whole, while also achieving socio-economic objectives
- 3.2 Mitigate climate change by preventing or minimizing the loss of carbon storage in biomass and soil
- 3.3 Consider the impacts of climate change in land use planning
- 3.4 Establish a framework for protecting areas of cultural and ecological significance
- 3.5 Use watersheds or other natural boundaries as the basis for establishing protected areas
- 3.6 Coordinate planning and management across administrative boundaries

4. Plan development incrementally, in a considered, proactive fashion

- 4.1 Assess and manage cumulative impacts
- 4.2 Maintain the existing moratorium on large-scale hydro-electric development and extend it to include inter-basin water diversions
- 4.3 Plan transportation and transmission corridors in a coordinated fashion, recognizing community needs and protecting significant ecological features
- 4.4 Prevent the introduction of invasive species

5. Apply the best continuous learning approaches through adaptive management

- 5.1 Base management decisions on the best available knowledge, but regularly revisit and revise strategies as the knowledge base improves
- 5.2 Support planning and management with an appropriate decision-support system

6. Provide communities and governments with the necessary information resources for planning and management

- 6.1 Create a Far North information system to facilitate the use of best available knowledge, including aboriginal traditional knowledge
- 6.2 Improve the available information base through a comprehensive inventory, enhanced monitoring and special studies

