

KEY FINDINGS



Canada

Alberta



NORTHERN RIVERS ECOSYSTEM INITIATIVE

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Additional information on the Northern Rivers Ecosystem Initiative is available on the Internet at
<http://www.pnr-rpn.ec.gc.ca/nature/ecosystems/nrei-iern>

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KEY FINDINGS of the Northern Rivers Ecosystem Initiative

The governments of Canada, Alberta and the Northwest Territories established the Northern Rivers Ecosystem Initiative (NREI) to answer questions and address recommendations from the Northern River Basins Study (NRBS), which took place between 1992 and 1996. The NREI was a science-based effort to gain more information to help understand the impacts of human activities on aquatic ecosystems in this region of Canada's north. Its mission was to provide further scientific information as part of the governments' 1997 response to the recommendations of the NRBS. Its goal was to understand the impacts of development on the northern river ecosystems and help protect aquatic ecosystems.

This five-year initiative began in 1998 and finished in 2003. It focused on NRBS priorities such as pollution prevention, hormone problems in fish, water flows and quality, contaminants, nutrients, safe drinking water and enhanced environmental monitoring. Many new policies and regulations were put in place during the NREI study years. These have been supported and enhanced by the scientific research conducted by NREI. Other initiatives, studies and monitoring programs have complemented the NREI work.

The following is a general summary of the findings of the Northern Rivers Ecosystem Initiative. Also included are references to other studies and monitoring programs done during these years. Further details may be found in the two main reports: the NREI Synthesis Report, which provides a general overview of findings; and the NREI Final Report, which states how each NRBS recommendation was addressed.



POLLUTION PREVENTION

As the northern basins are developed and human populations increase, there is an increasing risk that more contaminants will enter the environment. Pollution prevention is an important principle guiding government regulatory activities. Preventing pollution at its source is a fundamental way to protect the environment.

In Alberta and the NWT, as in other jurisdictions, new projects or expansions of major developments that have significant environmental issues may have to go through an Environmental Impact Assessment. In this process, the developer must outline ways they intend to protect the environment.

Industries and municipalities are continually developing new technologies to reduce pollutants in their effluents and air emissions. For example, the Alberta government required kraft pulp mills to eliminate the use of elemental chlorine for bleaching. All of the mills that once used chlorine now use chlorine dioxide, which means that dioxins and furans are no longer detectable in river water.

Dioxins and furans are no longer detectable in river water since pulp mills changed their bleaching process.

Another industry that people are concerned about is oil and gas, particularly the extensive oil sands operations near Ft. McMurray. Oil sands operations continue to expand. These mining operations have a major impact on the land. So far, however, they have not measurably affected the Athabasca River because wastewater is contained in tailings ponds.

Another source of pollutants is municipal sewage effluent. All municipalities in Alberta are required to treat their sewage before it is released to rivers. As of 2015, all municipalities in Alberta have approved plans for municipal sewage treatment plants.

Sewage treatment plants in the northern river basins are gradually being upgraded to reduce contaminants in their effluent.

In both Alberta and the Northwest Territories, industries are required to monitor their effluents as a condition of their approvals to operate. This allows the performance of a municipal or industrial effluent treatment system to be reviewed. Compliance with release requirements can also be checked. This information is also used to assess potential impacts on receiving waters. Pollution of waterways can also result from agricultural operations. Many farmers and producers are increasing their focus on ways to protect the environment. During the NREI study years, there were several initiatives to increase environmental sustainability in agricultural production. For example, Alberta's Agricultural Operation Practices Act includes environmental standards for livestock production.

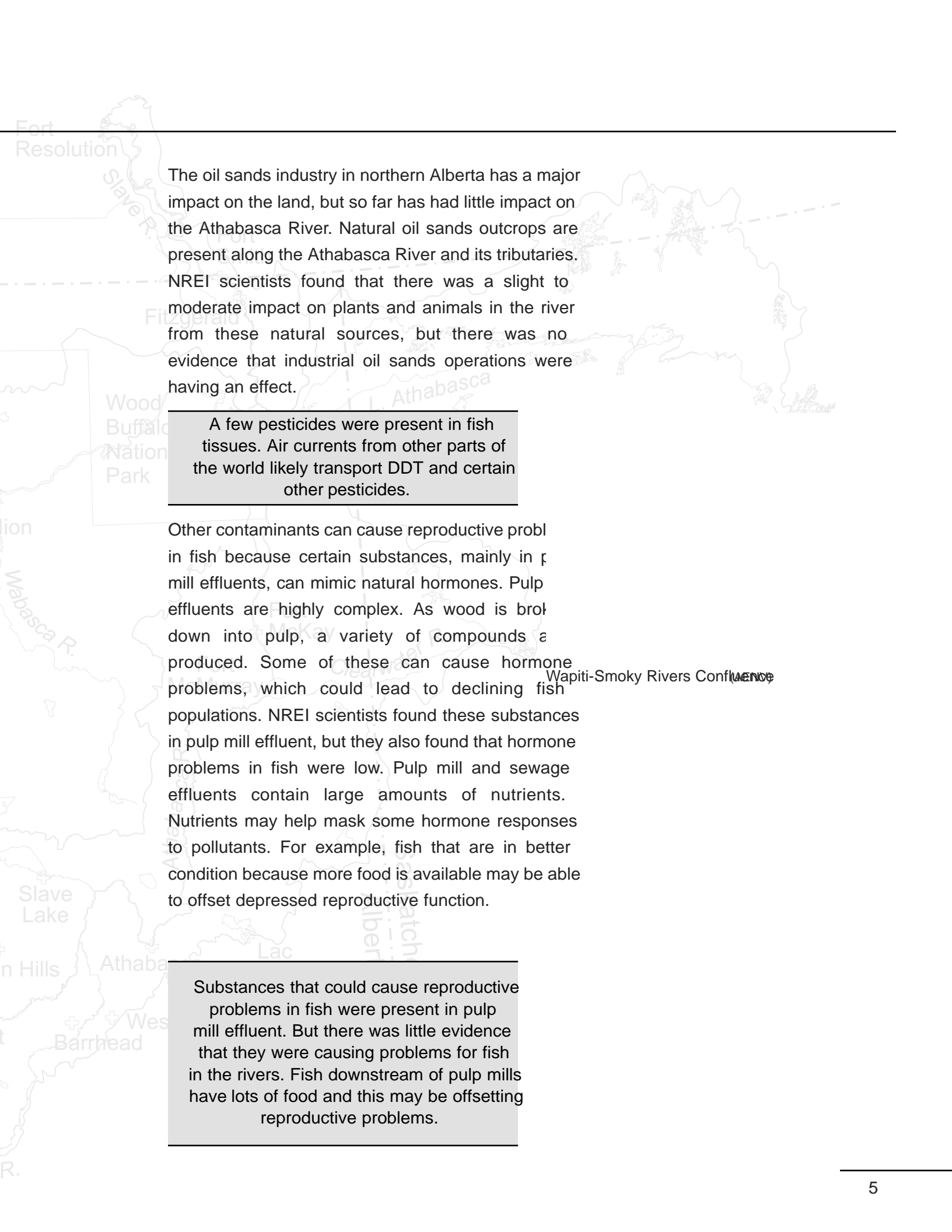
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CONTAMINANTS

Over the past decade, there has been a major effort to reduce levels of contaminants in the environment, mainly through regulatory or technological initiatives. A focus of both the NRBS and NREI was to gain understanding of contaminants ... where they come from and how they affect rivers and plants and animals, including fish. Some of the contaminants studied over the last decade come only from human activities. Several of these are toxic, persistent and could bioaccumulate in food chains. These chemicals are mostly chlorinated organic compounds, including dioxins and furans, PCBs, DDT and toxaphene. Dioxins and furans are no longer detectable in the water of the northern rivers because kraft pulp mills have changed their pulping process to reduce or eliminate them. Levels have declined in fish. Even so, NREI scientists still found traces of these chemicals in fish and river sediments immediately downstream of Hinton on the Athabasca River and Grande Prairie on the Wapiti River. The sources for these are not known, but it is possible that bottom sediments are still contaminated from previous pulp mill effluents.

PCBs have not declined in fish tissues or river sediments. Specific sources of these chemicals are unknown.

Pesticides were also investigated during NREI. Toxaphene, DDT and other chlorinated organic pesticides were present in very low concentrations in fish tissue. Levels of DDT have not declined in fish at many of the sites along the Athabasca and Wapiti rivers, nor in the Lesser Slave River ... even though DDT has not been used in Canada for decades. A currents likely transport some of these pesticides to this country from other parts of the globe. This may be the source of continued contamination by several toxic chemicals in the northern watersheds.



The oil sands industry in northern Alberta has a major impact on the land, but so far has had little impact on the Athabasca River. Natural oil sands outcrops are present along the Athabasca River and its tributaries.

NREI scientists found that there was a slight to moderate impact on plants and animals in the river from these natural sources, but there was no evidence that industrial oil sands operations were having an effect.

A few pesticides were present in fish tissues. Air currents from other parts of the world likely transport DDT and certain other pesticides.

Other contaminants can cause reproductive problems in fish because certain substances, mainly in pulp mill effluents, can mimic natural hormones. Pulp mill effluents are highly complex. As wood is broken down into pulp, a variety of compounds are produced. Some of these can cause hormone problems, which could lead to declining fish populations. NREI scientists found these substances in pulp mill effluent, but they also found that hormone problems in fish were low. Pulp mill and sewage effluents contain large amounts of nutrients. Nutrients may help mask some hormone responses to pollutants. For example, fish that are in better condition because more food is available may be able to offset depressed reproductive function.

Substances that could cause reproductive problems in fish were present in pulp mill effluent. But there was little evidence that they were causing problems for fish in the rivers. Fish downstream of pulp mills have lots of food and this may be offsetting reproductive problems.

DISSOLVED OXYGEN AND NUTRIENTS

Several NRBS recommendations were related to dissolved oxygen and nutrients, and NREI studies contributed new information to these issues. To protect fish and their food organisms, future guidelines for dissolved oxygen may need to be based on local conditions in the river.

Aquatic animals need dissolved oxygen to survive. If levels of dissolved oxygen become too low, many types of fish and other animals could die. Levels of dissolved oxygen in bottom sediments tend to be lower than in the water above the bottom. The dissolved oxygen guideline (minimum 6.5 mg/L) adopted by many jurisdictions in Canada assumes that there would be no more than a 3 mg/L difference between dissolved oxygen levels in the river bottom and in the water above it. It has been assumed that fish eggs and bottom-dwelling animals would be protected if dissolved oxygen in the water remains above the guideline level. But NREI research showed that there was little relationship between dissolved oxygen levels in the sediment and those in the water above. These findings make the usefulness of the dissolved oxygen guideline uncertain. Future dissolved oxygen guidelines may need to be based on site-specific conditions (for example, bottom type, location of spawning areas, flow and effluent inputs).

Nutrients are discharged by municipalities and pulp mills, as well as occurring naturally. When nutrients are abundant, plants in the river grow rapidly. Then, in winter when rivers are ice covered, this plant material decomposes and uses up dissolved oxygen. As well, sewage and pulp mill effluent contain organic material that consumes oxygen. The combined effects could deplete dissolved oxygen in the river and harm fish populations.

One of the NREI studies looked at the relationship between nutrient levels and plant growth in the Athabasca and Wapiti rivers. Levels of nitrogen and phosphorus increased in a downstream direction, and the amount of algae on rocks and the bottom also increased. Nutrient guidelines were proposed for several sections of these rivers.

Mesocosm Technology: Large Systems
(NWRI, Environment Canada)

HYDROLOGY AND CLIMATE

According to traditional ecological knowledge, the average temperature in the north is increasing, weather is becoming more variable, and water levels in lakes, rivers and the deltas are declining. These reports are supported by scientific evidence, which shows that the average temperature in the area has increased over the last 20 years.

Over the last 20 years, the average temperature has increased. This could lead to drying of the Peace-Athabasca Delta and harmful effects on its ecology.

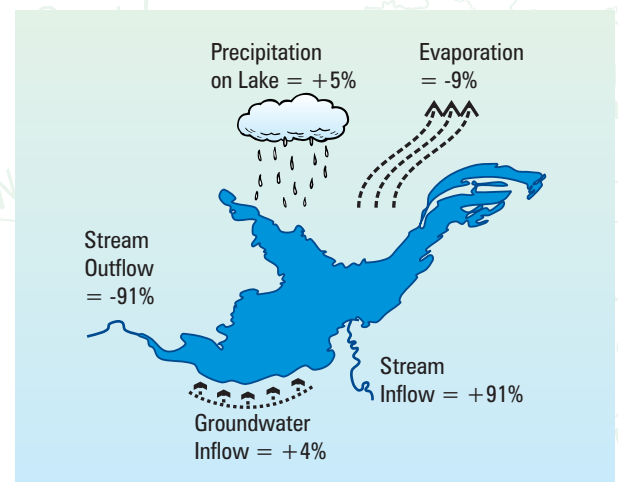
The Peace and Athabasca rivers flow into the Peace-Athabasca Delta. Their flows are essential to the ecological integrity of the Delta, and to the Slave River Delta further downstream. Between 1974 and 1996, water levels in the deltas declined and vegetation changed. Both the NRBS and NREI found

that the operation of the W.A.C. Bennett Dam and climate change influence flooding in the Peace-Athabasca Delta. The dam tends to reduce flood peaks because upstream flows are captured.

Several NREI studies used new or updated computer models to investigate how climate change and the Bennett Dam might affect the deltas in the future. Under future climate conditions, there could be a shift towards slightly higher annual flow, with most of the increase occurring during the winter. Models also show that melting would start earlier in spring as the average temperature increases. Lower flows and decreasing water levels during the summer are a possibility, which could affect the rivers and lakes in the Peace-Athabasca Delta. As well, timing of inflows to the Williston Reservoir would follow a similar pattern. Inflows could be higher in the winter and slightly lower throughout the summer.



W.A.C. Bennett Dam (AENV)



Water balance of Great Slave Lake, 1964-1998. (AENV)

BASIN MANAGEMENT

Activities on the land can affect water. Watershed management plans are key tools to help protect the land, wildlife, rivers and lakes. Under NREI, new assessment tools were developed to help resource managers assess, plan and manage watersheds and their rivers. How we manage one resource affects the management or use of other resources in an area. Governments are increasingly using an integrated approach for managing water and the environment.

Several environmental management plans are under way in the study area. For example, a draft ecosystem management plan for the Peace-Athabasca Delta was prepared in 2000. It was presented to the main stakeholders, but so far little progress has been made. New information collected during NREI and the updated models should help with future planning for this important area.

One of the NRBS recommendations was to create a group to oversee monitoring and research activities in the northern river basins. This would standardize monitoring techniques and improve overall knowledge. In 1997, the governments of Canada, British Columbia, Alberta, Saskatchewan, the Northwest Territories and Yukon signed the *Mackenzie River Basin Transboundary Waters Master Agreement*. The Agreement commits the governments to cooperate in maintaining the ecological integrity of aquatic ecosystems in the basin while allowing sustainable development and equitable use of the water. The *Mackenzie River Basin Board* was established to implement it. The

Board's vision is "a healthy and diverse aquatic ecosystem for the benefit of present and future generations." A technical committee was formed by the Board to manage monitoring activities throughout the Mackenzie River Basin.

The Mackenzie River Basin Board was set up to maintain ecological integrity in the Mackenzie Basin while allowing sustainable development and use of the water.

Alberta's new water strategy, called *Water for Life*, addresses water management concerns for the future. The strategy envisions governments, stakeholders and the public cooperating in a network of community, basin and provincial partnerships – combining knowledge and resources to manage Alberta's water in an efficient and effective manner.

Although regulation, monitoring and assessment of air and water quality are usually the jurisdiction of governments, many organizations have formed in the past few years to help manage the environment. Most of these organizations are based in specific areas, such as in the oil sands area. In general, these organizations are working together to assess the cumulative effects of development.



Peace River at Dunvegan (AENV)

WILDLIFE AND BIODIVERSITY

A major challenge now and in the future is to preserve biodiversity. Human alteration of habitat is the single greatest threat to biodiversity around the world.

One area that is home to a great variety of wildlife is the Peace-Athabasca Delta. The Delta is a wetland of international significance, and if it is to continue as a wetland, flooding must occur periodically. Flood events are crucial to waterfowl use of the Delta, as well as to traditional lifestyles.

The Peace-Athabasca Delta flooded in 1996 and 1997. Since then, the amounts of open water and flooded vegetation in the Delta have declined. After the 1996 flood, waterfowl use of the Delta was very high. By 2001, waterfowl populations had declined to pre-flood levels.

Flooding and drying cycles in the Peace-Athabasca Delta are essential to waterfowl and shorebird populations.

Migrating shorebirds also use the Delta. As the small lakes dry after flooding, mudflats are exposed. This provides excellent habitat for shorebird use. But habitat conditions along their migration route may also dictate whether these birds use the delta or not.

Another important habitat is the boreal forest. Commercial timber harvesting in the boreal forest has a major impact on biodiversity, especially of birds. Several NREI studies found that the diversity and abundance of birds in the boreal forest were highest in mature stands of timber. It is critical to make sure that forest stands are managed in an environmentally sustainable way.

Seismic exploration can also have a major impact on the boreal forest. Impacts include loss of forest habitat and fragmentation of the forest, increased access to off-road vehicles and destruction of aquatic habitat. Since late 1996, companies exploring for gas and oil in the Green Area of Alberta are required to use low-impact seismic lines.



Delta Shorebirds
(G. Beyersbergen, CWS, Environment Canada)

LEGACY OF THE NREI

The governments of Canada, Alberta and the Northwest Territories began the Northern Rivers Ecosystem Initiative to respond to recommendations from the Northern River Basins Study. The completion of the final reports from the NREI brings to a conclusion the Northern River Basins Study, which was initiated more than ten years ago.

We now know much more about the environment and the impact of human activities in the basin. This awareness has prompted governments to put in place policies and regulations that protect the health of ecosystems, yet allow for sustainable development.

Nevertheless, some contaminants are still detectable in fish and sediments, in spite of these new regulations and technologies. This should remind us that even if small amounts of persistent toxic contaminants enter into aquatic ecosystems, the result could be long-term exposure to aquatic life and humans.

All of the new initiatives and knowledge generated during the past few years will need to be considered in light of a changing climate. Global warming is the greatest threat to the northern environment. We don't know precisely how climate change will affect river flows, lake levels, concentrations of contaminants, or fish and wildlife habitat. Climate change should be considered as an important context for all new developments and management plans.

Climate change should be considered when new developments are proposed and management plans prepared.

The Northern River Basins Study and the Northern Rivers Ecosystem Initiative are now finished. This significant legacy of knowledge and awareness will help guide the environmental future of the North.

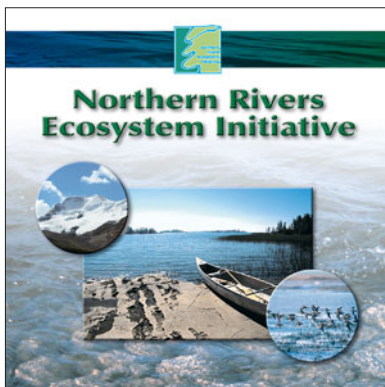


Great Slave Lake
(Hurcomb, GNWT)

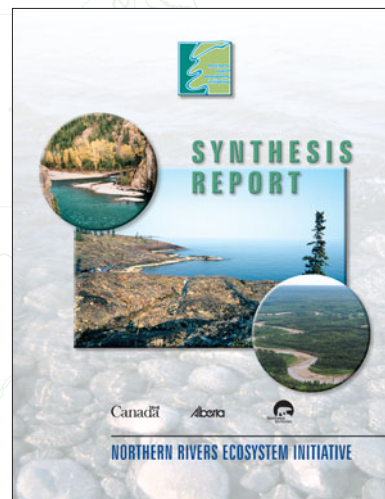
NREI COLLECTIVE FINDINGS

The Northern Rivers Ecosystem Initiative (NREI) was launched in 1998 as a means of facilitating the implementation of the actions and commitments made by the Governments of Canada, Alberta and the Northwest Territories in response to recommendations made at the conclusion of the Northern River Basins

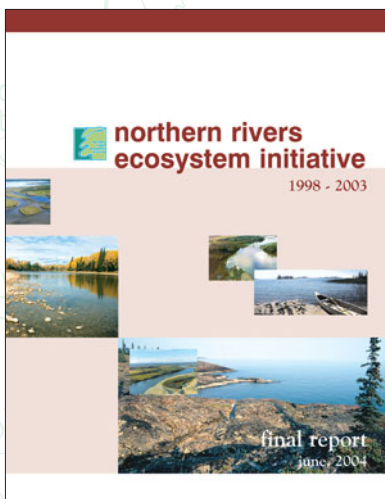
Study in 1996. Outcomes from these actions and commitments can be found in greater detail in the series of reports produced as a result of the NREI. For further detail on how to obtain copies of these products please refer to the contact information provided on the inside cover.



Northern Rivers Ecosystem Initiative: Collective Findings, is a compilation of the technical reports prepared as part of the NREI.



Northern Rivers Ecosystem Initiative Synthesis Report, provides a summary of the science undertaken during the NREI, along with brief overviews of several regulatory and policy initiatives currently in place to protect the health of these northern aquatic ecosystems.



Northern Rivers Ecosystem Initiative: Final Report, details all that has been accomplished by the Governments in meeting their commitments to the Northern River Basins Study recommendations.