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Regional Aquatics Monitoring Program

RAMP

2003 Summary Report

ACKNOWLEDGEMENTS

The 2003 RAMP Summary Report was prepared on behalf of the RAMP Steering Committee by Hatfield Consultants Ltd. The report summarizes key findings presented in the 2003 RAMP annual technical report written by Hatfield Consultants Ltd., Jacques Whitford Environment Ltd., Mack, Slack & Associates Inc., and Western Resource Solutions.

Thanks to those of the RAMP Steering Committee who reviewed earlier versions of the summary report.

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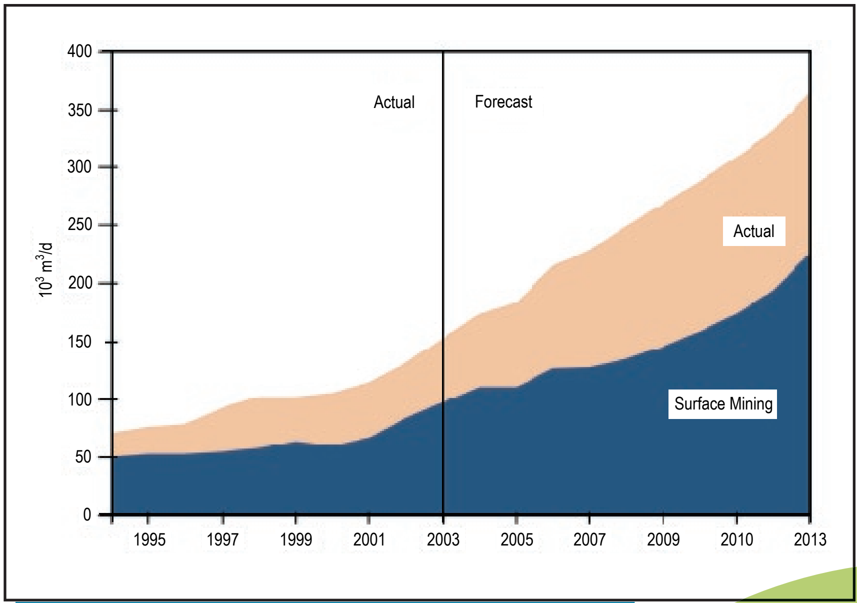
1 INTRODUCTION

The Alberta oil sands deposits originated over one hundred million years ago when much of western Canada was covered by a vast inland sea. As the local plants and animals died, they settled to the sea floor. As these deposits accumulated, the pressure and temperature of deeper deposits increased, eventually converting the organic remains into liquid hydrocarbons, sulphur compounds, carbon dioxide and water. The resulting oil-bearing sand deposits known as the McMurray Formation, represents one third of all known world oil reserves, estimated at 1.7 to 2.5 trillion barrels of bitumen.

Bitumount

In 1967, Great Canadian Oil Sands Limited (now Suncor Energy Inc.) initiated the region's first commercially successful bitumen extraction and upgrading facility. Since that time, investment and development in the Athabasca oil sands region near Fort McMurray has increased substantially, with 16 companies currently planning, or already undergoing, resource extraction from the McMurray Formation.

In addition to the oil sands operations, other developments have also increased within the Regional Municipality of Wood Buffalo (RMWB), including pipeline construction, forestry operations, drilling activities, and municipal growth/infrastructure development. Upstream of the RMWB, developments such as pulp and paper operations (five mills), agriculture and municipal wastewater facilities all influence water quality of the Athabasca River system.



Alberta crude bitumen production

source: Alberta Energy and Utilities Board, Statistical Series (ST) 2004-98

THE REGIONAL AQUATICS MONITORING PROGRAM

The Regional Aquatics Monitoring Program (RAMP) is a joint environmental monitoring program that assesses the health of rivers and lakes in the oil sands region. RAMP was initiated in 1997, and has continued to grow and adapt to the needs of the communities, regulators and industry. RAMP is designed to be flexible so that the program can respond to past monitoring results, new oil sand developments, technological advances and community concerns.

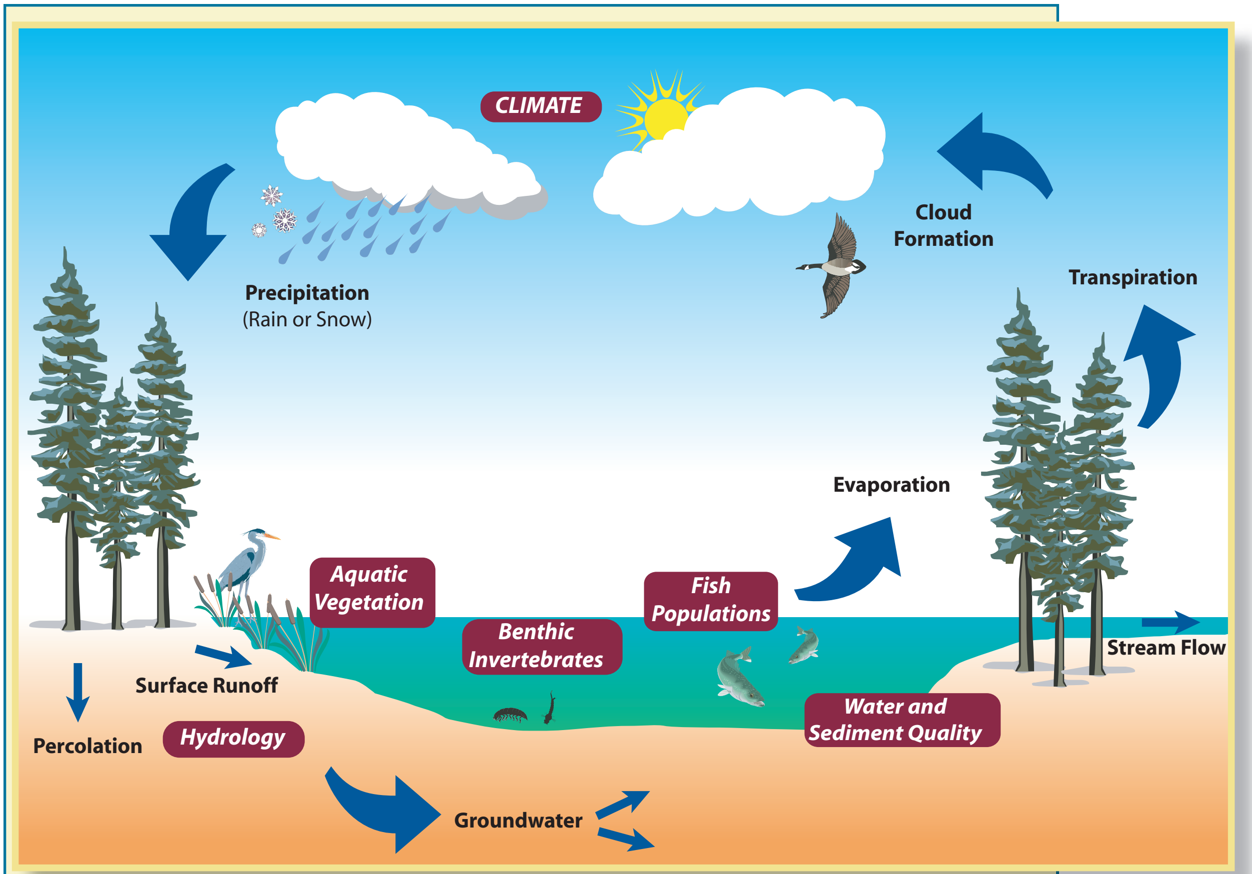
Objectives of RAMP

- Monitor rivers and lakes in the oils sands area to assess potential effects of oil sands development;
- Collect environmental data to better understand the oil sands region;
- Compare actual monitoring data with Environmental Impact Assessment predictions;
- Respond to community concerns; and
- Incorporate traditional ecological knowledge into monitoring programs.

What Does RAMP Monitor?

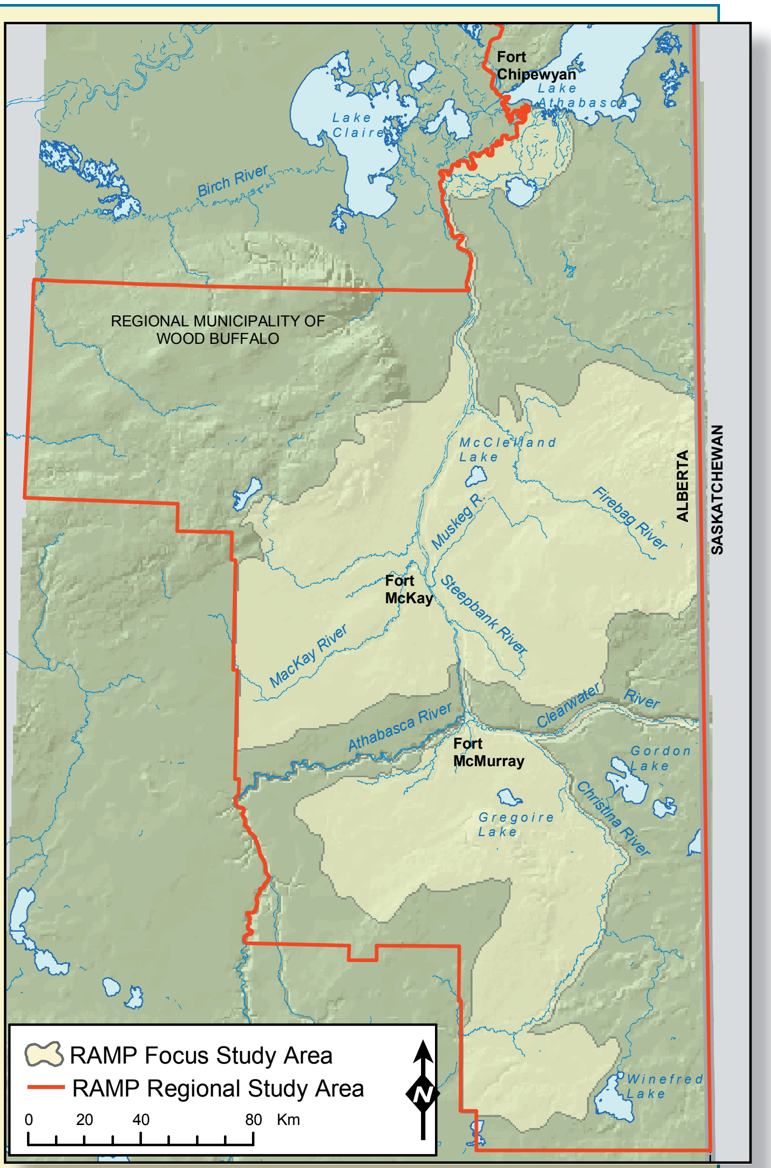
In 2003, RAMP conducted monitoring of:

- Fish and fish habitat;
- Water and sediment quality;
- Benthic invertebrates (small animals at the bottom of lakes and rivers);
- Wetland vegetation;
- Lakes sensitive to acidification; and
- Hydrology (water flow) and climate.



The Components of RAMP are All Part of the Aquatic Ecosystem

WHERE IS THE RAMP STUDY AREA?



Map of RAMP Study Area

The Regional Municipality of Wood Buffalo in northeastern Alberta defines the RAMP regional study area. Within this study area, sampling effort is focused in areas where oil sands development is occurring or planned, and downstream along the Athabasca River.

The lower Athabasca River flows through mixed boreal forest scattered with peat land formations. The regional topography is relatively flat, but partially bordered to the west by the Birch Mountains and to the east by intermittent slopes including the Muskeg Mountains, which extend northward from the Clearwater River valley. Upon reaching the Peace-Athabasca Delta, the Athabasca River becomes a vast, interconnected series of braided channels and wetlands flowing into Lake Mamawi and Lake Athabasca.

1 - INTRODUCTION

Focus of 2003 RAMP Monitoring Activities

In 2003, RAMP studies focused on the following waterbodies:

- Athabasca River and Peace-Athabasca Delta;
- Tributaries to the Athabasca River, including the Clearwater, Steepbank, Muskeg, MacKay, Ells, Tar, Calumet and Firebag rivers and McLean, Poplar, Beaver, Mills and Fort creeks;
- Small tributaries of the Muskeg River including Jackpine, Muskeg, Shelley, Khahago, Iyinimin, Stanley and Wapasu creeks;
- North Steepbank River (tributary to the Steepbank River);
- Christina River (tributary of the Clearwater River);
- Wetlands in the vicinity of current and proposed oil sands developments;
- 50 acid sensitive lakes in northeastern Alberta.

Steepbank River

Shipyard Lake

WHO WAS INVOLVED IN THE 2003 RAMP?

STEERING COMMITTEE

Industry	Stakeholders	Government
Alberta Pacific Forest Industries Inc.	Athabasca Chipewyan First Nations	Alberta Environment
Albian Sands Energy Inc.	Athabasca Tribal Council	Alberta Energy and Utility Board
Canadian Natural Resources Limited	Chipewyan Prairie First Nations	Regional Municipality of Wood Buffalo
Devon Energy Corporation	Fort Chipewyan Metis Local #124	Fisheries and Oceans Canada
ExxonMobil Canada Ltd.	Fort McKay First Nations	Environment Canada
OPTI Canada Inc.	Fort McKay Metis Local #122	
Nexen Canada Inc.	Fort McMurray First Nations	
Petro-Canada Oil and Gas	Mikisew Cree First Nations	
Shell Canada Limited.	Oil Sands Environmental Coalition	
Suncor Energy Inc.	MICA	
Syncrude Canada Ltd.		
(Secretary: Hatfield Consultants Ltd.)		

Finance Subcommittee	Technical Subcommittee	Communication Subcommittee	Investigators
All funding participants, and any interested Steering Committee members.	Representatives from industry, communities, government, and investigators.	Representatives from industry, communities, government, and investigators.	Consultants, Aboriginal community representatives, and Alberta Environment

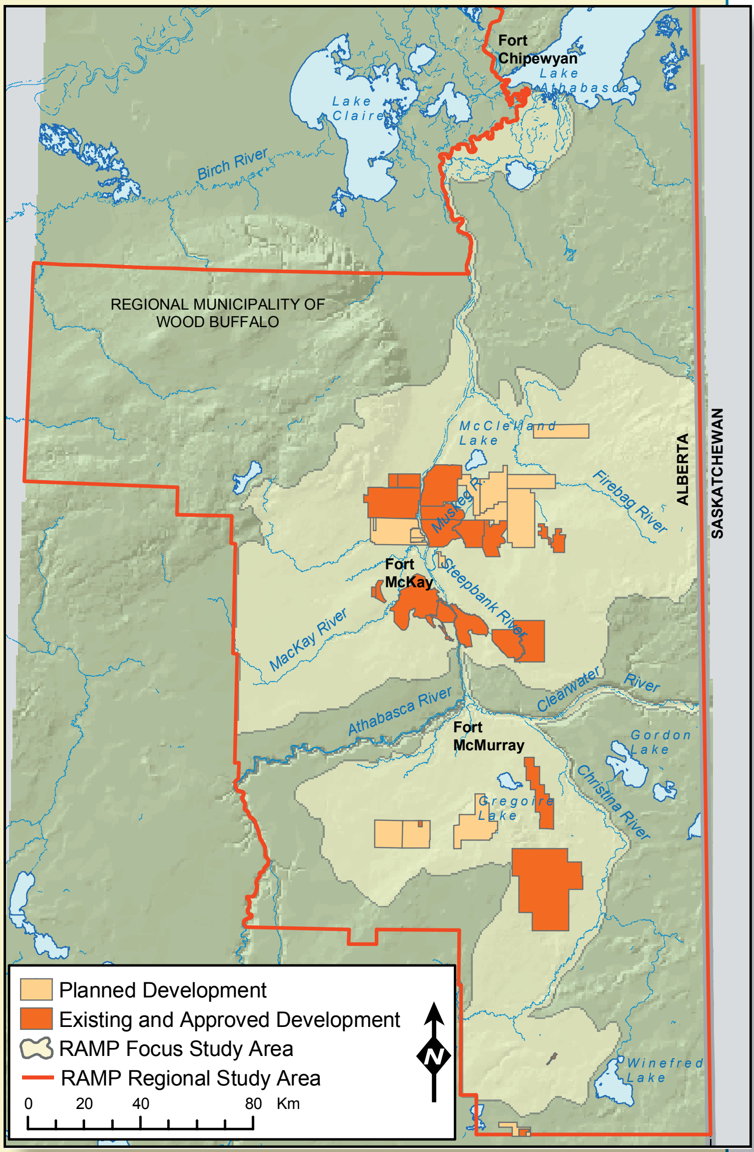
Technical Program Implementation	Communication Plan Implementation
Preparation of technical program for review by Steering Committee; Technical workshops	Newsletters; Annual Report; Community meetings

RAMP's Ongoing Evolution

The oil sands region near Fort McMurray has experienced a substantial increase in industry developments since the start of RAMP in 1997. During this time, industry participation in RAMP has increased to eight companies representing 16 different oil sands projects.

RAMP monitoring activities have increased in response to the expanded membership and increased development within the program study area.

RAMP will continue to adapt to ensure that regional aquatics monitoring needs are being met.



Map of Oil Sands Development Areas

The information gathered from the RAMP climate and hydrologic monitoring stations is used to increase our understanding of how streams and lakes react to rain and snow events. This knowledge allows for more accurate modeling of "typical flows", as well as flooding, drought and other irregular events, including changes in flows resulting from human activities like Oil Sands Development.

2003 CLIMATE MONITORING

The behavior of streams, lakes and wetlands is influenced by rainfall, snowfall, temperature, humidity, solar radiation and wind speed. Monitoring this climatic information provides a better understanding of the potential environmental impacts associated with oil sands development.

Aurora Climate Station

The Aurora Climate Station monitors rainfall, snowfall, temperature, humidity, wind speed, wind direction and solar radiation (sunshine) in the vicinity of the Muskeg River. The station is located near Jackpine Creek at the Canterra Road.

Tipping Bucket Rain Gauges

Tipping bucket rain gauges were installed at the Aurora Climate Station, Calumet River, Iyinimin Creek, Tar River, Christina River and McClelland Lake to measure local differences in rainfall within the RAMP study area.

Snow Course Surveys

Snow course surveys measure snow accumulation within different terrain types of the study area. This information is used to predict how much water will be released during spring melt.

2003 is the third year a snow pack survey was completed along the east slope of the Birch Mountains (CNRL Horizon Project Area). Additional snow pack measurements were also taken in the vicinity of Fort Creek.

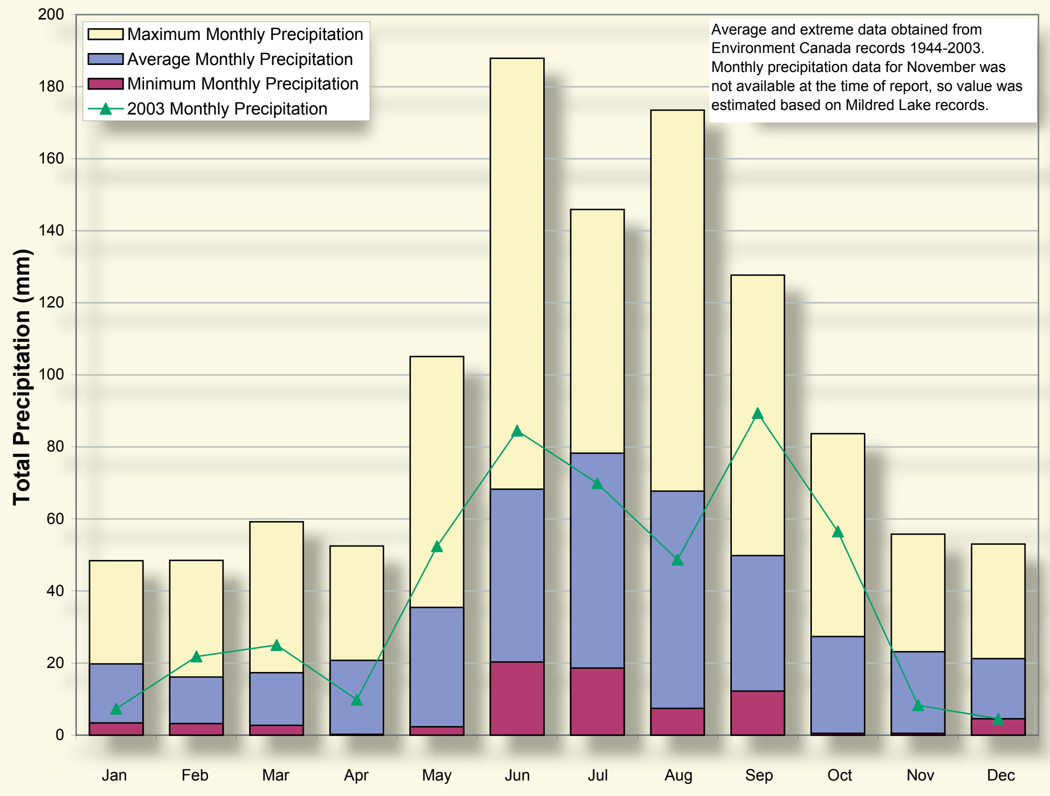
2003 WEATHER REPORT

Precipitation (rain and snowfall) was slightly above normal in 2003. Total precipitation measured at the Fort McMurray Airport was 478 mm, compared to the long-term average (1944 to 2003) of 445 mm.

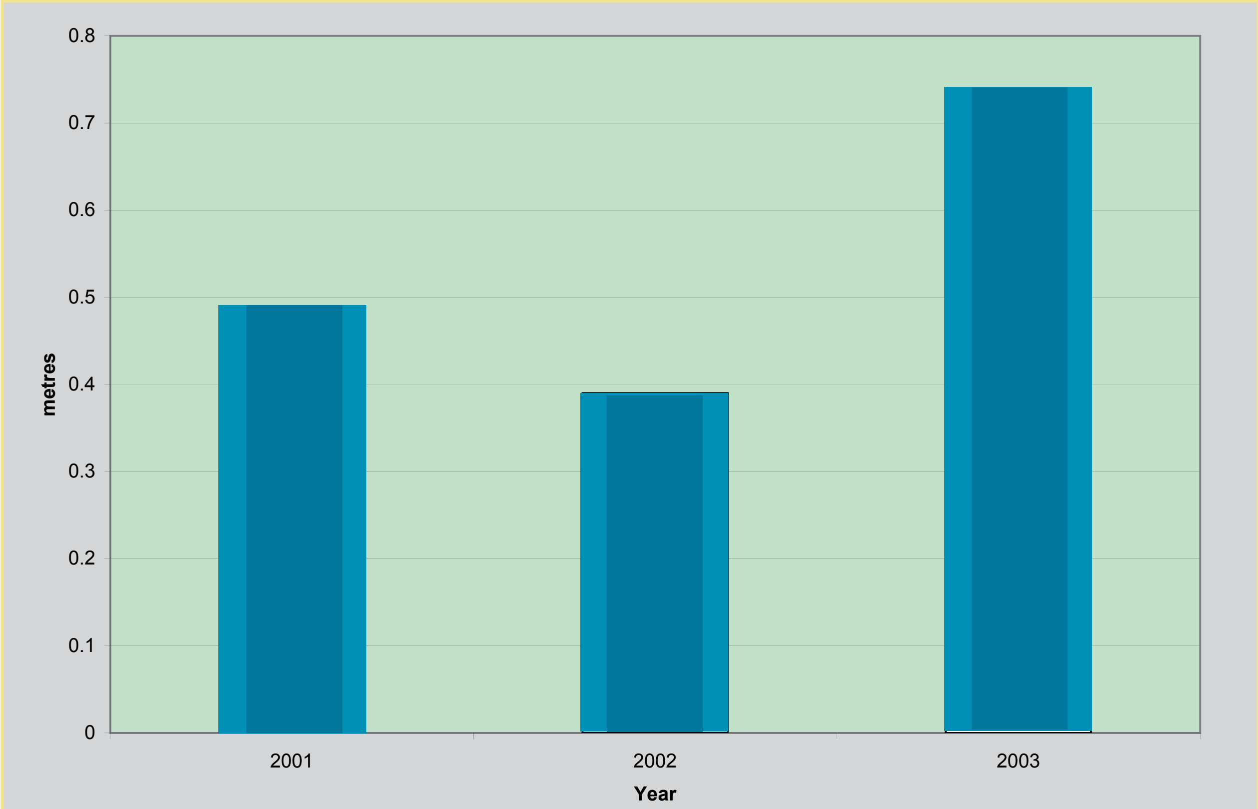
Fort McMurray Airport

This graph shows the monthly distribution of precipitation in 2003 compared to average (purple) and extreme (yellow and burgundy) historical measurements.

December snowfall matched an all-time recorded low in Fort McMurray.



Historical (1944-2003) vs. 2003 monthly precipitation at Fort McMurray



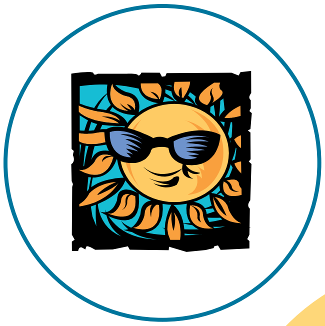
Yearly comparison of Birch Mountains Snowfall

Winter snowpack measured in the Birch Mountains in 2003 was significantly greater than 2001 and 2002.

Did you know?...

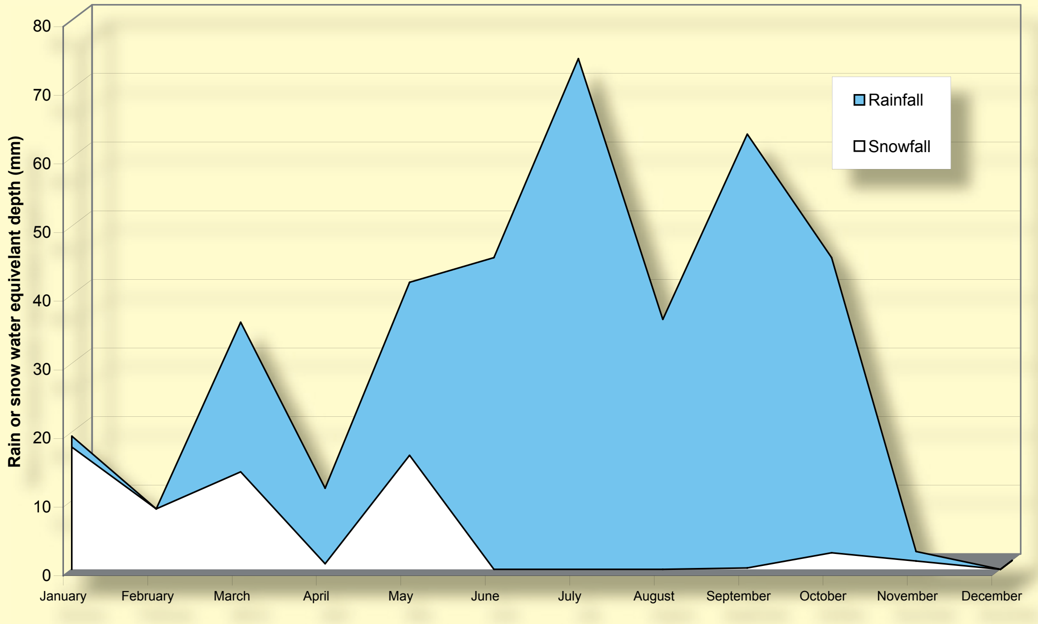
The ***coldest*** day recorded at the Aurora Climate Station in 2003 was March 1, which was ***-39.9 degrees Celsius***.

The ***warmest*** day of 2003 at the Aurora Climate Station was August 1, measuring ***34.1 degrees Celsius***.

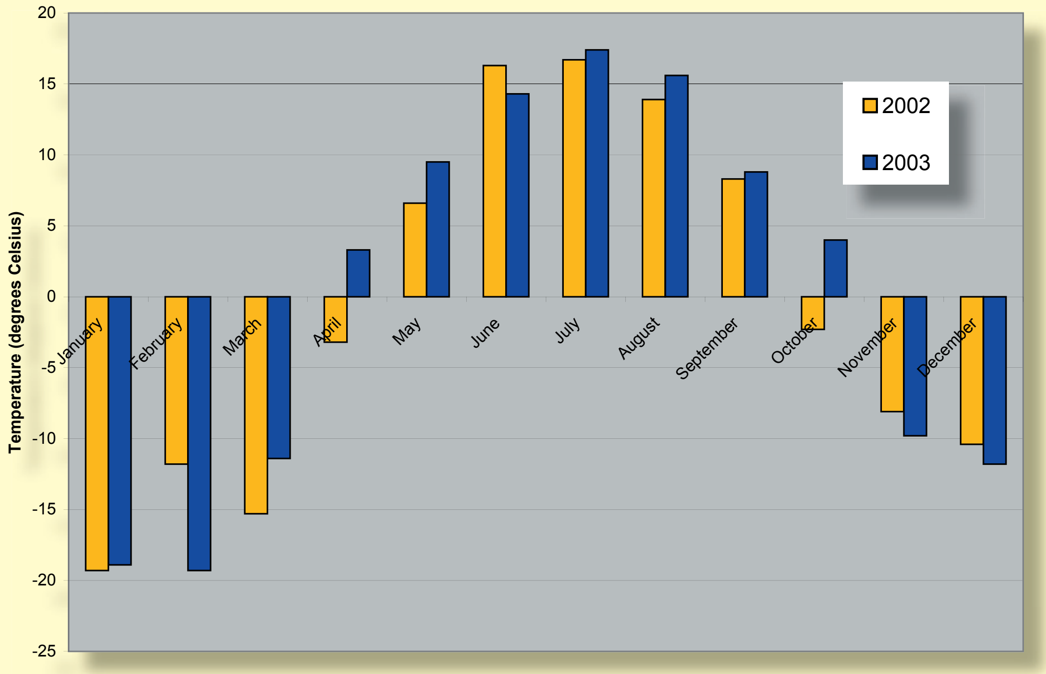


Aurora Climate Station

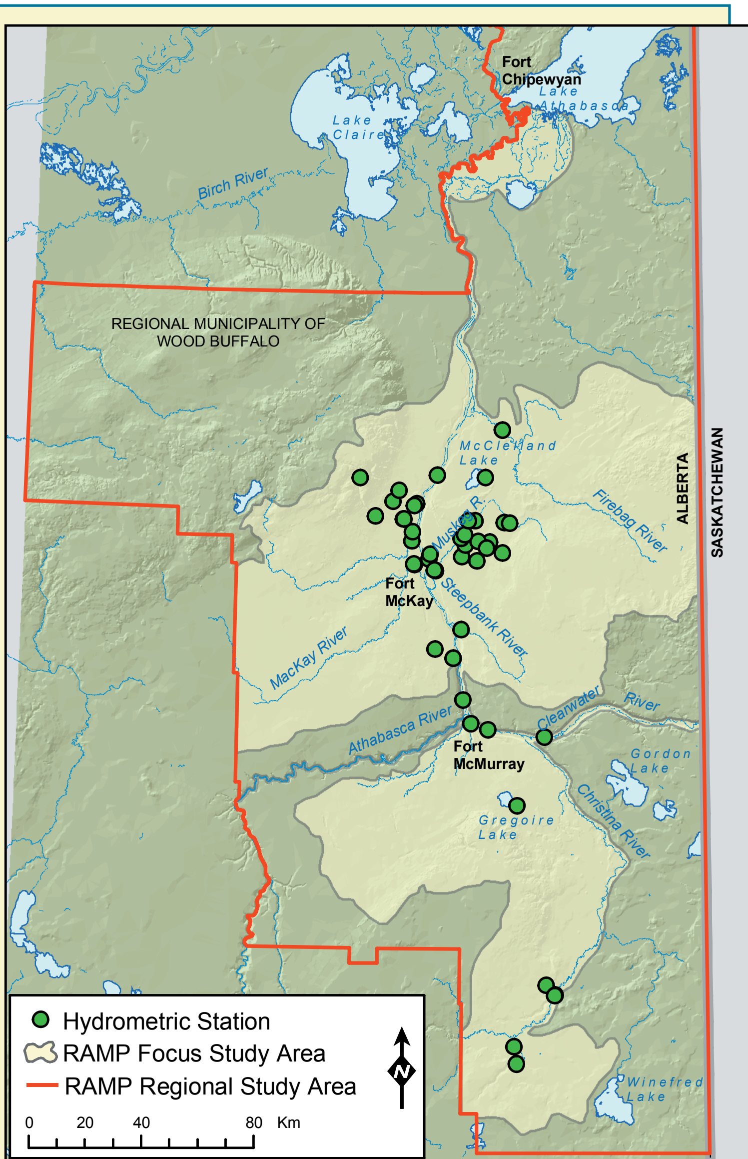
Average monthly rainfall and snowfall at the Aurora Climate Station, 2003



Average monthly temperatures at the Aurora Climate Station, 2002 and 2003



2003 HYDROLOGY MONITORING



Map of Hydrometric Monitoring Stations

The RAMP Hydrology Program uses water level monitoring equipment combined with regular field visits to measure ***discharge***, ice thickness, and water depth of selected lakes and streams in the oil sands region.

> ***Discharge*** *is the volume of water that passes by a given location on a stream in a given period of time. Discharge is usually measured in cubic metres per second.*
> *(1 cubic metre = 1,000 litres)*

Prior to oil sands development, information is collected to identify the natural changes in water flows within watersheds from year-to-year. Then, if an area is developed, the information is used to determine whether surface waters are affected as a result of the development activities.

2 - CLIMATE AND HYDROLOGY

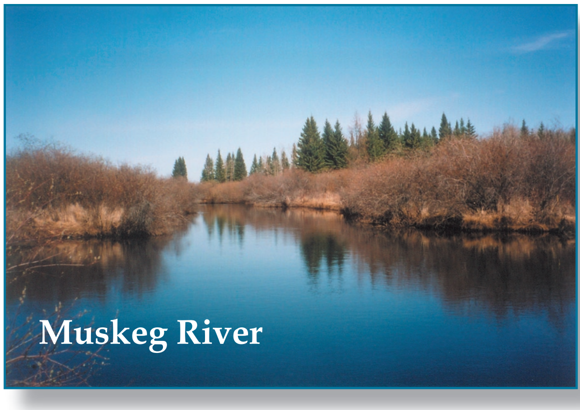
2003 Hydrology Monitoring Results

Data collected from rivers and streams are presented in hydrographs, which show the discharge of water at a single location over time. Typically, streams in the RAMP study area exhibit low winter flows that increase in the spring/early summer in response to snowmelt. In the summer, flows are moderate and influenced primarily by rain and groundwater flow. Autumn marks a transition period from moderate summer flows back to low winter base flows.

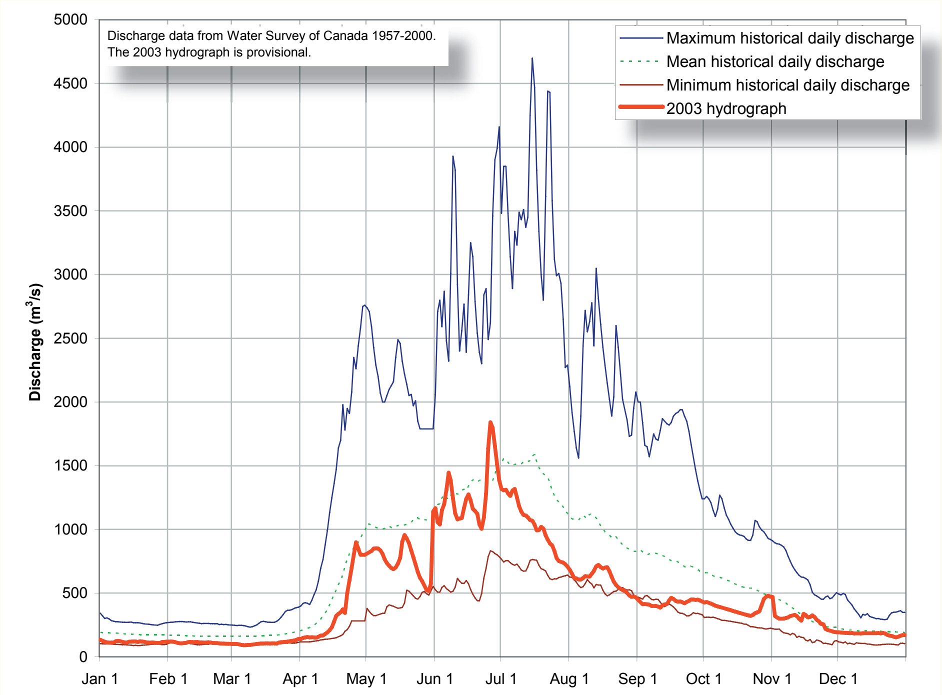
In 2003, hydrology varied from river to river within the RAMP study area. For example, for representative rivers where long-term records are available, runoff was below normal in the Mackay and Athabasca basins, near normal in the Muskeg basin and well above normal in the Steepbank basin. Peak flows were normal in all four basins.


Athabasca River

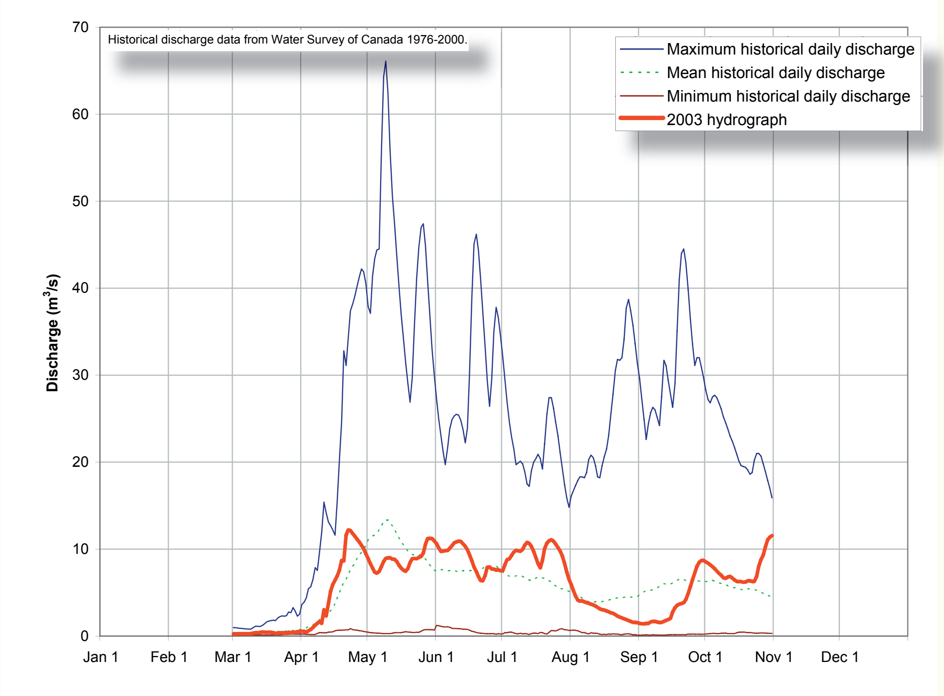
Unusual conditions in 2003 that influenced local hydrology included atypically warm temperatures in January and a relatively wet autumn.


Muskeg River

There was no evidence that the water volumes at stations downstream of oil sands development (lower Athabasca River, lower Muskeg River, Muskeg River near the Aurora/Albian boundary) was different from upstream reference stations.



2003 discharge hydrograph for the Athabasca River at Fort McMurray

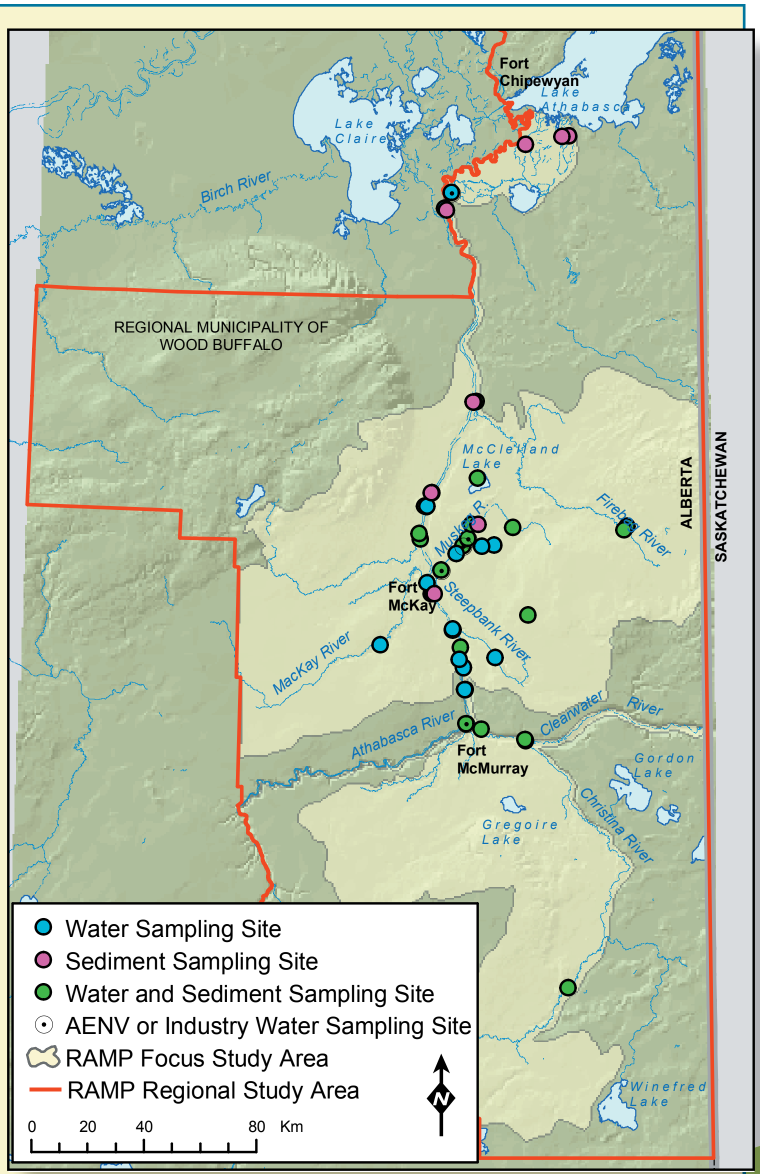


2003 discharge hydrograph for the Muskeg River

Monitoring the physical and chemical characteristics of water and sediment provides insights into how natural and human activities affect the health of aquatic ecosystems. Water quality measurements provide a snap-shot view of current conditions, while sediment quality measurements can show how chemicals accumulate over time. Together, these data act as an indicator of aquatic ecosystem health and integrity.

WHY ARE WATER AND SEDIMENT QUALITY MONITORED?

- To establish the chemical and physical features of waterbodies in the RAMP study area;
- To identify changes in water and sediment quality over time; and
- To evaluate whether changes in water and sediment quality are impacting aquatic organisms (algae, bugs and fish) that depend on these resources.



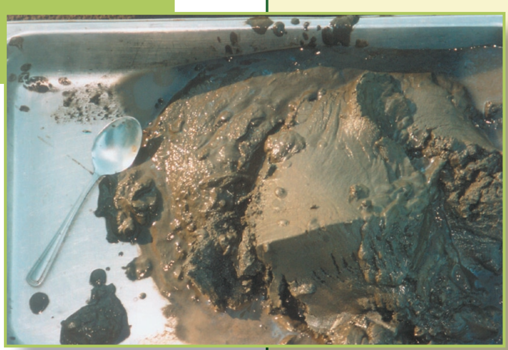
Map of Water and Sediment Sampling Stations

WHAT CHEMICAL PARAMETERS DID RAMP ANALYZE IN 2003?

Water

- pH
- conductivity
- hardness
- dissolved oxygen
- major ions
- nutrients
- total and dissolved metals
- recoverable hydrocarbons
- naphthenic acids
- total phenolics

Sediment



- carbon content
- percent sand, silt and clay
- total metals
- recoverable hydrocarbons
- total volatile hydrocarbons
- total extractable hydrocarbons
- polycyclic aromatic hydrocarbons

WHAT DO THESE MEASUREMENTS TELL US ABOUT WATER AND SEDIMENT QUALITY?

- *pH* is an indication of the acidic or basic (alkaline) nature of water. Neutral waters have a pH near 7. Large changes in water acidity can affect the number and variety of organisms able to survive in a lake or stream.
- *Hardness and total dissolved solids* are two indicators of water quality related to the concentrations of major ions (electrically charged atoms). The toxicity of many metals decreases as hardness increases.
- *Dissolved oxygen* is a measure of how much oxygen is available for aquatic organisms to breathe.
- *Nutrients* include a variety of nitrogen and phosphorus compounds that are required in very small amounts for plant growth.

- *Metals* are often detected at low concentrations (less than 1 mg/L) in rivers and lakes, and are often associated with suspended sediments that settle down to the bottom of lakes and streams. Higher levels of dissolved metals can be harmful to aquatic organisms.
- *Suspended solids* are the amount of material located in the water column of a stream or lake. When suspended solids levels are high, waters look cloudy or dark brown in colour. When suspended solids levels are low, waters appear clear. The light brown colour of the Athabasca River is a result of the naturally high levels of suspended solids (sediments) that it carries.
- *Organic compounds* consist of chemicals that include chains or rings of carbon atoms, such as hydrocarbons, phenols, polycyclic aromatic hydrocarbons (PAHs) and naphthenic acids. These compounds may originate from natural sources such as oil sands deposits and forest fires, or they may be the result of industrial activities.

A number of water and sediment samples are also tested in a laboratory to see how they affect the ability of different aquatic organisms to survive and grow. Algae, water fleas and fathead minnows were used to conduct water toxicity tests, and midge larvae, amphipod crustaceans and oligochaete worms were used for sediment toxicity testing.

Water samples are analyzed four times a year to see if there are differences from season to season. Sediment quality is analyzed in the fall following the summer accumulation of suspended materials.

2003 WATER QUALITY RESULTS

Athabasca River

In 2003, water quality in the Athabasca River downstream of Fort McMurray was generally consistent with previous years.

Athabasca River

No water quality issues (based on Alberta Water Quality Criteria) were detected at any of the stations along the Athabasca River from upstream of Donald Creek to the delta. These results indicate that inputs from tributaries in the oil sands region, regardless of ongoing development, did not clearly affect water quality in the Athabasca River.

Tributaries of the Athabasca River

In general, tributaries of the Athabasca River experiencing oil sand development in their watersheds, including the Muskeg, the MacKay, the Clearwater, the Christina, and the Steepbank rivers, were found to have comparable water quality to those of other (undisturbed) tributaries found throughout the region.

However, tributaries with water quality characteristics of note included:

Beaver River

This stream exhibited concentrations of several key water quality variables, including sulphate, conductivity, chloride, and several dissolved metals that were outside the range of natural variability of other local tributaries. These results suggest an influence from both naturally exposed oil sands combined with human activities on this watercourse.

Poplar Creek

This stream exhibited high levels of chloride, alkalinity, colour and dissolved metals (but similar sulphate concentrations) relative to other tributaries. However, natural saline seeps have influenced Poplar Creek even prior to development.

Calumet River

This stream, which had almost no flow during the fall survey, exhibited the highest dissolved organic carbon, colour and alkalinity of all tributaries sampled. These differences are likely natural because the Calumet River has yet to experience major development within its watershed.

Tar and Ells Rivers

Although water quality in these rivers was similar to other tributary rivers, toxicity tests showed reduced survival of fathead minnows. These rivers are located in an area yet to experience major oil sands development.

2003 SEDIMENT QUALITY RESULTS

Generally, sediment quality varied significantly among stations surveyed, with no effects of oil sands development or operations suggested.

Of note, the Muskeg River basin has seen the most oil sands-related development, yet sediment quality at the river's mouth was similar to stations located upstream of development and was similar to pre-development observations.

Levels of PAHs, which are naturally high in the oil sands region, were variable among all stations and did not show any pattern in terms of location or time that would suggest any effects related to oil sands development. Stations exhibiting high PAHs included:

- Athabasca River upstream of Donald Creek (east bank);
- Stanley Creek (mouth);
- Muskeg River upstream of the Canterra Road crossing; and
- Ells River (mouth).

Concentrations of metals were also variable among stations surveyed, with particularly high values observed at stations with a high proportion of fine sediment and high carbon content.

RAMP is currently reviewing the sediment monitoring program on the Athabasca River. Because the majority of sediments in the river are transported to the delta each year during spring high flows, annual accumulation of sediments in the oil sands region is limited and likely not useful for long-term monitoring.

Benthic invertebrates, or benthos, are aquatic organisms that spend part of their life in or on the bottom of rivers, lakes and wetlands. Typical benthos include insects, snails, clams, and worms. These animals are an important food source for many species of fish and are an important indicator of fish habitat quality.

Benthic Sampling

Benthic invertebrates living at a specific location in a stream or lake are referred to as a benthic invertebrate community. The number and types of benthic animals in a community reflect the characteristics of their surroundings, which makes them sensitive indicators of environmental effects.

In general, benthic communities in unpolluted waters consist of a large number of animals (high abundance) and a wide range of species (richness), including those known to be sensitive to pollution. RAMP monitors benthic invertebrate communities as a measure of water, sediment and habitat quality. The purpose of the RAMP benthic survey is to:

- Collect information on benthic communities before extensive oil sands development begins within select drainage basins; and
- Monitor the potential effects of development within drainage basins where oil sands development has already begun.

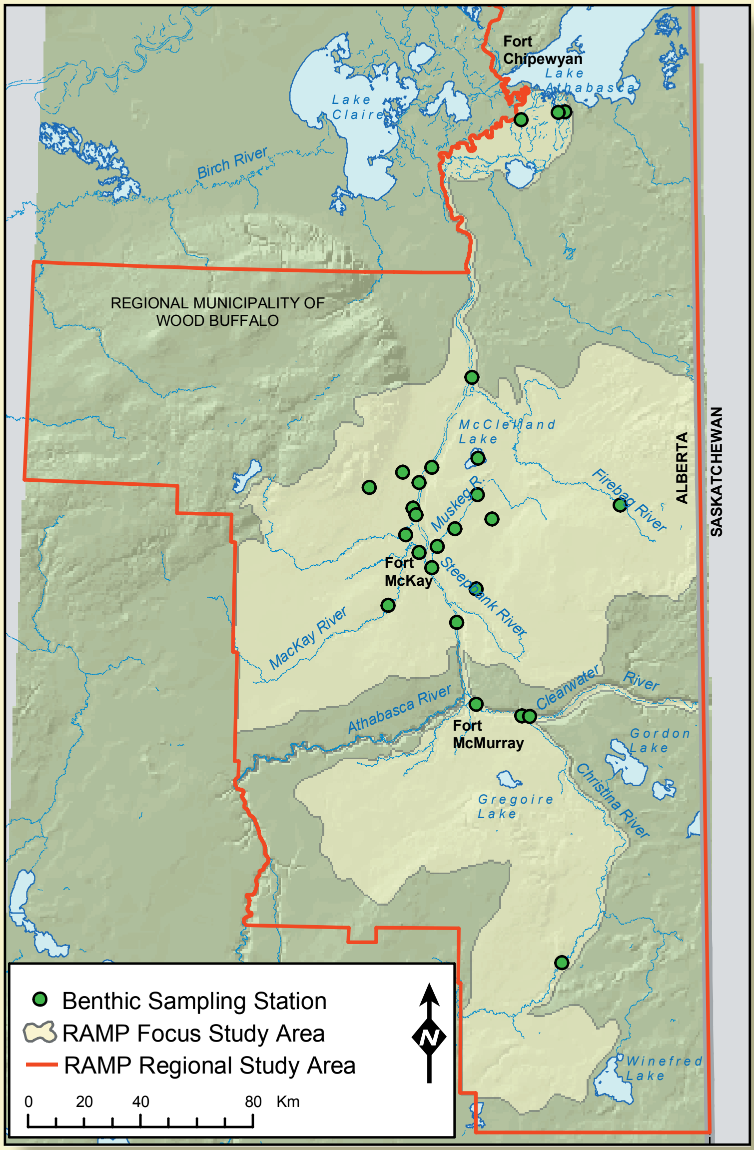
Midge

Mayfly

2003 BENTHOS MONITORING

In 2003, benthic monitoring was conducted at the following locations:

- The upper and lower portions of the Calumet, Christina, Clearwater, Ells, Firebag, Tar, MacKay and Muskeg rivers;
- Jackpine Creek and the mouth of Fort Creek;
- Three stations within the Peace-Athabasca Delta; and
- Stations throughout Shipyard, McClelland and Kearl lakes.



Map of Benthic Invertebrate Sampling Stations

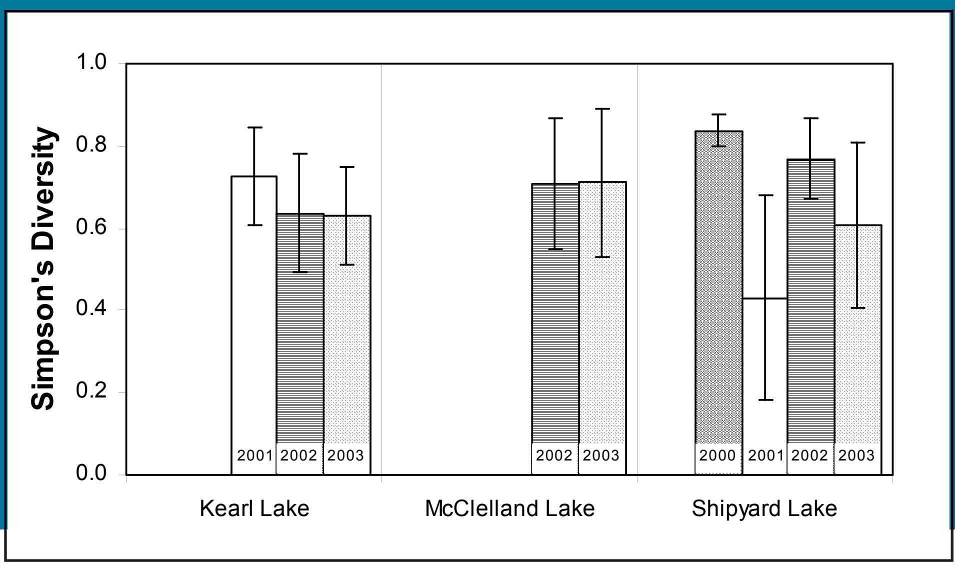
2003 BENTHIC INVERTEBRATE SURVEY FINDINGS

Over 250 different species of benthic invertebrates were identified during the 2003 sampling program. Most communities were composed of species ranging from highly tolerant to highly sensitive to changes in environmental quality.

Local Lakes

Among the three lakes studied, only Shipyard Lake is located within an active development region and could potentially be impacted by oil sands activities. Shipyard Lake benthic communities have exhibited more variability over time than other lakes sampled, although diversity was the only measurement that differed significantly from Kearl and McClelland lakes.

Kearl and McClelland lakes are located in zones of planned or approved development and, therefore, are not currently influenced by development.



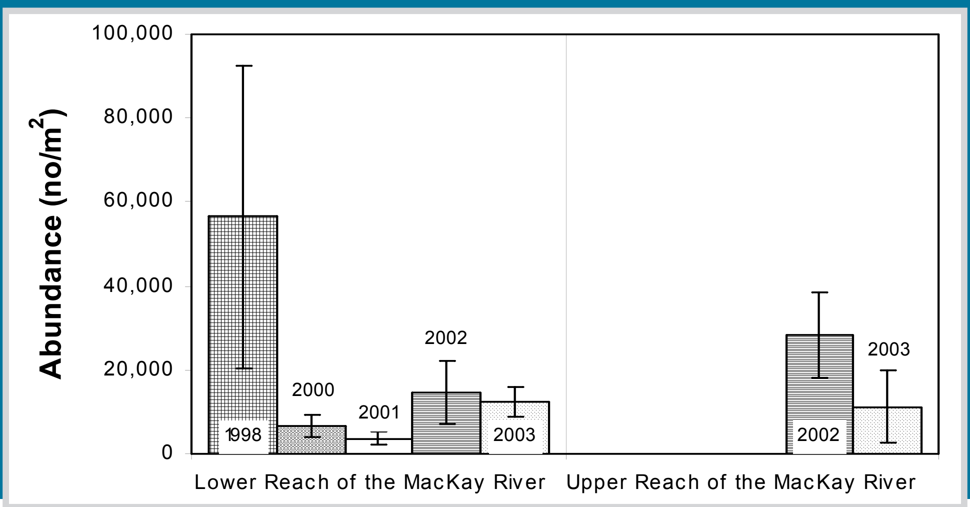
Benthic invertebrate diversity in Kearl, McClelland and Shipyard lakes

Peace-Athabasca Delta

Invertebrate communities at stations in the Peace-Athabasca Delta were within expected ranges for undisturbed communities in the region. All three sites were dominated by species with intermediate to high tolerance of pollution.

Local Rivers and Streams

There was no clear indication of benthic habitat degradation in rivers where mining is currently being conducted (lower reaches of the Muskeg River, MacKay River, lower Christina and Clearwater rivers).



Benthic Invertebrate Abundance in the MacKay River

The lower sections of the Clearwater and Christina rivers exhibited minor declines in benthic habitat quality relative to the upstream sections in these rivers, but these differences were likely due to differences in substrate, water flow, streamside vegetation and channel structure.

Benthic surveys were conducted in other rivers, including Jackpine Creek and the Firebag, Ells, Calumet and Tar rivers to establish pre-development baseline conditions prior to the initiation of future oil sands operations. Benthic invertebrate communities found in these rivers were consistent for the region.

Overall, none of the lakes and streams surveyed in 2003 clearly suggested habitat degradation as a result of human activities.

5 FISH POPULATIONS

Fish are an important monitoring tool because they are good ecological indicators and a highly valued resource. RAMP monitors fish populations in the Athabasca River and its tributary streams in the oil sands region to see if they are being affected by oil sands development and to check that fish are safe to eat.

The RAMP fish program monitors:

- The presence and abundance of fish species in the oil sands region;
- Where the fish go and how much time they spend in the oil sands region;
- Fish habitat;
- Fish health; and
- Fish tissue (fillets) chemistry.

In 2003, RAMP conducted the following monitoring of fish populations in the oil sands region:

- Operation of a two-way fish counting fence on the lower Muskeg River;
- Additional spring fish sampling on the lower Muskeg River using hoop nets, backpack *electrofishing* and fish larval traps;
- Tissue collection and analysis for sportfish species in the Athabasca River, Lake Claire and Christina Lake; and
- Fish inventories on the Athabasca River (spring and fall), the Clearwater River (spring and fall), and the Firebag River (spring only).

Electrofishing *is most commonly conducted with portable back-pack units or specially-equipped boats. These units produce an electrical pulse, which is passed through the water, temporarily immobilizing any fish within a three to five metre radius. The fish then float to the surface where they are easily netted.*

5 - FISH POPULATIONS

2003 FISH INVENTORY PROGRAM

RAMP conducts fish inventory studies because certain fish species are more easily stressed by increased chemical levels. Therefore, changes in the composition and abundance of fish species act as an indicator of ecosystem health.

Walleye

Northern Pike

Arctic Grayling

Historical List of Fish Species Captured in the Athabasca River

- Arctic grayling
- brassy minnow
- river shiner
- lake cisco
- Bull trout
- spoonhead sculpin
- spottail shiner
- longnose sucker*
- fathead minnow
- walleye*
- ninespine stickleback
- longnose dace
- northern pike*
- goldeye*
- pearl dace
- Iowa darter
- lake chub
- brook stickleback
- slimy sculpin
- lake whitefish*
- burbot
- emerald shiner
- trout-perch*
- mountain whitefish
- finescale dace
- white sucker
- flathead chub
- yellow perch
- northern redbelly dace

* Key fish indicators identified for the Athabasca River (CEMA 2001)

The **most abundant large-bodied species captured in the Athabasca River** in 2003 (in declining order) were:

1. walleye;
2. goldeye;
3. white sucker;
4. longnose sucker; and
5. northern pike.

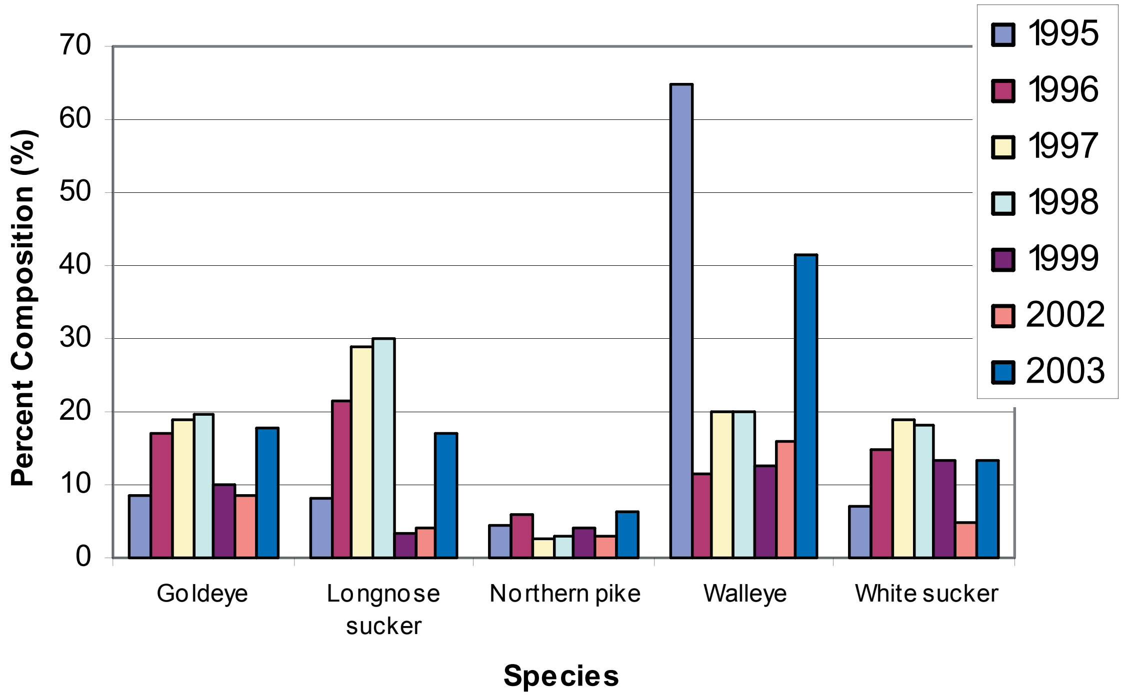
This ranking is identical to that found in 2002, and corresponds to the known characteristics of the fish community utilizing the Athabasca River in the oil sands region.

A higher percentage of goldeye, longnose sucker and white sucker were captured in 2003, compared to past years.

The percentage of walleye captured also increased in 2003 relative to previous years, but did not exceed the historical high observed in spring 1995.

The percentage of northern pike remained consistent with historical inventory results.

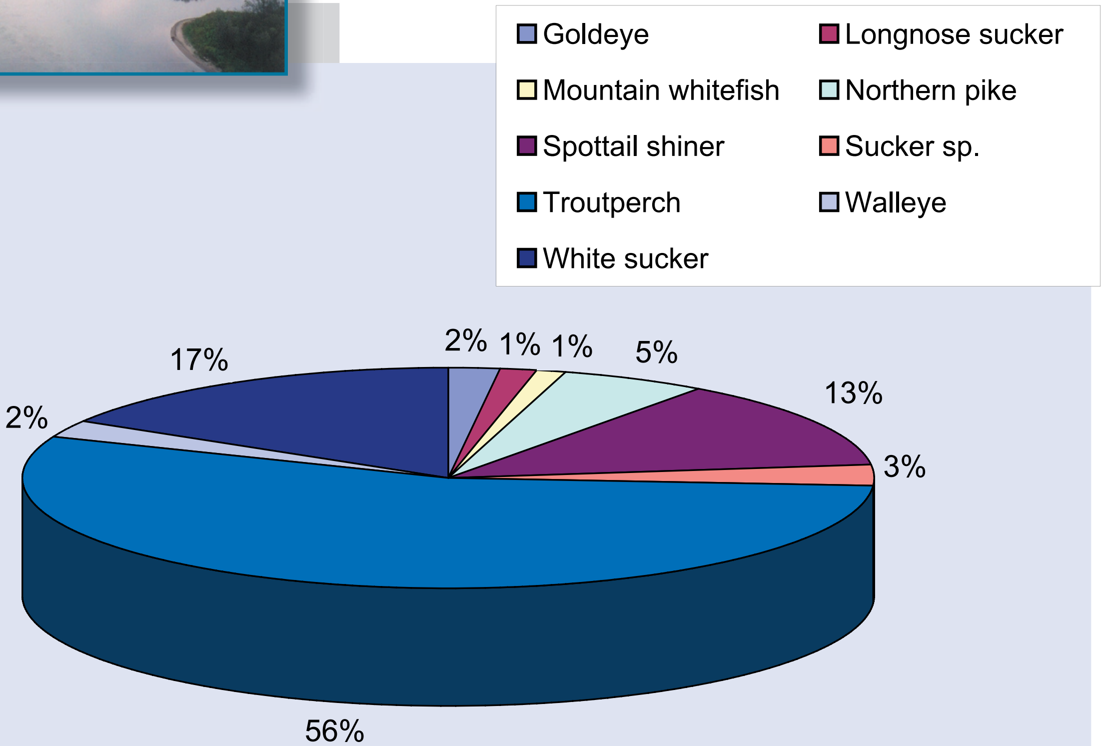
Percent composition for common large-bodied species, Athabasca River spring electrofishing inventory, 1995 to 2003.



Note: Figure based on fish captured and observed.

Clearwater River

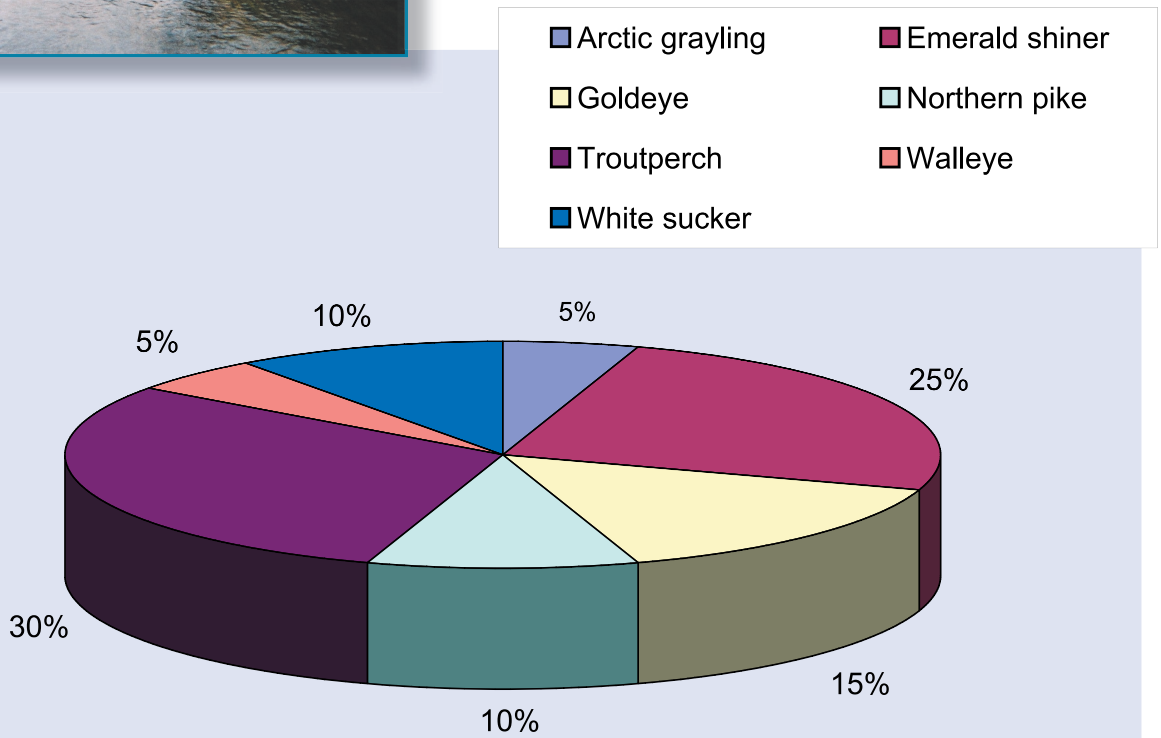
The fish community of the Clearwater River observed during the spring and fall surveys was dominated by trout-perch and spottail shiner. Large-bodied fish present included white sucker, northern pike, walleye and mountain whitefish, similar to species found in the Athabasca River.



Species composition of fish captured during electrofishing on the Clearwater River, Spring 2003

Firebag River

A total of 20 individuals and 7 species were captured/observed during the spring 2003 fish inventory on the Firebag River. Emerald shiner and trout-perch were the most abundant fish observed.



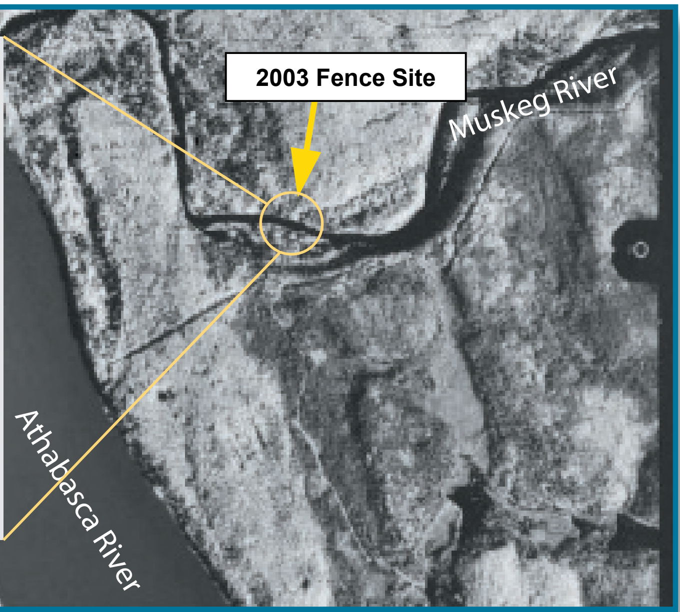
Species composition of fish captured during electrofishing on the Firebag River, Spring 2003

Muskeg River Fish Fence Program

The Muskeg River is an important tributary to the Athabasca River system due to its proximity to various existing and proposed oil sands developments and its importance to the local community of Fort McKay. Therefore, accurate information on fish and fish habitat in the watershed is needed to support impact monitoring and to help identify any adverse impacts that may occur over time.

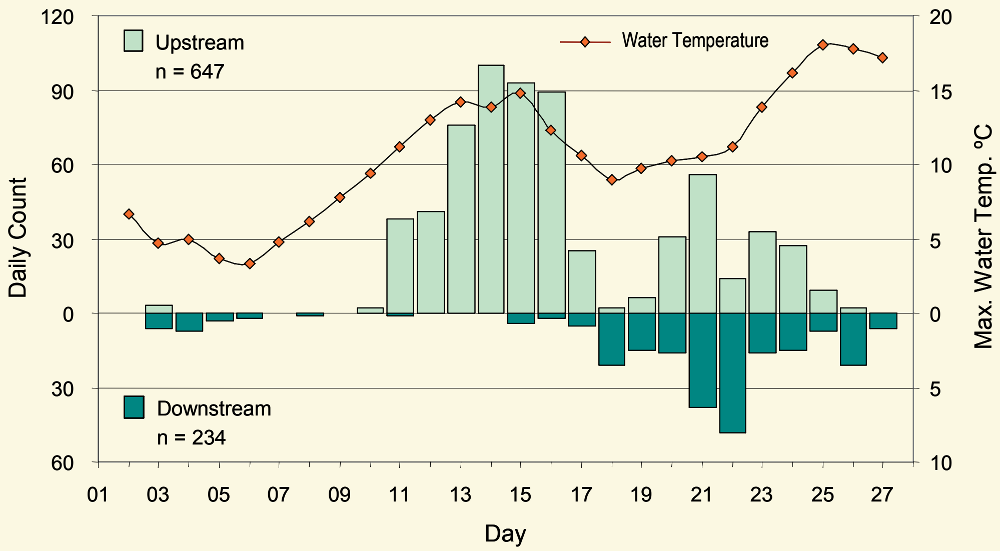
A two-way fish counting fence was operated across the lower Muskeg River from May 2 to May 27. The objective was to obtain accurate estimates of fish movement into and out of the river during the spring spawning season for species such as Arctic grayling, northern pike, walleye and sucker species.

View of Muskeg River fish fence, May 2003



In total, 1,206 fish representing nine fish species were captured. White sucker, longnose sucker and northern pike accounted for over 99% of all fish counted. Only two Arctic grayling were observed passing the fence (one moving upstream, one moving downstream).

The majority of upstream white sucker migrants were sampled at the fence when daily maximum water temperatures reached approximately 10°C. Upstream migration for longnose sucker followed a similar pattern to the white sucker. Fish moved upstream in two distinct waves, which closely follow the rise and fall of water temperatures.



Timing of white sucker migration and its relation with water temperature in the Muskeg River, May 2003

Comparison of fish count data from 2003 with other successful fish fence studies on the Muskeg River (1976, 1977, 1995) indicated that the size of spawning runs in the Muskeg River have declined over time. The most dramatic decline occurred between studies conducted in 1976/1977 and 1995 and, interestingly, prior to initiation of oil sands development in the Muskeg basin. The cause of the decline is uncertain, but could be related to natural factors such as recent low water levels (previous five years) and an increase in beaver activity resulting in reduced availability of spawning areas.

Fish Tissue

The RAMP fish tissue program is conducted to measure the levels of metals and organic ***tainting*** compounds present in fish populations of the Athabasca oil sands region, and to identify any potential risks to humans, fish, and wildlife.

Tainting is defined as abnormal odour and/or flavour detected in the edible tissues of fish.

Tainting compounds present at concentrations above ***1 mg/kg*** are believed to result in an undesirable odour or taste.

How much is 1 mg/kg?

Picture a credit card lying on a football field. The area covered by the card is roughly equal to 1 in 1 million (or 1 mg/kg).

To address community concerns, fish tissue sampling was conducted in the Athabasca River, as well as in Lake Claire and Christina Lake.

Fish species sampled from the Athabasca River included lake whitefish and walleye. For Lake Claire and Christina Lake, tissues from lake whitefish, walleye and northern pike were analyzed.

Mercury Concentrations in Fish Tissue

Mercury was measured because mercury in fish tissue is an historical issue for the region and a concern for local stakeholders.

In Canada, the government provides guidelines regarding consumption limits of mercury. Mercury is a metal that occurs naturally in many rocks, soils and waterbodies throughout the world. Mercury is also a by-product of many industrial activities, but is not a part of the process used to extract bitumen from oil sands.

In 1999, Health Canada issued the following mercury consumption guidelines:

Occational Consumer
(three (3) 100-gram servings per week):

Fish should contain, at a maximum, 0.5 milligrams of mercury per kilogram of fish tissue.

Subsistence Consumer
(eight (8) 100-gram servings per week):

Fish should contain, at a maximum, 0.2 milligrams of mercury per kilogram of fish tissue.

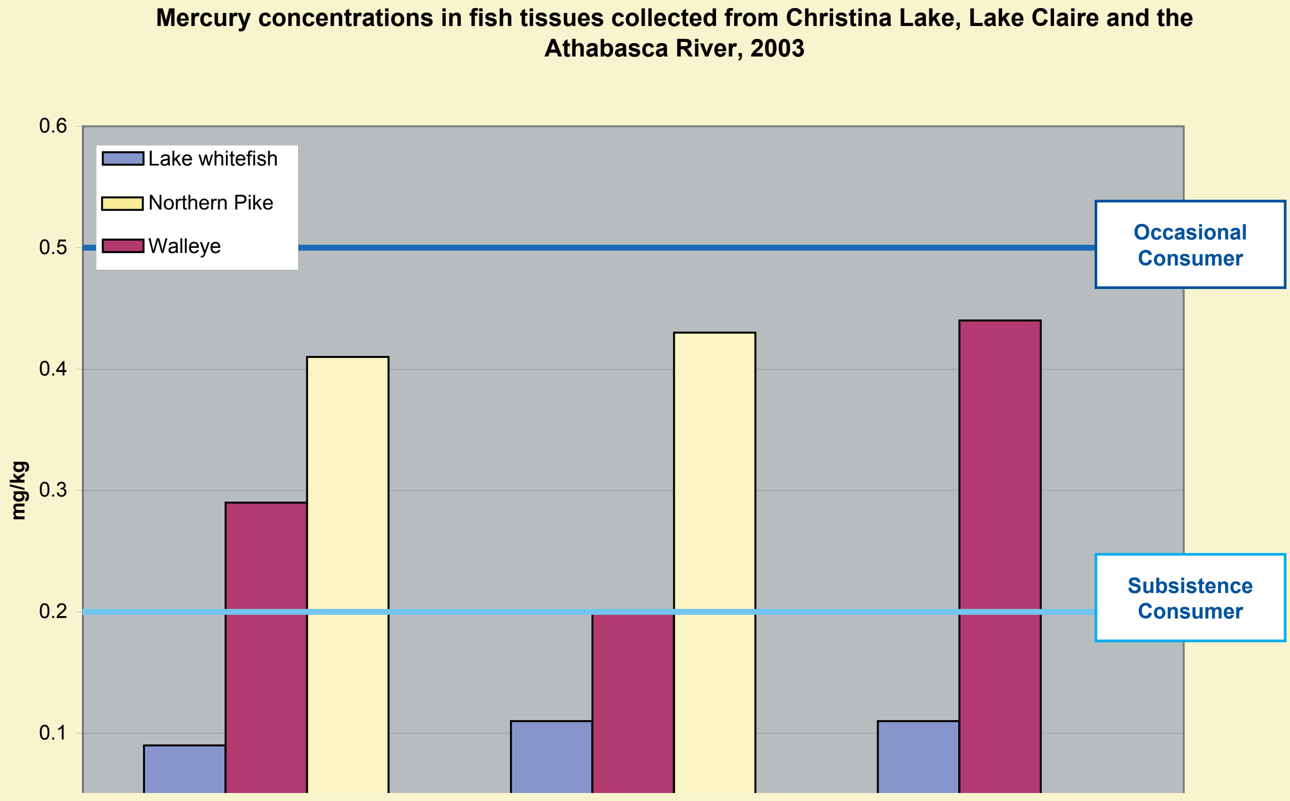
In 2004, the province of Alberta issued the following mercury guidelines for consumption of walleye caught in the Athabasca River:

"Women of child-bearing age and children under the age of 15 should not eat walleye captured from the Athabasca River; and all other people should not eat more than one meal of these fish per week."

(source: 2004 Alberta Guide to Sportfishing Regulations)

Athabasca River in winter

2003 Fish Tissue Results



Mercury concentrations in fish tissues collected from Christina Lake, Lake Claire and the Athabasca River, 2003

Generally, lake whitefish had lower mercury levels compared to walleye and northern pike. This is likely due to differences in feeding behavior. Adult lake whitefish consume a wide variety of benthic invertebrates and small fish. In comparison, diets of northern pike and walleye include a much greater proportion of fish. The fish that are eaten also may contain mercury; therefore, the more fish that are eaten, the more mercury fish like pike and walleye accumulate in their tissues.

Mercury levels in walleye, pike and whitefish were below occasional consumer guidelines at all sites; however, walleye from the Athabasca River and Christina Lake and pike from Lake Claire and Christina Lake had mercury levels that exceeded subsistence consumption levels.

Elevated mercury levels in fish do not appear to be linked to oil sands development, given concentrations in fish, water and sediment fell within natural, background ranges observed in the oil sands region prior to development.

Concentrations of 16 of 24 metals were below analytical detection limits. Concentrations of the remaining metals, including barium, copper, iron, manganese, selenium, strontium, titanium and zinc were low, and varied little between sexes and species.

All six tainting compounds were below analytical detection limits, indicating that fish flavor is unlikely to be affected.

Athabasca Oil Sands

Oil Sands Development (winter)

6 ACID SENSITIVE LAKES

Acid sensitive lakes are waterbodies considered vulnerable to increasing acidity through the deposition of ***acid-forming compounds***. These compounds can cause the water to become more acidic, which can harm the health of many fish, bugs and plants. The goal of the acid sensitive lakes monitoring program is to identify the early signs of acidification before lakes and the organisms within them are harmed.

Examples of ***acid-forming compounds*** *released by industry include oxides of sulphur (SO_x) and nitrogen (NO_x).*

The acid sensitive lakes program measures lakes once a year for the following qualities:

- Water acidification (pH levels);
- Water quality measures (colour, carbon levels, suspended solids, and nutrients); and
- Natural level of protection from acidification (alkalinity, buffering capacity).

A lake is generally considered to be affected by acidification when buffering capacity is reduced and subsequently pH drops below 6, and when pH falls below 4 or 5, species diversity becomes restricted.

In 2003, RAMP monitored 50 lakes and ponds for potential changes in pH and buffering capacity. Of these lakes, 17 were added to the program in 2002 in order to monitor potential acidification occurring near oil sands developments.

Alberta Environment specialists conducted the monitoring activities on behalf of RAMP.

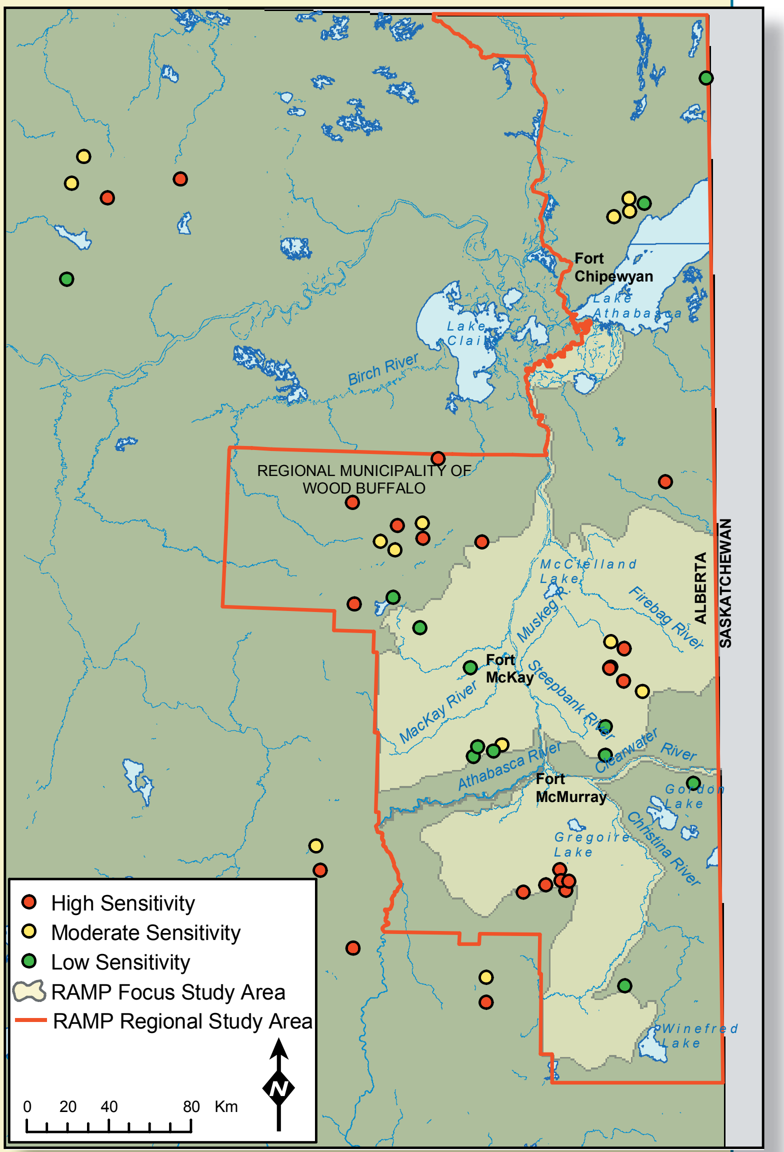
Kearl Lake

2003 ACID SENSITIVE LAKES STUDY RESULTS

The water chemistry of the 50 lakes monitored by RAMP was found to fall within the range of 460 regional lakes previously examined by CEMA (Cumulative Environmental Management Association) and confirmed the RAMP lakes were representative of lakes in the region.

Interestingly, lakes that received water from upland regions, such as Birch Mountains, Stony Mountains and the Muskeg River uplands, had distinctly lower pH, conductivity and buffering capacity than lakes in other areas.

It is still too early for the Acid Sensitive Lakes monitoring program to detect trends in lake acidification over time. More years of data are required. However, comparison between the first three and last two years of monitoring data indicated that 26 of the 50 RAMP lakes became less acidic, while 6 were more acidic. Most of these changes were small and likely related to normal seasonal variability.



Map of Acid Sensitive Monitoring Stations

RAMP will continue to monitor acid sensitive lakes on annual basis to develop a database that will allow an assessment of potential lake acidification over time.

7 AQUATIC VEGETATION

RAMP studies aquatic vegetation and water quality in wetlands located close to oil sand developments. Aquatic vegetation is an important indicator of the overall environmental health of wetlands. Changes in abundance and distribution of aquatic vegetation may influence the use of a wetland by fish, bugs, birds and wildlife.

Wetlands are an important component of the environment because they:

- Filter out sediment and pollutants from water;
- Recharge the water table;
- Reduce soil erosion of downstream waterbodies; and
- Provide food and shelter for aquatic organisms.

HOW WAS AQUATIC VEGETATION MONITORED IN 2003?

In 2003, wetland monitoring focused on the wetland areas within Shipyard Lake, Isadore's Lake and Kearl Lake. Shipyard Lake is located within the Athabasca River floodplain and is adjacent to Suncor's Steepbank/Project Millennium Mine. Isadore's Lake is a wetland also located on the Athabasca River floodplain and is adjacent to the Albian Sands Muskeg River Mine Project. Kearl Lake is a large lake-wetland complex located approximately 12 km east of the Athabasca River in the Muskeg River watershed. No oil sands operations are currently operating in the vicinity of Kearl Lake.

Aquatic vegetation monitoring

Field surveys were conducted at each lake to assess the presence, health and percent cover of both underwater and emergent aquatic plants. Historical air photos from 1949 to 2001 also were used to assess changes in the distribution of aquatic vegetation communities and the amount of open water present in each wetland over time.

2003 AQUATIC VEGETATION STUDY RESULTS

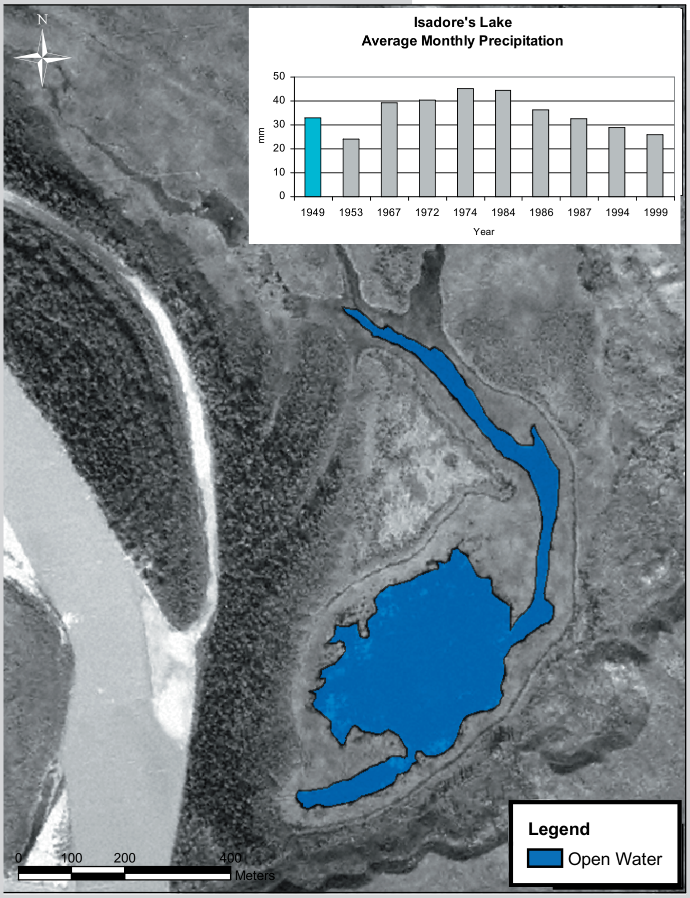
The diversity of aquatic plant species surveyed in 2003 was lower than what was found in 2001. It is likely that this change was largely due to the RAMP Technical Subcommittee's decision to refine the sampling methods and focus the survey on emergent and submergent aquatic plants and to discontinue surveying plants associated with areas of transition from water to dry land.

Number of vegetation species collected per cover type, 2001 and 2003

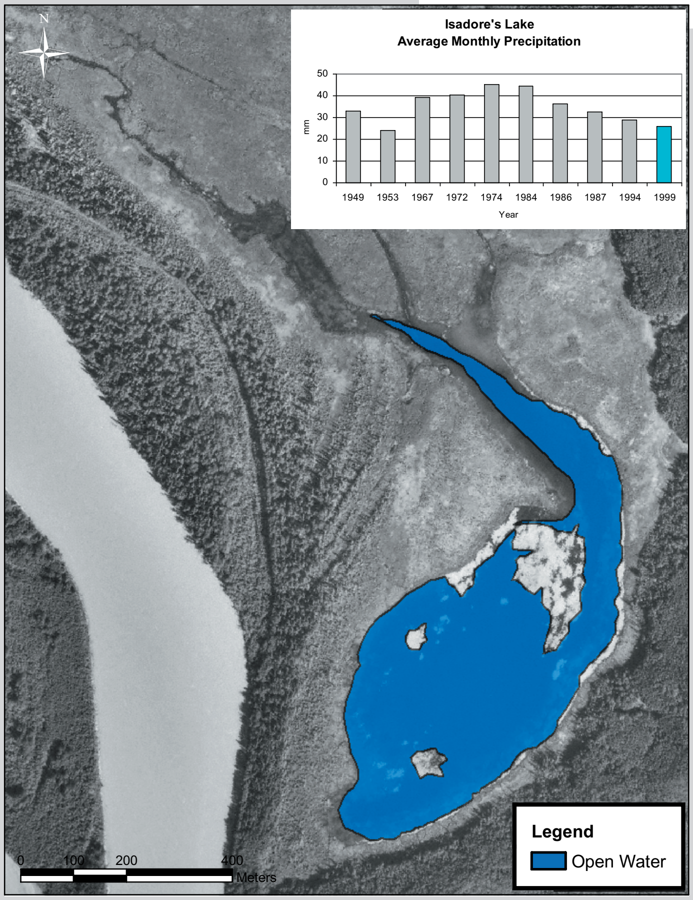
Vegetation Type	Shipyard Lake		Isadore's Lake		Kearl Lake	
	2001	2003	2001	2003	2001	2003
	0	0	13	1	2	1
Soft stem, non-grassy plants	18	14	23	16	24	21
Grasses	3	1	7	3	9	10
Moss	1	3	6	1	5	6
Lichen	0	0	5	0	0	0
Total	**22**	**18**	**54**	**21**	**40**	**38**

Results of the historical air photo analysis indicated that the wetlands have undergone large natural changes over time. In particular, water levels and the amount of open water in Isadore's Lake and Shipyard Lake varied substantially from year to year. Interestingly, the amount of precipitation in a given year had only a minor role in determining the extent of open water in these lakes.

Isadore's Lake: 1949



Isadore's Lake: 1999



The results of the 2003 program indicated that the aquatic vegetation monitoring program needs to be refined to take into account the high natural variability in water levels and vegetation of local wetlands.

Quality assurance and quality control (QA/QC) is a process used to ensure that the information obtained in field and laboratory studies is useful, accurate and comparable to the quality of information from other studies.

RAMP has developed a QA/QC plan for its field programs, laboratory analyses and office procedures. All RAMP components strictly follow the procedures described in the QA/QC plan.

Collecting fish data

9 OTHER RAMP INITIATIVES

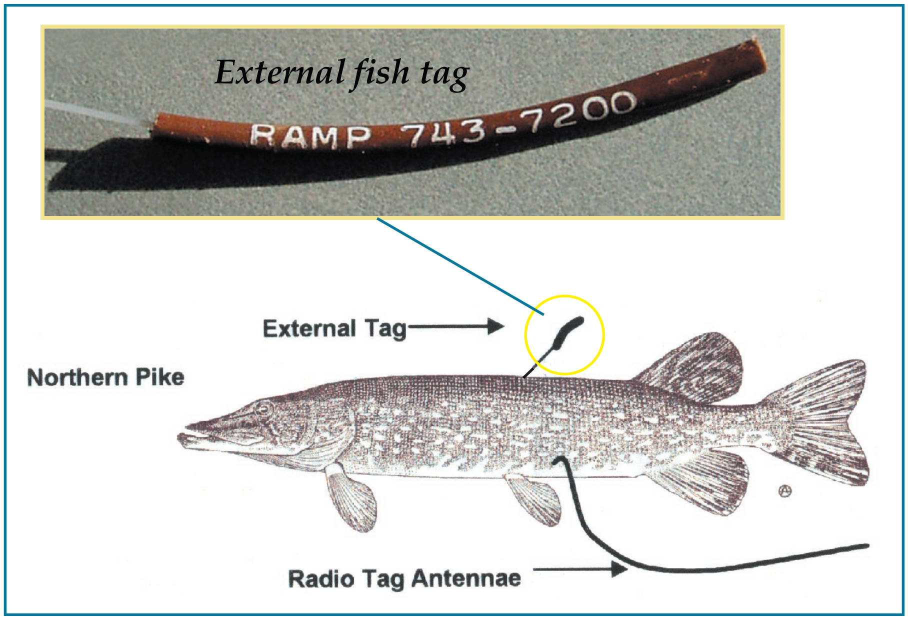
In addition to the previous core monitoring components, RAMP also strives to promote community participation and to effectively communicate findings to the public. Some of the activities that the public are encouraged to take part in include:

- Fish Tagging Program;
- Fish Abnormalities Program;
- River Response Network; and
- RAMP Webpage (www.ramp-alberta.org)

FISH TAGGING PROGRAM

A number of fish in the Athabasca River basin have been fitted with radio transmitters and/or external tags. The tagged fish are part of a collaborative fish movement study for the oil sands Regional Aquatics Monitoring Program (RAMP) and the Cumulative Environmental Management Association's (CEMA) Surface Water Working Group.

Members of the public can be an integral part of the study by reporting any tagged fish that are caught. The tag number, the tag colour, and the fish's length and weight are important details to report. Other information on the tags can include company name, address, and phone number.



A fish with external and radio tags

The external tag is located near the dorsal fin (see diagram) and may be coloured brown or blue (RAMP), pink (Syncrude) or blue/yellow (Fish and Wildlife Division). Radio tagged fish have an antennae protruding from the side of their body.

If a fish with an external tag is caught, please phone one of the following people:

Larry Rhude
Alberta Sustainable Resource Development
Tel: (780) 743 - 7200

Shannon Crawley
Chipewyan Prairie First Nation
Tel: (780) 715 - 3471

Lisa Schaldemose
Fort McKay First Nation
Tel: (780) 791 - 2505

Ian Walker
Fort McMurray First Nation
Tel: (780) 334 - 2828

Caroline Adam
(located in Fort Chipewyan)
Athabasca Chipewyan First Nations (ACFN)
Tel: (780) 697 - 3300

Melody Lepine
Mikisew Cree First Nation
Tel: (780) 714 - 6500

Eric Davey
Athabasca Tribal Council
Tel: (780) 791 - 7445

Scott Flett
Alberta Environment
Tel: (780) 697 - 3733

Please release live radio tagged fish and report the external tag number and fish information to help keep the study moving! If the fish is kept, please return the radio tag. The radio transmitter can be found implanted in the abdomen of the fish.

FISH ABNORMALITIES PROGRAM

Abnormalities occur in all fish populations and can be the result of natural or human influences. Some of the more common causes of abnormalities include parasites, infections, injuries, genetics, and presence of chemicals in the water.

Common fish abnormalities include lesions, growths, scarring, unusual scale patterns, body colour changes and physical deformities like missing fins, curved spines or blindness.

A fish with curved spine

9 - OTHER RAMP INITIATIVES

Communities within the oil sands region have teamed with RAMP to gather information about abnormal fish found in the area. Individuals within each community will be trained to sample fish with abnormalities and send these samples to the Department of Fisheries and Oceans (DFO) in Winnipeg for further evaluation. If you catch a fish that looks abnormal, you can obtain assistance from any one of the same contacts identified for the fish tagging program (see page 45).

RIVER RESPONSE NETWORK

Occurrences of foam, scum, turbidity and other events, many of which are of natural origin, occur in rivers throughout the world. Events of this type have occurred on the lower Athabasca River in recent years prompted questions about their nature and source. Because of the expansion of the oil sands industry and the concerns of local residents, RAMP has developed the River Response Network to respond to reports of non-spill type events on the lower Athabasca River.

- RAMP will provide a coordinated investigation of reported non-spill events. There is a network of member contacts along the lower Athabasca River that will respond to reports of this type.

- Currently, the River Response Network is intended to operate only during the open-water season on the lower Athabasca.

- The River Response Network will be activated by calls from the public or a RAMP member's observations.

Should you see something on the river that is of concern, please call 1-800-222-6514 (toll-free) or contact one of the following:

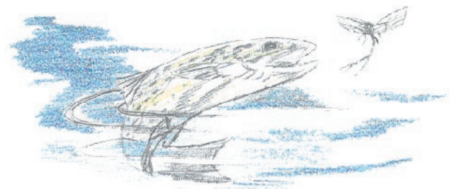
Fort Chipewyan: **Scott Flett (AENV)**
Tel: (780) 697 - 3733

Fort McKay: **Carmalee Farn-Baker (Albian)**
Tel: (780) 713 - 4440 / (780) 714 - 0509

Tar Island: Laura Smithies (Suncor)
Tel: (780) 743 - 6658

Fort McMurray: Ian Walker (Fort McMurray First Nation)
Tel: (780) 334 - 2828
Roger Ramcharita (AENV)
Tel: (780) 743 - 7470 / (780) 714 - 8415

Upstream of Fort McMurray: Mark Spafford (ALPAC)
Tel: (780) 525 - 8160 / (780) 689 - 9347



The RAMP Webpage

The RAMP webpage provides easy access and useful tools for people interested in the program. Visit the webpage to see the latest news, maps, sample site locations, past RAMP reports and current contact information. There are also online reporting forms for people to fill out in the event that they observe a fish with abnormalities or a tag.

Please visit the RAMP webpage at:

http://www.ramp-alberta.org

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