Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Peel River

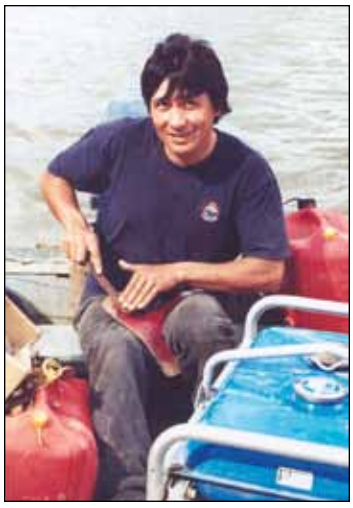
Water and Suspended Sediment Sampling Program (2002 - 2007)

Water quality in the Peel River is generally excellent. The recent sampling carried out in the Peel River above Fort McPherson shows that the water is safe for drinking*, swimming and aquatic life.

**After boiling for five complete minutes*

The Peel River...

- Rises in the Oglivie Mountains, Yukon Territory;
- Is formed by the confluence of the Blackstone and Ogilvie rivers;
- Joins the Mackenzie River approximately 65 km south of Aklavik;
- Has a mean annual flow of 675 m^3/s, which means that on average 675,000L of water passes by the community of Fort McPherson each second; and,
- Contributes 16% of the fine sediment to the Mackenzie Delta each year. This is equal to 20 billion kilograms of sediment!



Steven Tetlichi, Fort McPherson Community Liaison and Field Guide

Canada

Why were samples collected?

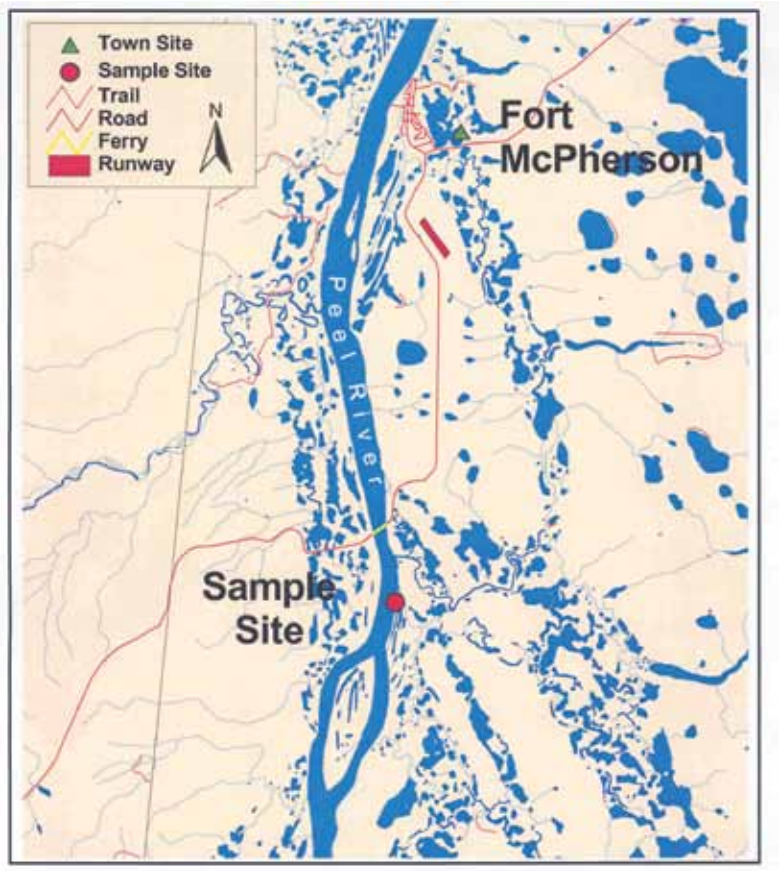
Samples were collected from the Peel River to:

- Learn more about water and suspended sediment in the river;
- Contribute to the existing knowledge about water quality in order to track changes over time;
- Address community concerns about contaminants in water and suspended sediment; and
- Support the development of water quality objectives for the Yukon-Northwest Territories Bilateral Waters Agreement.

Suspended sediment is the soil (sand, silt, clay, organic debris) that floats in water.

Where and when were samples collected?

The Peel River water and suspended sediment samples were collected upstream of Fort McPherson between 8 Mile and the big island. This sampling site has been operated by Environment Canada as part of their water quality network since 1969.



The samples for this study were collected by Indian and Northern Affairs Canada (INAC) staff with help from Steven Tetlichi during the open water season from 2002-2007.

What were we looking for?

Water and suspended sediment samples were tested for:

Basic Tests: pH, total dissolved and suspended solids (TDS, TSS), turbidity, conductivity, hardness, alkalinity, nutrients (phosphorous, nitrogen), major ions (calcium, magnesium, sodium, potassium)

Metals: aluminum, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury, nickel, thallium, tin, uranium and zinc

Polynuclear Aromatic Hydrocarbons: a group of organic compounds that contain two or more benzene rings
- Some of these include acenaphthene, flourene phenanthrene, pyrene, and benzo(a)pyrene

Organochlorines: compounds that contain chlorine made by humans, including pesticides (i.e., DDT, lindane) and PCBs

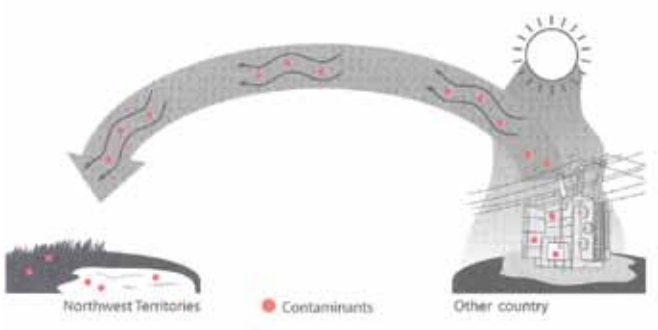
What are metals?
Sources of metals can be natural (soil and bedrock erosion) or human-made. Small quantities of metals are important for all living things; when found, it does not mean that the water quality is bad.

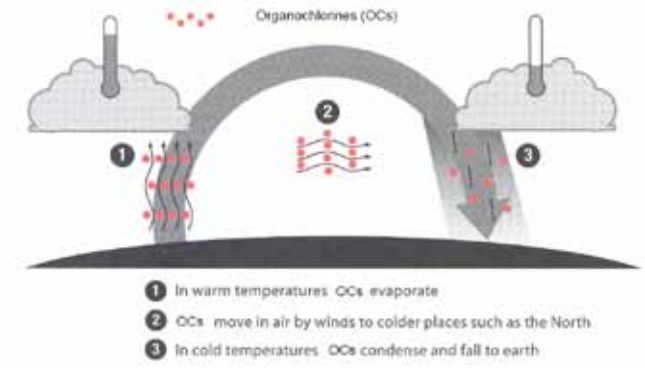
What are Organochlorines?
Organochlorines include pesticides for insect control, herbicides for crop protection and PCBs for past use in electrical equipment. Organochlorines last a long time in nature. They can be toxic and can cause harm to living things. Most organochlorines in the North arrive from other parts of the world and Canada.

What are Hydrocarbons?
Hydrocarbons are present in low concentrations virtually everywhere. Forest fires, volcanic eruptions, decaying organic matter and natural oil seeps are all natures' sources of hydrocarbons. Human sources include woodstoves, automobile exhaust, cigarette smoke, aluminum smelting, wood preservatives, asphalt production and waste incineration. Hydrocarbons are also used to make pesticides. These compounds enter water attached to dust, snow or rain or on particles washed from the soil by runoff.

How do pesticides (DDT) and contaminants such as PCBs get into our northern environment?

Organochlorines and PCBs can travel through the air or water currents for thousands of kilometres. On warm days, the compounds can slowly evaporate into the air and travel for long distances until they reach cold arctic regions. Most organochlorines and PCBs that are present in the Northwest Territories come from sources in other countries and southern Canada.





What was collected?

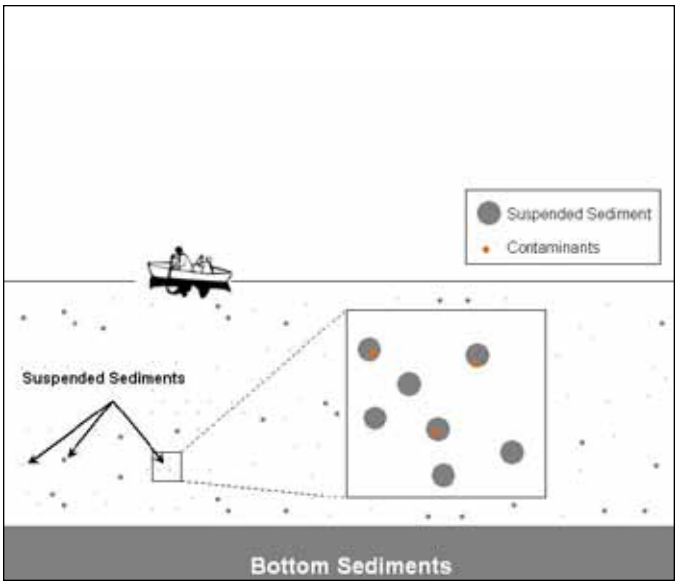
Water (surface and sediment-free samples)

Shannon Blake of Fort McPherson collecting surface water.

The centrifuge is a large sampler that separates the river water from the suspended sediment. This is important because the water and suspended sediments of the Peel River can have very different chemistry. We want to look at both separately.

Suspended Sediment (soil floating in the water)

The suspended sediment is collected in the centrifuge bowl, transferred into sampling jars and sent to the laboratory for analysis.



Why collect suspended sediment? Metals and organic compounds tend to quickly leave the water – chemically most prefer to be attached to suspended sediments. In the water environment, we want to look for these compounds where they would most likely be found.

What affects water quality?

Natural water quality varies from place to place, with the seasons, with climate, and with the types of soils and rocks through which water moves. When water from rain or snow moves over the land and through the ground, the water will dissolve minerals in rocks and soil, moves through organic material such as roots and leaves, and react with algae, bacteria, and other microscopic organisms. Water also carries plant debris, sand, silt, and clay to rivers and streams making the water appear muddy or cloudy. In the winter, under ice, or when water evaporates from the river during the summer, dissolved substances are more concentrated in the water that remains. Each of these natural processes changes the water quality and potentially the water use.

Dissolved substances in water include minerals, salts, metals and small amounts of organic material that are not visible. Dissolved subtances can sometimes affect the taste, smell, or clarity of water.

The most common dissolved substances in water are minerals or salts. Dissolved substances include common constituents such as calcium, sodium, bicarbonate, and chloride; and plant nutrients such as nitrogen and phosphorus. In general, these common substances are not considered harmful to human health or aquatic life.

What were the results in the Peel?

All waterbodies have unique water quality characteristics and the Peel River is no exception. The Peel River has a pH of 7.8 which is typical of fresh waters. The river has a lot of minerals in it and is considered 'hard'. High levels of dissolved substances such as calcium and magnesium are what makes water hard. The limestone (calcium carbonate) rocks found in certain parts of the basin contribute to the hard water. Hard or mineralized water means you might need more soap to make bubbles and you might have scaling or build up in your tea pot. Levels of suspended sediments in the Peel River are also relatively high. The river cuts through the Peel Plateau, an area underlain with sedimentary rocks which are easily erodedinto tiny bits that get carried by the river. Suspended sediments make the Peel River murky or cloudy at certain times of the year, especially during the spring melt when water levels are high and sediment load is at a peak.

Overall, the results from the Peel River sampling program indicate that the water quality in the Peel River above Fort McPherson is very good. This means the water is safe to drink and to swim in. However, no matter how pristine a water body, it is always recommended that water be boiled for five minutes prior to drinking in order to kill any waterborne microorganisms (Giardia and Cryptosporidium). Concerns about metals or other substances in Peel River surface water can be addressed by filtering the water or letting it settle before use.

The confluence of the Peel and Snake rivers. Note the huge contributions of suspended sediment from the Snake into the Peel.

Water Quality

The water was tested for metals, organochlorines and hydrocarbons. Two sets of national guidelines have been developed for assessing water quality:

1. Drinking Water Quality Guidelines (Health Canada), and
2. Guidelines for the Protection of Freshwater Aquatic Life (Environment Canada).

The guidelines are recommended limits for substances in water that is estimated to be safe. The guidelines are intended to protect human health or the environment.

Metals (aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, uranium, zinc)	The water was tested for both total and dissolved concentrations of metals. Total metals include metals dissolved in water (like sugar) and metals attached to suspended sediments. Dissolved metals include only the metals that are dissolved in water. Most metals were within the historical range of water quality at Peel River above Fort McPherson (1969-2000). The Drinking Water Quality Guidelines are meant to be applied to treated tap water - not source water such as the Peel River. However since "Can I drink the water?" is a common and important question, the guidelines were used to assess the surface water of the Peel River. As expected, due to the high sediment load of the Peel River, total metals did not always meet the guidelines. However, when the samples were filtered and the water was tested again, Health Canada's guidelines were always met. Surface water was also assessed by comparing the metal results to the Guidelines for the Protection of Fresh Water Aquatic Life. These guidelines are used to assess the health of habitats used by fish and other aquatic life but cannot determine whether the fish are of good quality (safe to eat). Some metals did not meet these guidelines, yet it is unlikely that the levels of metals in the Peel River represent a hazard to aquatic life. This is because most metals are attached to suspended sediment which makes the availability for uptake by fish and other aquatic life very low.
Organochlorines (DDT, PCBs)	The water was tested for 19 different organochlorine compounds. These included pesticides like DDT (Dichloro-Diphenyl-Trichloroethane) and lindane. None were found. The water was tested for total PCBs (polychlorinated biphenyls). None were found.
Hydrocarbons	The water was tested for 17 different hydrocarbons. On occasion, very small amounts (parts per billion) of hydrocarbons were found. Given the kinds of hydrocarbons found and the fact that areas within the watershed are known for their oil and gas resources, it is likely that the hydrocarbons are from natural sources. Guidelines for the Protection of Freshwater Aquatic Life and the Drinking Water Quality Guidelines (where guidelines exist) were always met. *In water, a ug/L is one part per billion (ppb). A ppb in water is like one drop in all the water of five water trucks.*

Suspended Sediment Quality

The suspended sediment was tested for metals, organochlorines and hydrocarbons.

Environment Canada has developed two levels for measuring these compounds in bottom sediments and assessing their affect on aquatic life: a lower limit and an upper limit. Levels above the lower limit have the potential to affect aquatic biota. However, levels above the upper limit are more likely to affect aquatic biota. Levels above the upper limit might be reason for further testing. It is important to mention that these guidelines are national in scope and do not consider site-specific conditions such as underlying geology. Further, they are intended for bottom sediments, not suspended sediments. To date, guidelines for suspended sediments have not been developed.

Metals (aluminum, arsenic, cadmium, chromium, copper, iron, lead, nickel, uranium, zinc)	Some metals (arsenic, zinc and on occasion, cadmium) were above the lower limit. Because metals in the Peel River are mostly attached to suspended sediment, the metals are less available to aquatic organisms and therefore very unlikely to cause any adverse affects. Concentrations of these metals were always below the upper limit. With no active mines or industrial developments in the Peel watershed, the sources of the metals appear to be natural and are related to underlying geology.
Organochlorines (DDT, PCBs)	The suspended sediments were tested for 19 different organochlorine compounds. These compounds include pesticides like DDT, lindane and herbicides such as 2,4-D (dichlorophenoxy acetic acid). 2,4-D was the only compound found on one occasion in 2004. 2,4-D is a herbicide commonly used to control weeds on lawns. Today, it is the third-most widely used herbicide in North America. Considering this herbicide is not used in the region, lab contamination or atmospheric transport is the most probable source for 2,4-D. *In suspended sediment, ng/g is one billionth of a gram (ppb). To understand this level: set out to walk one billion feet, you will walk around the world 7.5 times. Now take one step forward – that is one ppb.* The suspended sediments were tested for over 200 different types of PCBs (polychlorinated biphenyls). Total PCB levels were extremely low (85X less than the recommended limit). Based on the laboratory report and the kinds of PCBs found, atmospheric transport is the most likely source. PCBs are found all over the world. The levels of PCBs in the suspended sediments of the Peel River ranged from 0.07-0.4 ppb. The recommended lower limit is 34.1 ppb.
Hydrocarbons	The suspended sediments were tested for 17 different kinds of hydrocarbons. Among the compounds for which guidelines exist, 10 hydrocarbons were above the lower limit. All levels of hydrocarbons remained far below upper limit. Given that parts of the watershed are rich in oil and gas resources, the compounds found are likely associated with upstream natural oil seeps. Local forest fires and/or atmospheric transport may also be contributing to the levels found in the river. Levels are similar with the types and concentrations of hydrocarbons found in the Slave, Liard and Mackenzie River suspended sediments.

What do the results mean?

Water quality in the Peel River upstream from Fort McPherson reflects the local and seasonal environment conditions. The recent sampling shows that the water is safe for drinking (after boiling for five minutes) and aquatic life.

How will this data be used?

The data collected has and will:

- Contribute to the understanding of water and suspended sediment quality in this important northern watershed;
- Contribute to environmental land use planning initiatives;
- Help to develop site-specific trans-boundary water quality objectives for the Yukon-Northwest Territories Bilateral Waters Agreement; and
- Help detect changes in water quality resulting from human disturbances and/or natural phenomena.

What's Next?

Sampling continues. Environment Canada routinely collects surface water samples four times a year from the Peel River upstream from Fort McPherson. Indian and Northern Affairs Canada (INAC) will perform follow-up water and suspended sediment sampling in five years.

Shoreline along the Peel River.

For more information, please contact:

Andrea Czarnecki
Water Resources Division
Indian and Northern Affairs Canada
Yellowknife, NT
Ph: 867.669.2509
CzarneckiA@inac-ainc.g,c.ca