4. Liard Sub-basin

Introduction

Geography

The Liard River and its tributaries drain an area of approximately 275,000 square kilometres, making it Canada's ninth largest watershed.[114, 139] The Liard River begins its journey in the Pelly Mountains of southeastern Yukon, flows through northeastern British Columbia and then crosses into the Northwest Territories where it drains into the Mackenzie River (Figure 4–1). At 1,115 kilometres, the Liard is Canada's eleventh longest river.[114] With an average annual discharge of 1,970 cubic meters per second, it ranks seventh among Canadian rivers in volume of water discharged.[114]

Short, cool summers and long, cold winters characterize the climate of the Liard sub-basin, with average annual temperatures hovering around the freezing point. Average summer highs are about 25°C. There are about 150 frost-free days per year. Approximately 450 millimetres of precipitation fall in the basin annually.[140]

Much of the Liard sub-basin is covered by coniferous and mixed-wood forest. Intensive agriculture is limited to a small area near Fort Nelson in the southernmost part of the sub-basin. There are extensive mountainous areas in the sub-basin, especially in the headwaters along the Yukon-Northwest Territories border and in the western part of the sub-basin. Some of the mountainous areas along the Yukon-Northwest Territories border are prone to massive landslides. Heavy summer precipitation, melting permafrost, deforestation and disturbances to the land caused by the petroleum industry may cause landslides. Landslides can have major effects on local water quality and quantity.

Human Populations

There were 8,500 people living in the Liard sub-basin in 2001. Most of the population is centred in Fort Nelson, BC (4,188) and Watson Lake, Yukon (912). Fort Simpson, which lies at the confluence of the Liard and Mackenzie rivers, is considered in the Mackenzie-Great Bear section of this report (see **Chapter 7**). First Nations people make up approximately 27% of the population. Not captured in the census is the large number of winter industrial workers that may come from other communities. In recent years, this transient labour force was estimated to number about 2,000 people in Fort Nelson.[141]

Industry

Logging occurs principally within the Fort Nelson Timber Supply Area, an area that encompasses much of the portion of the sub-basin that lies within British Columbia.[142] The amount of wood harvested since 1994 has remained relatively constant at 1.5 million cubic meters per year. Some logging also occurs in southeastern Yukon.[143]

The Liard sub-basin contains extensive oil and

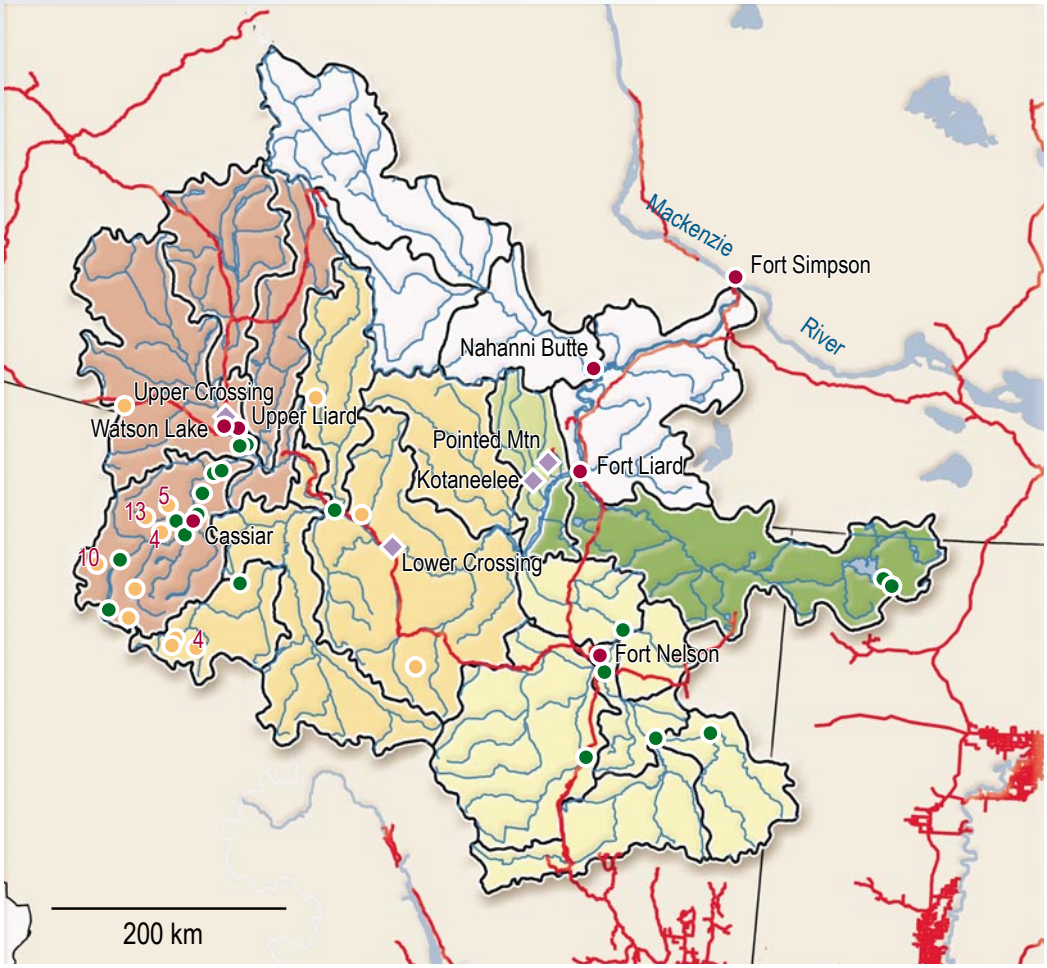

Figure 4–1.
Map of the Liard sub-basin.

gas reserves and there are many producing oil and gas fields (Figure 1–4). The Maxhamish field has become particularly active in recent years, with a peak in 1997 of nearly $40 million in sales.[144] On the NWT side of the border, major oil and gas finds have occurred near Fort Liard and Pointed Mountain. In the Yukon, the only producing gas field is the Kotaneelee in the southeastern corner of the Territory.

Currently, only three mines are operating in the sub-basin; a tungsten mine is located near the border of the Northwest Territories and the Yukon Territory in the South Nahanni Watershed; the other two are jade/nephrite mines located in northeastern BC (Figure 1–5). Historically, however, mining was an important industry in the Liard sub-basin, with approximately forty-five old mines located within the BC portion of the basin alone (Figure 4–1).

Tourism and outdoor recreation are growing contributors to the economy in the Liard River sub-basin.[145] Liard Hotsprings Provincial Park in BC and Nahanni National Park in the NWT are very popular with visitors. The Alaska and Cassiar Highways bring many travellers through the Liard sub-basin en route to the Northwest Territories, Yukon and Alaska.

Improve Water Quality

Water Quality Guidelines

Water quality refers to the amounts of chemical, physical and microbiological substances that are present in water. The Canadian Council of Ministers of the Environment (CCME) has established guideline concentrations for various substances in water that are deemed to be safe for most forms of freshwater aquatic life.[146] When concentrations exceed the guidelines, freshwater life may be placed at risk.

What is happening?

Since water quality monitoring began in the 1980s, water quality on the Liard River has not shown a consistent trend. It appeared to improve at two of the four monitoring sites between the 1980s and later years, while no consistent trend was apparent at the other two sites (Figure 4–2). The percent of tests that exceeded CCME Environmental Quality Guidelines for

The Government of British Columbia used the *Canadian Water Quality Index* to examine trends in water quality in the Liard River. No environmentally significant trends were found. This means that water quality has not deteriorated and human activities in the sub-basin are not affecting water quality. The low water quality ratings at certain locations and at certain times were due to high runoff and the associated high sediment load, not human activities. This was confirmed by the results of a study, conducted by the Department of Indian Affairs and Northern Development, that examined water and sediment quality and fish contaminant levels in the Liard River near Fort Liard between 1991 and 1995.

protecting freshwater aquatic life ranged from 0 to 34%. Test failures were attributed to naturally high levels of copper and, occasionally, zinc.

Why is it happening?

Regional geology influences both the type and quantity of minerals and metals that may be washed into rivers by erosion. Landscape features, including the type and amount of vegetation, the soils and the gradient of the land, also affect what enters the water. Seasonal changes in weather can have substantial effects on water quality by increasing or decreasing runoff over the land and into surface waters.

High copper concentrations usually occur more frequently when the turbidity of the Liard River is also high (Figure 4–3). Turbidity provides a measure of the amount of clay, silt and other particles suspended in water. High levels of several metals occur most often during spring and summer when river discharge and turbidity are also high.[139]

What does it mean?

The high levels of copper and zinc in the Liard River are usually associated with times of high turbidity. However, aquatic plants and animals do not easily absorb metals that are bound to suspended particles in the water. The binding of metals to particles in the water affords aquatic plants and animals a degree of protection from the toxic effects of the metals.

Although up to 34% of the water quality tests on the Liard River did not meet the more restrictive copper or zinc guidelines for aquatic life, they all met the copper and zinc objectives of one and five milligrams per litre, respectively, for the protection of community

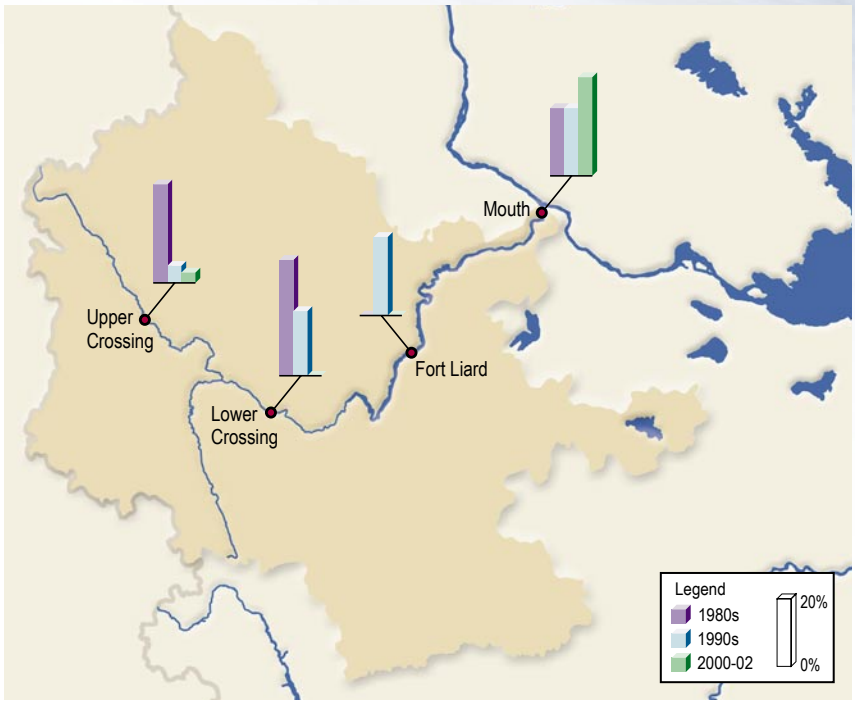

Figure 4–2. Percent frequency with which water at four sampling stations on the Liard River exceeded Canadian Environmental Quality Guidelines for the Protection of Aquatic Life since the 1980s.

Data Source: Environment Canada.

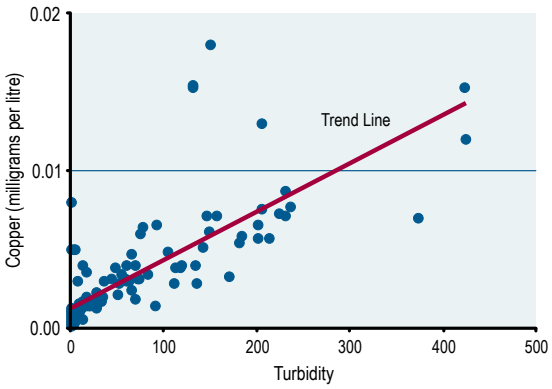

Figure 4–3.
Levels of copper (and other metals) are correlated with turbidity levels in the Liard River.

Data Source: Environment Canada.

(drinking) water. Copper and zinc are more toxic to aquatic life than to humans. Thus the guidelines are more restrictive for aquatic life than for community (drinking) water.

What is being done about it?

Water quality stations on the Liard River continue to be monitored by Environment Canada. Long-term records of water quality help to identify problems when they arise.

Federal, provincial and territorial laws govern the use of water and discharge of wastewater and other wastes. Companies and communities monitor effluent quality and the quality of water in aquatic ecosystems into which effluent is discharged. If a proposed development has the potential to adversely affect local water quality, the proponent must conduct studies to assess water quality before, during and after the development occurs and must adopt measures to minimize its effects on water quality.

Overall Assessment – Favourable

Natural conditions are the probable causes of water quality variations in the Liard River over the years. In general, water quality in the Liard River was as good in 2002 as it was during the 1980s.

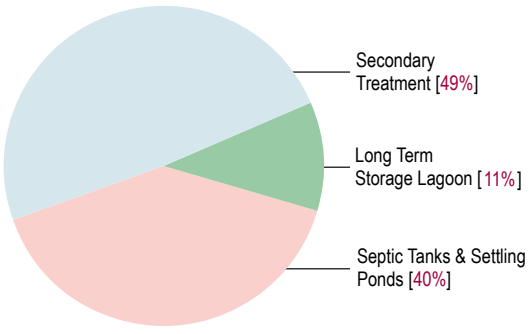

Figure 4–4.
Sewage in the town of Fort Nelson, where 49% of the sub-basin's residents live, receives secondary treatment prior to being discharged. Sewage in Watson Lake, where 11% of the sub-basin's residents live, is stored in a sewage lagoon. The remainder of the people in the sub-basin use on-site systems to store their sewage.

Data Sources: Statistics Canada; Environment Canada Municipal Water Use Database; Dept. of Municipal and Community Affairs (GNWT); Health Canada.

Sewage Effluent

What is happening

Only the community of Fort Nelson releases sewage effluent to surface waters of the Liard sub-basin. Fort Nelson, where about 49% of the people in the sub-basin live, uses secondary (sometimes called biological) treatment to remove impurities before releasing sewage to the Muskwa River (Figure 4–4). The community discharges approximately one million cubic meters of treated sewage each year.

Watson Lake, the second largest community in the Liard sub-basin, pumps its sewage into anaerobic lagoons which feed into a long-term storage lagoon, with no discharge to the surface waters of the Liard sub-basin (Figure 4–4). Other communities in the Liard River sub-basin use in-ground septic systems and settling ponds for their sewage wastewater.

Why is it happening?

The level of treatment that sewage receives prior to being discharged is usually proportional to the size of the population served by the sewage treatment plant. Fort Nelson, the largest community in the Liard sub-basin uses secondary (biological) treatment to clean its sewage. Smaller communities use less advanced treatment systems but, importantly, they do not release their sewage to surface waters of the sub-basin.

What does it mean?

Sewage wastewater consists of more than human waste. It can also contain disease-causing pathogens and chemicals such as motor oil, paint thinner, antifreeze, pesticide residue, pharmaceuticals and solvents. Nutrients in wastewater can increase the growth of algae in rivers and lakes. When the algae

die, they consume oxygen, which, under certain conditions, can have a detrimental effect on the aquatic ecosystem. Toxic pollutants in sewage effluent can accumulate in fish and other aquatic organisms, working their way up the food chain and eventually affecting human consumers.

Fortunately, effective sewage treatment removes most of the impurities so that the remaining wastewater can be safely returned to the river and become part of the natural water cycle again. Wastewater treatment protects human health and reduces stress on the receiving environment. Secondary treatment is a biological process that uses naturally occurring micro-organisms to break down organic matter and purify the liquid. Secondary treatment is an adequate level of sewage treatment for a community the size of Fort Nelson.

In-ground septic systems and settling ponds are often used to treat and hold sewage in very small communities or on reserves and in rural settings where homes are not linked into a community sewage system. Such systems must be carefully managed and monitored to ensure that they do not harm local groundwater, which is the main source of drinking water in rural areas in much of the Liard sub-basin.

What is being done about it?

The discharge of treated sewage is regulated under provincial and territorial laws. Sewage treatment plants must be licensed and their licenses stipulate the conditions under which they are permitted to discharge treated wastewater. The conditions relate to how much wastewater can be discharged, when it can be discharged, how 'clean' it must be before it can be discharged and how often it must be tested to ensure compliance.

Overall Assessment – Favourable

The amount of treated sewage discharged in the Liard sub-basin is small. Sewage treatment is adequate for the major communities in the sub-basin. In rural areas and on reserves, the extensive use of septic systems, subsurface fields and settling ponds means that local groundwater quality must be monitored to ensure that well water does not become contaminated by seepage from such structures.

Ensure Sufficient Water Quantity

Information about stream flow at four of the five-stream flow stations on the Liard River is summarized below. From upstream to downstream, they are Upper Crossing (of the Alaska Highway), Lower Crossing, the Beaver River confluence with the Liard, and at Fort Liard.

Flow in the Liard River

What is happening?

Annual flow at Upper Crossing on the Liard River declined 12.5% between 1960 and 1995 (Figure 4–5). A similar trend was also apparent further downstream

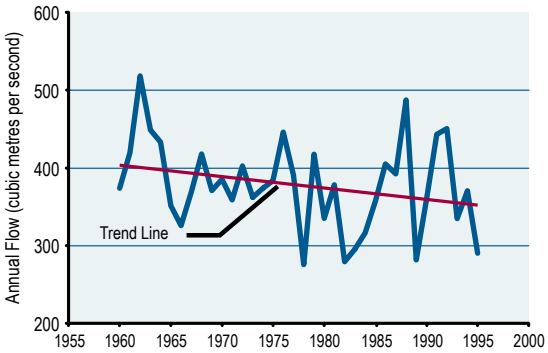

Figure 4–5.
Average annual stream flow at Upper Crossing decreased by 12.5% from 1960 to 1995. Similar trends were seen at two other monitoring stations on the Liard River.

Data Sources: Environment Canada, Water Survey of Canada; BC Ministry of Sustainable Resource Management.

at Lower Crossing and Fort Liard. There, declines averaged 10.9% and 11.2%, respectively. At the Beaver River confluence, stream flow did not decline over time.

Why is it happening?

River flow is influenced by landscape features and by factors dependent on climate, such as the amount and timing of precipitation, snowmelt, and surface runoff. Experts agree that climate change will strongly impact river flow, particularly in regions where snow accumulation plays an important role in the hydrologic regime.[147] During the period 1960–1995, average annual stream flow in the Liard River at Upper Crossing was dependent on precipitation, as measured at Fort Nelson (Figure 4–6). The downward trend in annual stream flow at three of the four-stream flow stations along the Liard River may reflect a decrease in precipitation in the Liard sub-basin. The downward trend in annual stream flow on the Liard River is similar to the finding that flow in the Smoky River declined between the 1970s and 1990s (see **Chapter 3 – Flow in the Smoky River**).

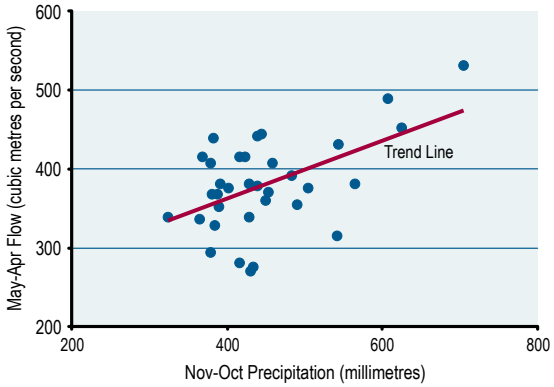

Figure 4–6.
Average annual stream flow at Upper Crossing is closely related to annual precipitation. The 'lag' effect of winter snowpack accumulation prior to its release in runoff the following spring was considered in examining this relationship.

Data Source: Environment Canada.

What does it mean?

Changes in stream flow may affect habitat and populations of fish and other wildlife species that live in and around the river. Erosion, sediment deposition and sediment carrying capacity are all related to stream flow. Changes in river flow could affect the availability and quality of water for domestic and other purposes, and could affect boating on the river.

It is not known whether the recent, small decreases in stream flow on the Liard River are consistent with normal long-term fluctuations or whether they are early signals of the effects of climate change. Furthermore, the ecological consequences of such decreases have not been determined.

What is being done about it?

Environment Canada will continue to monitor stream flow and climate, and to integrate this information into predictive models of climate change (see **Chapter 1 – The Mackenzie GEWEX Study (MAGS)**).

Overall Assessment – Mixed Signals

Flow in the Liard River has declined slightly over the past few decades, possibly as a result of changes in climate. This decline is consistent with a decline that was reported in the Smoky River (see **Chapter 3 – Flow in the Smoky River**). Whether the declines are due to climate change caused by human beings or whether they are part of a normal pattern of long-term fluctuations remains unknown. In addition, the ecological impacts of decreasing flows need to be better understood.

Seasonal Patterns of Flow in the Liard River

What is happening?

Monthly stream flow patterns at Upper Crossing on the Liard River have changed slightly over the past four decades (Figure 4–7). In recent years, the proportion of the total annual flow occurring between fall and spring has increased, whereas the proportion of flow occurring during the spring freshet and summer has diminished. This trend has also been observed further downstream at Lower Crossing, Beaver River and Fort Liard.

Why is it happening?

Higher stream flow from fall until early spring and lower spring freshets, as have occurred in recent years, may be caused by warmer, wetter winter weather. During warm winters, snow and ice may melt periodically. When combined with wetter conditions, this increases winter stream flow. At the same time, the accumulation of snow and ice is reduced, leaving less to melt during the normal spring melt period. As a result, stream flow is lower than usual during the spring freshet and the summer. Low summer flows may also be indicative of a warmer, drier summer climate.

What does it mean?

Climate and flow interact to affect freeze-up and break-up, with potential consequences for ice jamming and flooding along the Liard River. Changes in the timing of discharge can also affect the organisms that live in and around the river. The key activities of these organisms, such as migration and spawning, are often timed to coincide with or avoid peak flows or melt periods. Prolonged melting periods and lower spring freshets could force some species to change their migratory habits and to spawn and initiate other key activities at different times of the year than they are accustomed to.

What is being done about it?

There is ongoing work to monitor stream flow and climate, and to integrate this information into predictive models of climate change. The issue of climate change is a global concern and several initiatives are underway to better understand its potential effects, to identify ways to adapt to a changing climate, and to reduce greenhouse gas emissions. Please refer to **Chapter 1 – Actions on Climate Change** for additional information on what is being done about climate change.

Overall Assessment – Mixed Signals

The timing of discharge in the Liard River has changed slightly in recent decades. The lower flows in

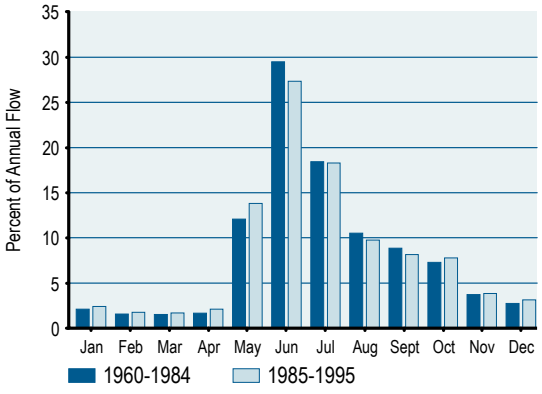

Figure 4–7.
At Upper Crossing on the Liard River between 1985 and 1995, there was a greater percentage of flow in the early spring, a lower percentage in the summer, and a greater percentage through the late fall and early winter compared to the period between 1960 and 1984.

Data Sources: Environment Canada; BC Ministry of Sustainable Resource Management.

summer and the higher flows from fall to early spring are consistent with predictions from climate change models, suggesting that a changing climate may be partially responsible for the observed changes. Alternatively, it is possible that these small changes are part of a normal pattern of long-term fluctuations.

Sustain In-Stream Water Uses

Water Allocations

What is happening?

Information on surface water allocations was obtained for the Yukon and BC portions of the sub-basin, but not for the Northwest Territories. Few communities or industries withdraw water from the Liard River itself. Fort Nelson, the largest community in the Liard sub-basin, takes its water from the Muskwa River. Watson Lake, the second largest community, uses groundwater. The total volume of surface water licensed for withdrawal from the Yukon and BC portions of the Liard sub-basin is slightly less than 60,000 cubic meters per day. This amount is an extremely small proportion of the total amount of water available in the Liard sub-basin. Removal of this amount of water will not harm the aquatic ecosystem.

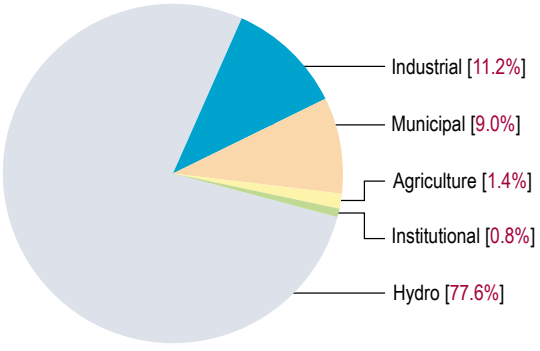

Figure 4–8.
Surface water in the Liard sub-basin is used by one microhydro facility, by other industries and by communities.

Data Sources: Land and Water, British Columbia, Inc.; BC Ministry of Sustainable Resource Management; Dept. of Indian Affairs and Northern Development.

Why is it happening?

Rancheria Power in the Yukon accounts for three quarters of the surface water licensed for withdrawal from the BC and Yukon portions of the Liard sub-basin (Figure 4–8). This microhydro facility, located on Canyon Creek in the upper part of the basin, diverts water to its generator and then promptly returns the water to its natural course. The remainder of the surface water taken from the Liard sub-basin is used by the mining and oil and gas industries, in work camps, and for community use.

What does it mean?

Most water withdrawals are not from the main stem of the Liard River itself, but from smaller tributaries and streams. The localized impact of water allocations cannot be properly assessed without stream flow information on each specific tributary or stream. However, the low volumes of water allocated for out-of-stream uses should not negatively impact the aquatic ecosystem.

What is being done about it?

Federal, provincial and territorial laws govern the use of surface water in the Liard sub-basin. These laws and their regulations stipulate the conditions under

which water users must obtain licences. Licensees must operate within the conditions of their licences. These conditions relate to such things as the amount of water that can be taken and the quality of the water if it is returned to the river.

Overall Assessment – Favourable

Surface water in the Liard sub-basin is withdrawn for industrial and community needs, with the primary user being a microhydro facility in the Yukon. The total volume of water licensed for withdrawal is negligible in comparison to the flow of water in the Liard River.

Commercial, Subsistence and Sport Fishing

What is happening?

Commercial Fisheries

Currently, the only commercial fishery in the Liard sub-basin is in Bistcho Lake in northwestern Alberta. Between thirty-one and seventy-eight tonnes of walleye, pike and whitefish have been harvested each year since 1990 (Figure 4–9). The total commercial harvest of fish from Bistcho Lake declined during the mid-1990s, but increased from 1997 to 2000. This recent increase in the total harvest was due primarily to an increase in the catch of whitefish.

Subsistence Fisheries

In general, First Nations subsistence fisheries in the Liard sub-basin are unmonitored. In the Alberta portion of the sub-basin, however, subsistence fishing licences must be obtained and subsistence fishers must adhere to the conditions of their licences. A series of interviews with First Nations individuals indicated that white sucker, northern pike, burbot, walleye, whitefish, inconnu and Arctic grayling are part of the subsistence fishery in the Liard sub-basin.[148]

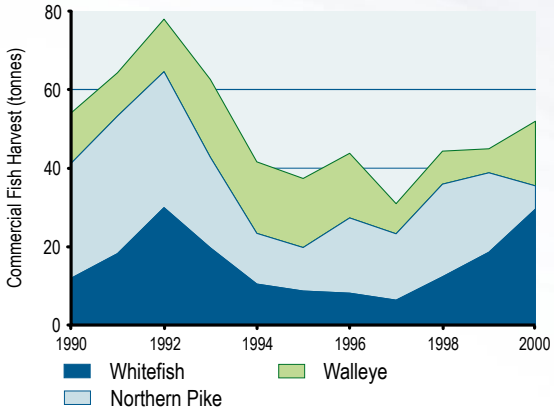

Figure 4–9.
Commercial fish harvest in Bistcho Lake, Alberta.

Data Source: Alberta Sustainable Resource Development.

Yukon Sport Fishing

Sport fishing for lake trout and other species occurs on many lakes, but primarily on Frances, Simpson and Watson lakes in the Yukon Territory. The change over a period of years in the effort that is required for an angler to catch fish is an indication of the change

The Yukon Government has stocked rainbow trout or arctic char in five lakes in the Yukon portion of the Liard sub-basin.

in population status of that species. From 2000 to 2002, anglers required more time to catch lake trout in Watson Lake than in earlier years, whereas they took less time to catch lake trout in Frances Lake. There was little change in the time required to catch lake trout in Simpson Lake (Figure 4–10).

Why is it happening?

Bistcho Lake is managed for commercial, subsistence, and sport fishing. When sport fishing increased on this lake, changes were made to the commercial fishery to ensure the sustainable harvest of fish. Those changes included the elimination of the freight subsidy that had been provided to offset costs of shipping fish to markets and reductions in quotas for walleye and pike.[149] The commercial fishery is managed to reduce the commercial harvest of walleye and northern pike, in order to allow for further expansion of the quality sport fishery for these species.

In the Yukon, historical over-fishing reduced the quality of the lake trout sport fishery on Watson and Frances lakes. The end of commercial fishing in 1991, together with a reduction in catch and possession limits for sport fishers, the institution of mandatory use of barbless hooks and catch-and-release for large fish have improved the quality of fishing in Frances Lake. Similar changes were put in place in Watson Lake; however the quality of the lake trout fishery there remains poor. Easily accessible and located near an urban centre, Watson Lake receives relatively high angling pressure. Despite such pressure, it continues to have an excellent northern pike fishery.

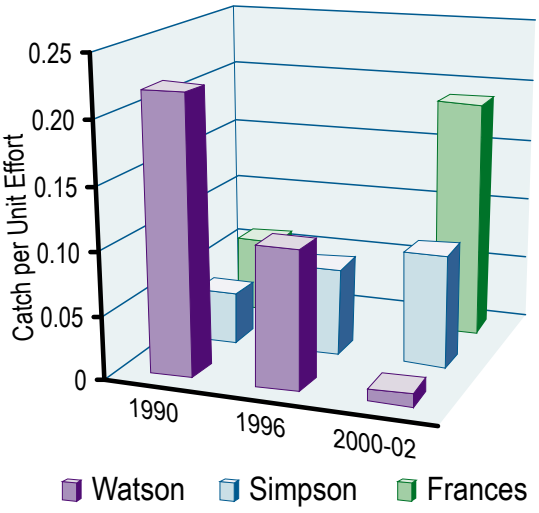

Figure 4–10.
The change in time required for an angler to catch a fish provides an indication of the status of fish populations in lakes. The number of lake trout caught per hour decreased in Watson Lake and increased in Frances Lake between 1990 and 2000–02. There was no change in Simpson Lake.
Data Source: Yukon Department of the Environment.

What does it mean?

The limited information on fishing in the Liard sub-basin makes it difficult to determine the state of the fish resource. However, the commercial fishery in Bistcho Lake has economic value. Sport fishing on Bistcho Lake and on lakes in the Yukon portion of the sub-basin likely also contributes to the local economy by attracting anglers to the region. Three fly-in fishing lodges and one boat-accessible lodge are located in the Yukon portion of the Liard sub-basin. In addition, there are several small lakes that support arctic char fish farming operations. Finally, subsistence fishing is an important aspect of First Nations culture and fish is an excellent and low-cost source of nutrition.

What is being done about it?

The Alberta government manages commercial, subsistence, and sport fishing in Bistcho Lake to ensure that the fish harvest is sustainable. The Province of BC intends to conduct regular angler surveys in order to gain a better understanding of target water bodies, species, and harvest.[150] In the Yukon portion of the sub-basin, the Yukon

Department of Environment manages freshwater fish in order to ensure the sustainable use of fish for present and future generations. The department has instituted "High Quality Management" programs in an attempt to maintain and improve sport fishing on key lakes in the Yukon portion of the Liard sub-basin.

Overall Assessment – Mixed Signals

Fish stocks in the Liard sub-basin are used to some extent by commercial, subsistence and sport fishers. Lake trout stocks have improved in Frances Lake but have deteriorated in Watson Lake. Watson, Frances and Simpson lakes have excellent northern pike fisheries and healthy fish communities. There are no other major concerns at this time, but the scarcity of information makes it difficult to determine the state of fish stocks or to identify changes in the use of this resource.

Ensure Healthy, Abundant and Diverse Aquatic Species and Habitat

Traditional Knowledge of Aquatic Species and Habitat

Some First Nations people in the lower portion of the Liard sub-basin reported a decrease in the abundance of waterfowl, including teals, Canada geese, mallard ducks, northern shovelers and swans, in the past two to three decades.[148] A decline in muskrat populations was also reported. A series of interviews with First Nations individuals indicated that the quality of fish has deteriorated. Specifically, flavour was poorer, flesh was more watery and parasites were more abundant.[148]

Overall Assessment – Unfavourable

Observations made by some Aboriginal inhabitants of the lower portion of the Liard sub-basin provide insight into the population trends, distribution and health of certain wildlife species. Of particular concern are the deterioration in fish quality and the declines in populations of muskrat and certain species of waterfowl that were reported by some of the people.

Aquatic and Riparian-Dependent Wildlife Species at Risk

What is happening?

Several aquatic and riparian-dependent wildlife species are deemed to be at risk, including one amphibian, nine fish, eight bird, and one mammal species (Figure 4–11). All of this information comes from the British Columbia and Yukon portions of the watershed. Information on species at risk in the NWT, including that portion of the Liard sub-basin, is

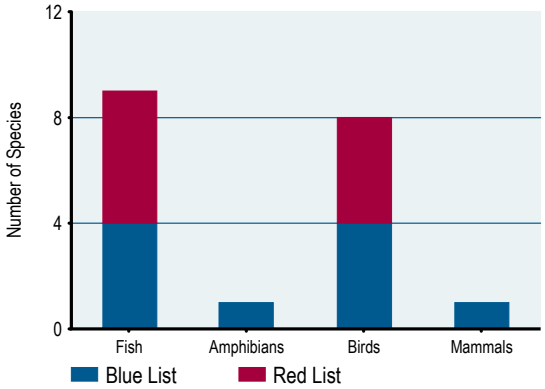

Figure 4–11.
Number of aquatic and riparian-dependent species at risk in the Yukon and BC portions of the Liard sub-basin.

Data Source: Yukon Department of Environment; Conservation Data Centre of the BC Ministry of Sustainable Resource Management.

discussed in **Chapter 6 – Aquatic and Riparian-Dependent Species at Risk**.

In BC, species are placed on the red list if they are considered to be endangered, threatened or extirpated. They are placed on a blue list if they are considered to be of special concern due to human and environmental pressures; or they are placed on a yellow list if they are considered to be secure.[130] In the Yukon, species designations are similar to those used in BC.[151]

Why is it happening?

Excessive harvest and habitat loss are key reasons why many wildlife species are designated as at risk.[152] In the Liard sub-basin, seismic lines and various logging activities are major causes of habitat loss and fragmentation.[150, 153, 154] In addition, seismic lines and logging roads provide new access for hunters and anglers to previously inaccessible or difficult-to-access areas.

By the mid-1980s, the BC portion of the Liard sub-basin contained 17,120 kilometres of roads, at a density of 0.12 kilometres of road per square kilometre of land. By the late 1990s, road density had increased by an average of 43% in the eastern BC region of the Liard sub-basin in the vicinity of Fort Nelson and in the corridor south towards Fort St. John (Figure 4–12). Seismic lines made during oil and gas exploration cover considerably more land than do roads. A 1980s survey of the BC portion of the Liard sub-basin found that there were 87,698 kilometres of seismic lines, at a density of 0.63 kilometres per square kilometre of land.

Roads and seismic lines provide people with access to valuable wildlife habitat. Increased access puts some species at a greater risk of being killed through collisions and by increased fishing, hunting and poaching. They also fragment habitat, forcing species that avoid roads into isolation or preventing them from undertaking seasonal migrations.[155] Local hydrology is also affected by roads, which disrupt the timing, volume and direction of water flow.

In the Liard sub-basin, some species, such as bull trout, are threatened by human activities such as over-fishing and other activities that damage habitat. Other species, such as cisco, spottail shiner and emerald shiner appear to be naturally rare, but are not under imminent threat from human activities.

What does it mean?

A loss of species results in ecosystems that are less stable and less capable of functioning and adapting to environmental changes. Although it is natural for some species to become extinct, the current global extinction rate is higher than what is expected naturally, and concern about biodiversity has increased in recent decades. The Liard sub-basin remains relatively undeveloped and has a low human population. Thus, its aquatic and riparian-dependent species remain relatively unaffected by human activity.[150, 154] Nevertheless, the Liard sub-basin has more species at risk than other sub-basins in the Mackenzie River Basin.

What is being done about it?

A committee to assess the status of species at risk in the NWT is being planned under proposed NWT

legislation that will protect species at risk. [156] The *Wildlife Act* and the *Forest and Range Practices Act* of British Columbia may confer special protection to species at risk. The *Yukon Wildlife Act* provides special protection for certain species, such as the trumpeter swan. Nationally, the *Species at Risk Act* (SARA) has recently been passed into law giving legal protection to Canadian species and habitats at risk. SARA is one component of a three-part strategy for protecting species at risk that also includes the Habitat Stewardship Program and the *Accord for the Protection of Species at Risk*, a Canada-wide agreement on federal-provincial-territorial cooperation. The Committee on the Status of Endangered Wildlife in Canada assesses the status of species in the country and determines whether or not they should be designated at risk of disappearing. New legislation at the provincial, territorial and national levels will help to protect wildlife in the Liard sub-basin.

Overall Assessment – Mixed Signals

There are nineteen aquatic and riparian-dependent wildlife species, including nine species of fish, considered to be at risk in the BC and Yukon portions of the Liard sub-basin. While some species at risk are naturally rare and not under imminent threat from human activities, others are threatened by various human activities particularly the fragmentation and loss of habitat due in part to the continued development of roads and seismic lines in the area. In a global context, the Liard sub-basin has experienced a relatively low level of impact to its species and ecosystems.

Ensure Human Health and Safety

Flood Hazard Management

What is happening?

The lower reaches of the Liard River are prone to flooding. About one-quarter of the population within the Liard sub-basin live on or near the shores of the

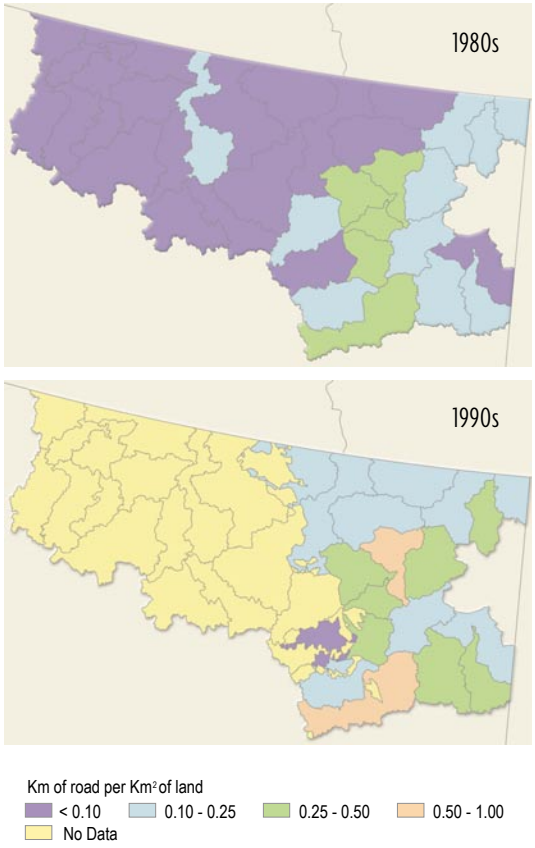

Figure 4–12. Between the late 1980s and late 1990s, road density increased in the eastern BC region of the Liard sub-basin.

Data Source: BC Ministry of Sustainable Resource Management.

Liard River. Records dating back to 1828 indicate that floods have affected the communities of Fort Liard and Nahanni Butte (Figure 4–13). They have also affected Fort Simpson, but this community is covered in Chapter 7.

Why is it happening?

Several of the floods at Fort Liard and all those recorded for Nahanni Butte have been due to summer storms with heavy rainfall.

Some floods on the Liard River are caused by ice jams occurring during the spring thaw. Ice jams may cause melt waters on the lower Liard River to back up and overflow the banks. Fort Simpson, at the confluence of the Liard and Mackenzie rivers, has been affected by ice jams on the Mackenzie River.

What does it mean?

Floods play an important role in river ecosystems because they shape river channels, transport sediments and nutrients downstream and affect plant succession on riverbanks. A supply of sediments to the Mackenzie River is necessary for maintaining the stability of downstream channels and the Mackenzie Delta.[157]

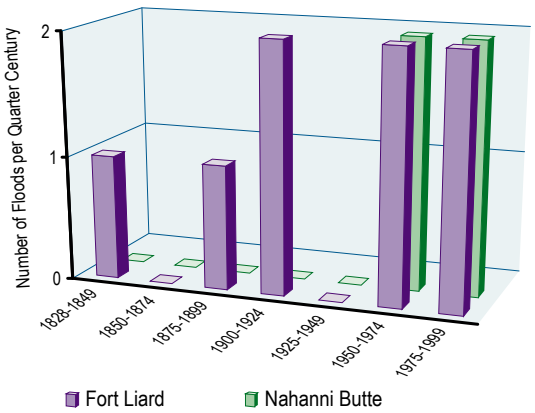

Figure 4–13.
History of floods along the Liard River.

Data Sources: Environment Canada; Kriwoken, 1983.

Floods can force people to evacuate their communities and cause significant damage to infrastructure, as evidenced by the $6 million worth of damage from the 1988 flooding of the Liard and Mackenzie rivers that washed out stream crossings and docks, and damaged pipelines.[157] They can also affect ferry services and other forms of river transportation.

What is being done about it?

Government agencies have identified flood-prone communities in the sub-basin. They have also developed flood risk maps for each community. The maps identify vulnerable locations in each community. Building in locations that are vulnerable to flooding was discouraged under the past Flood Damage Reduction Program and continues to be discouraged by zoning by-laws and planning guidelines and through conditions imposed by financial assistance programs that are available to developers.

Monitoring of water levels and stream flow continues, and will enhance flood-forecasting capability in the Liard sub-basin.

Overall Assessment – Favourable

Periodic flooding of the Liard River is a natural occurrence that is important for the health of the aquatic ecosystem. However, floods can damage communities along the lower reaches of the Liard River and threaten human safety. Flood forecasting provides warning to the affected communities. There is no indication that the frequency or severity of floods has increased in the Liard sub-basin.

South Nahanni Watershed

Nahanni National Park Reserve

In 1978, Nahanni National Park Reserve in the Northwest Territories was designated as one of the first UNESCO World Heritage Sites. The South Nahanni River, which flows through the park, is a Canadian Heritage River. Nahanni National Park Reserve is famous for its dramatic river canyons, hot springs, and waterfalls – the largest being Virginia Falls with a drop of ninety-six meters. The river is a world-class destination for canoeists and white water rafters.

Nahanni National Park is a long narrow park of 4,766 square kilometres along the South Nahanni River. The park protects about 13% of the 37,000 square kilometre Nahanni River watershed from development. It is located downstream from an existing mine site and other sites that could one day be developed as mines.

Most of the 450 to 900 people who visit Nahanni National Park each year go on wilderness river trips. Three hundred additional people visit on day trips in small airplanes. The human traffic in the park is degrading some of the more popular camping spots.[158]

Parks Canada lists six major threats to the park: mineral extraction; climate change and pollution; wildlife harvesting; visitation; forestry, fire and vegetation management; and park management and research, such as the maintenance of buildings and fuel caches and the use of jet boats.[158] Mineral extraction in the upper South Nahanni River watershed is the most prominent threat to the aquatic environment in the park.

Climate, Flora and Fauna

Arctic air influences the long, cold winters in the South Nahanni River watershed. Westerly air currents from the Pacific Ocean bring warmer and wetter weather during summer and fall. Ice break-up typically occurs in April. Maximum river flows typically occur

South Nahanni Watershed - continued

in mid-June. Rainstorms influence river flow from early summer until freeze-up in November.

The Nahanni area has a rich biological community that depends on the area's unique and highly diverse habitats.[158] Alpine taiga and tundra, as well as taiga plains dominate the landscape. Some of the mountainous areas consist of bare rock or permanent snow and ice. Spruce and pine dominate sub-alpine and mountain areas. Bog and mixed forest stands of white spruce and trembling aspen dominate the lower valley regions.

All the species of mammals that were present in the region at the time of European contact can still be found there.[158] Larger species include black and grizzly bears, Dall's sheep, mountain goats, and wolves. Even wood bison, reintroduced in the 1980s, are seen in the park reserve along the lower portion of the river. Over 180 species of birds have been recorded in the park.

Land Use History

First Nations people have used the South Nahanni for hunting, trapping and fishing for thousands of years. Their first contact with Europeans occurred in 1778 during Alexander Mackenzie's exploration of the Mackenzie River. Fur trading posts at Fort Simpson and Fort Liard encouraged settlement of First Nations families. Places within the park are of great spiritual value to the Dene people, in particular the First Nations population at Nahanni Butte. The Dene continue to hunt and fish in and around the park according to their customs and principles. Parks Canada wants to establish the park as a model of co-operation between themselves and the First Nations of the Deh Cho.[158]

Mineral Extraction

The South Nahanni River watershed also contains significant mineral deposits. The rich geology of the area has led to numerous mining claims.[159] Only two claims have infrastructure in place for mineral extraction. North American Tungsten (CanTung) owns a tungsten mine at the headwaters of Flat River, and Canadian Zinc Corporation (CZN) owns numerous mineral leases and infrastructure for a mine along Prairie Creek, about twenty-five kilometres upstream from the confluence with South Nahanni River.

CanTung operated from 1974 until 1986. The mine reopened in 2001 and is estimated to have

South Nahanni Watershed - continued

Virginia Falls on the South Nahanni River in Nahanni National Park. *Courtesy of: L. Smith*

a two-year supply of ore. The CZN mine on Prairie Creek is a silver, lead and zinc mine that never opened due to a drop in metal prices. If prices increase, this mine may open and other mine claims may be developed.

Water Quality

Studies conducted during the 1990s showed that the mines did not affect water and sediment quality.[159, 160] Water quality varied with the seasons, with concentrations of dissolved metals peaking during low flow periods under ice and those of sediment-bound metals peaking during the spring freshet. Some fish contained moderately elevated concentrations of metals, but it was concluded that the source was natural and not related to mining.[160]