

Kootenay Region

The Kootenay Region is located in the southeastern part of the Province, bordering the province of Alberta and the states of Washington, Idaho and Montana. It is located entirely within the Columbia River basin, draining portions of the Rocky, Purcell, Selkirk and Monashee mountains. The main BC Environment regional offices are located in Nelson and Cranbrook.

There have been 16 long-term water quality monitoring stations in this Region. Ten of these stations had no environmentally significant changes in water quality. Three stations had deteriorating trends in water quality, while three stations had improving trends. The water quality trends in these waterbodies are summarized in the table below.

If you have any questions on the trend reports or want more information on other waterbodies in the Region, please contact:

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Deteriorating Trends in Water Quality

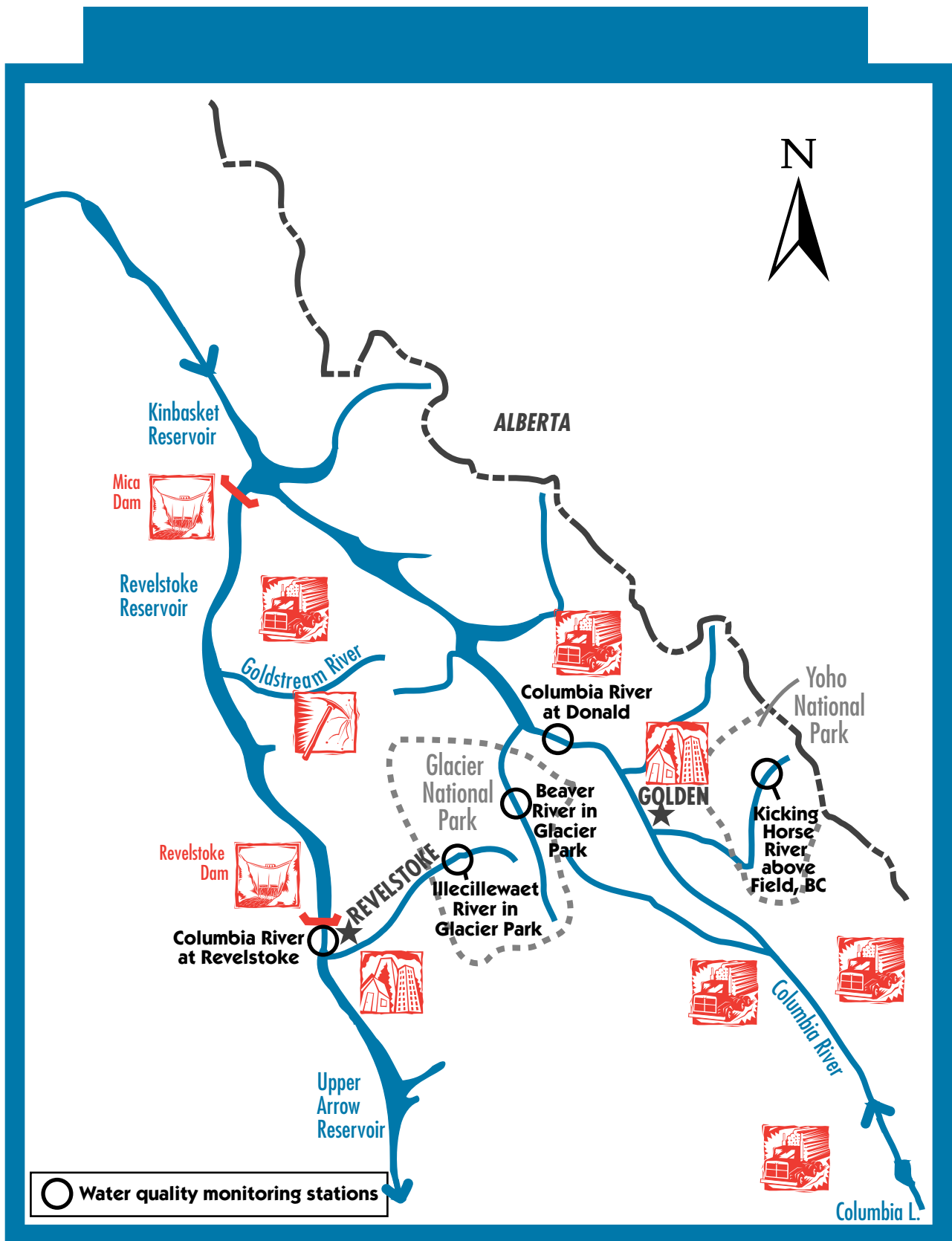
Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Elk River (1984–97)	Selenium Nitrogen	Coal mining Coal mining	Aquatic life Recreation	Studies are underway and monitoring is continuing.
Kootenay River at Creston (1979–97)	Phosphorus	Dam/reservoir	Aquatic life (declining Kootenay Lake fish production)	Fertilization of Kootenay Lake since 1992. Monitoring is continuing.
Columbia River at Revelstoke (1984–97)	Phosphorus	Dams/reservoirs	Aquatic life (limits fish production)	Studies have been done and fertilization of Upper Arrow Reservoir began in 1999.

Improving Trends in Water Quality

Location (Years)	Water Quality Indicators	Cause of Trend	Water Uses at Risk	Action
Kootenay River at Fenwick Station (1991–96)	Zinc	Waste abatement	Aquatic life	Continued waste abatement and monitoring.
Columbia River at Birchbank (1983–97)	Iron, Aluminum	Dams/reservoirs	Drinking water, aquatic life	Abatement for total dissolved gases is being planned. Monitoring is continuing.
Columbia River at Waneta (1983–96)	Cadmium, Chromium Iron, Lead, Zinc, Fluoride, Sulphate, Phosphorus	Waste abatement	Aquatic life, drinking water, irrigation, recreation	Continued abatement for cadmium, chromium, copper, zinc, and total dissolved gases. Monitoring is continuing.

No Changes in Water Quality – Other Water Quality Concerns

Location (Years)	Water Quality Indicators	Concern	Water Uses at Risk	Action
Kickinghorse River above Field (1987–95)		None		Monitoring is continuing.
Beaver River in Glacier National Park (1987–95)		None		Monitoring is continuing.
Columbia River at Donald (1984–95)		None		None needed.
Illecillewaet River in Glacier National Park (1987–95)		None		Monitoring is continuing.
Kootenay River at Kootenay Crossing (1987–95)		None		Monitoring is continuing.
Kootenay River at Canal Flats (1985–95)		None		Monitoring is continuing.
Moyie River at Kingsgate (1979–95)		None		None needed.
Flathead River at US Border (1979–95)		None		None needed.
Pend D'Oreille River at Waneta (1980–95)	Total dissolved gases	Dams have caused levels that are harmful to fish.	Aquatic life	Means of reducing total dissolved gases are being investigated. Monitoring is continuing.
Big Sheep Creek near US Border (1979–95)		None		None needed.



Upper Columbia River Area

Kickinghorse River Above Field, BC

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Kickinghorse River?

The Kickinghorse River above Field drains 344 km² of the Rocky Mountains in the headwaters of the Columbia River basin. This is a relatively pristine watershed completely within Yoho National Park and has high recreational values. The Kickinghorse River has been designated as a Heritage River by the Canadian Heritage Rivers Board due to its outstanding natural and historical features.

What are the main human influences on water quality?

The Trans-Canada highway, the Canadian National Railway mainline, recreational activities in the national park, and atmospheric deposition of contaminants carried by rain and snow are the main potential human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1987. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1987 to 1995.

Are there any other water quality concerns?

No. The water quality of the Kickinghorse River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

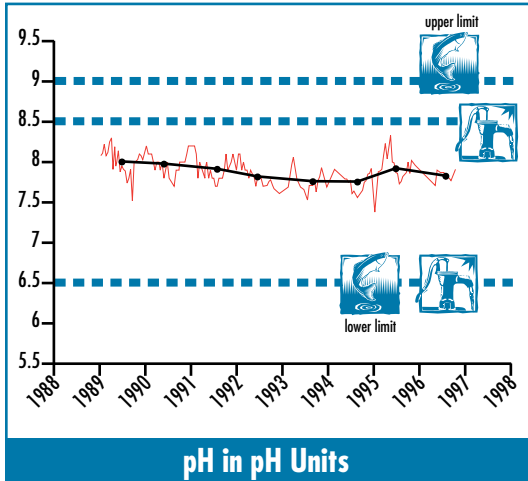
There are no apparent water quality concerns or changes at this time. Monitoring is continuing to help ensure that the integrity of the river is preserved, and to detect any changes in water quality in Yoho National Park.

Beaver River in Glacier National Park

What are the water quality trends?

There were no environmentally significant changes, although a slight declining trend in pH was observed.

No changes



What are the main attributes of the Beaver River?

The Beaver River in Glacier National Park drains 472 km² of the Purcell Mountains in the headwaters of the Columbia River basin. This is a relatively pristine watershed with high recreational values that lies completely within Glacier National Park.

What are the main human influences on water quality?

The Trans-Canada highway, the Canadian National Railway mainline, recreational activities in the national park, and atmospheric deposition of contaminants carried by rain and snow are the main potential human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1987. Flow has been monitored continuously downstream near the mouth of the river where the drainage area is 1150 km².

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1987 to 1995. A slight declining trend in pH was observed as shown in the graph. The cause of this apparent decline is not known and it may be nothing more than natural variation.

What is the environmental significance of the trend?

The slight declining trend in pH would have to persist at its present rate for about 50 years before pH reached the lower guidelines for drinking water and aquatic life and it became environmentally significant.

Are there any other water quality concerns?

No. The water quality of the Beaver River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

Monitoring is continuing to see if the declining pH trend persists and to detect any other changes in water quality in Glacier National Park.

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Columbia River at Donald?

The Columbia River at Donald flows in the Rocky Mountain Trench, draining 9,710 km² of the headwaters of the Columbia River, with the Rocky Mountains to the east and the Purcell Mountains to the west. Columbia and Windermere lakes lie at the upper end of the watershed, followed by the Columbia River Flats, whose marshes are important waterfowl habitat. Cirque glaciers in the high Purcells and Rockies drain to the Columbia River and the glacial silt imparts a gray, muddy colour to the river at times. The river is used for drinking water, irrigation and industry and supports a population of cutthroat, rainbow, bull, and eastern brook trout and whitefish. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?

Timber harvesting, the Town of Golden, Radium Hot Springs, highways, and railways are the main potential human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks from 1984 to 1995. The station is located just upstream from Kinbasket Lake, the reservoir created by the Mica Dam. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1984 to 1995.

Are there any other water quality concerns?

No. The water quality of the Upper Columbia River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

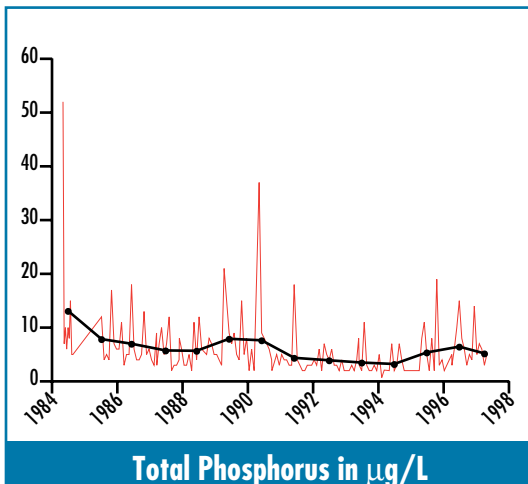
No. There were no apparent water quality changes or concerns during 1984-95, and monitoring was suspended in 1995.

Columbia River at Revelstoke

What are the water quality trends?

There was a deteriorating trend in phosphorus due to upstream dams and reservoirs. This is viewed as a deteriorating trend because the Arrow Lakes have a shortage of phosphorus, which has contributed to declining fish production. Fertilization of Upper Arrow Lake with phosphorus began in 1999 to boost fish production.

Deteriorating trend



What are the main attributes of the Columbia River at Revelstoke?

The Columbia River at Revelstoke drains the upper 26,700 km² of the Columbia River basin. The upper Columbia River is dominated by hydroelectric development. The Mica Dam and its massive reservoir, Kinbasket Lake, are located 130 km upstream and the Revelstoke Dam and Lake Revelstoke lie just 6 km upstream from Revelstoke. Just downstream lie the Arrow Lakes, which serve as a reservoir for the Hugh Keenleyside Dam at Castlegar. The Columbia River near Revelstoke is also used for irrigation, livestock watering, drinking water and recreation, and supports significant fish and wildlife populations. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?

The hydroelectric dams and reservoirs at Mica (1976) and Revelstoke (1983), timber harvesting, and a closed copper/zinc mine on the Goldstream River, which flows into the Revelstoke reservoir, are the main potential influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every four weeks from 1985 to 1997.

What are the water quality trends and what caused them?

The upstream dams and reservoirs have altered the flow and water quality patterns in the river, and a declining trend in total phosphorus was detected. The decline was probably due to the trapping effect of upstream dams and reservoirs.

What is the environmental significance of the trend?

Declining phosphorus in the Columbia River reduced lake productivity and fish production in the Arrow Lakes.

Are there any other water quality concerns?

Yes. Upstream dams may have caused high levels of total dissolved gases in the Columbia River at Revelstoke at times, but few measurements have been made. The water quality of the Upper Columbia River was not evaluated in the 1996 B.C. Water Quality Status Report.

What is being done? The Columbia Basin Fish & Wildlife Compensation Program, a BC Environment and BC Hydro joint venture, in partnership with the Ministry of Transportation & Highways, Revelstoke Marine Branch, the Columbia Power Corporation, and the Columbia Basin Trust, began fertilizing Upper Arrow Lake in April 1999 to improve fish production. This is an ongoing project and they are monitoring to evaluate the effect of fertilization on fish production. Similar fertilization in Kootenay Lake has been highly successful. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia River basin in Canada and the U.S. Water use planning is being conducted with B.C. Hydro for all dams in the Columbia basin to address total dissolved gas concerns.

Illecillewaet River in Glacier National Park

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Illecillewaet River?

The watershed above the Illecillewaet River water quality station has a drainage area of 203 km² in the Purcell Mountains and lies completely within Glacier National Park. This is a relatively pristine watershed with high recreational values. The Illecillewaet River flows into the Upper Arrow Reservoir on the Columbia River near Revelstoke after draining about 1,200 km² of the Purcell Mountains.

What are the main human influences on water quality?

The TransCanada highway, the Canadian National Railway mainline, recreational activities in the national park, and contaminants deposited with rain and snow are the main potential human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1987. Flow has been monitored continuously about 30 km downstream from the water quality station, where the drainage area is 1,170 km².

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1987 to 1995.

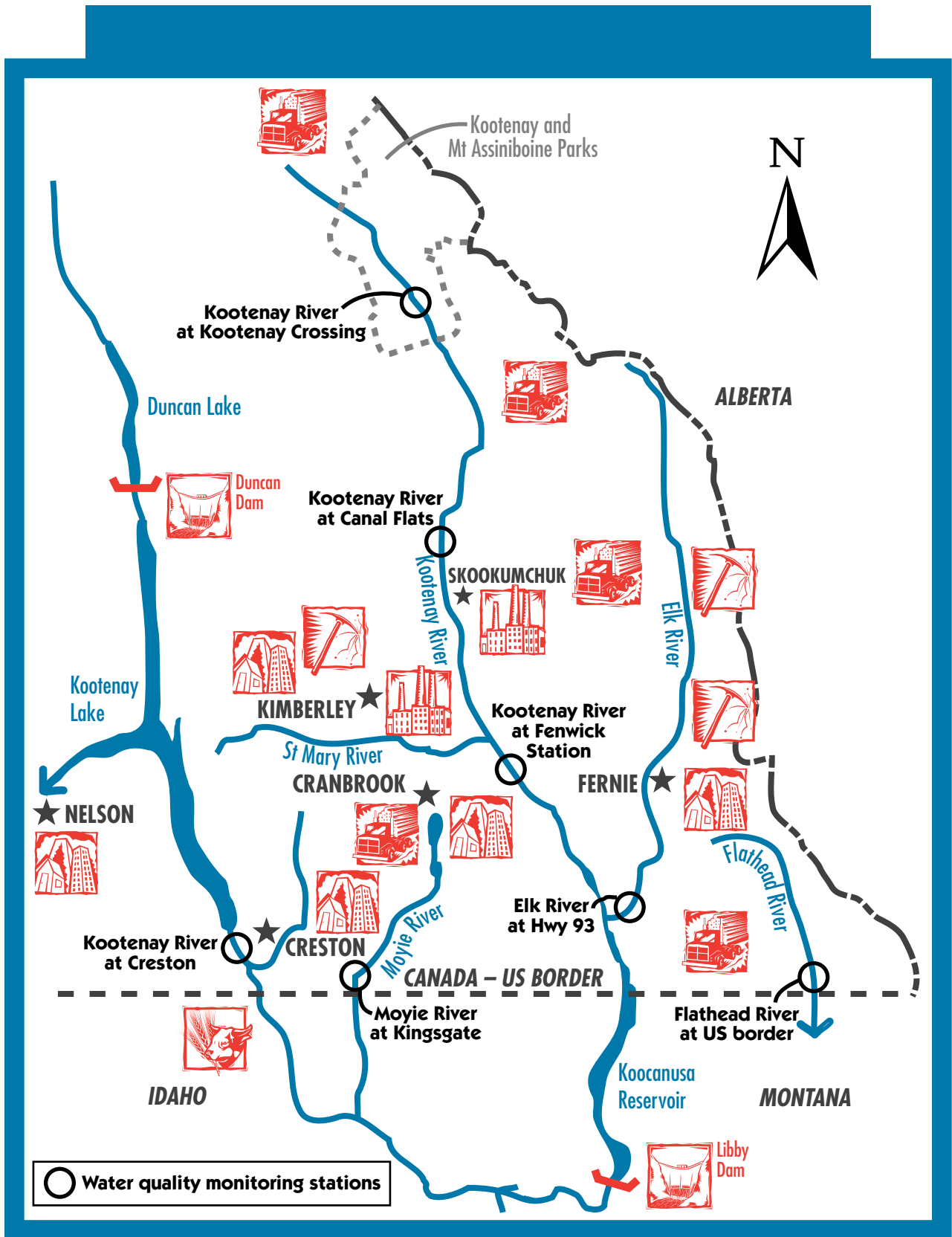
Are there any other water quality concerns?

No. The water quality of the Illecillewaet River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

There are no apparent water quality concerns or changes at this time. Monitoring is continuing to detect any changes in water quality in Glacier National Park.





Kootenay & Flathead River Area

Kootenay River at Kootenay Crossing

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Kootenay River at Kootenay Crossing?

The Kootenay River at Kootenay Crossing drains 420 km² of the Rocky Mountains in the headwaters of the Kootenay-Columbia River basin. Most of its watershed lies within Kootenay National Park and Mount Assiniboine Park and has high recreational values.

What are the main human influences on water quality?

Highway 93, recreational activities in the parks, contaminants deposited with rain and snow, and timber harvesting in the northern part of the basin are the main potential human influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks since 1987. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1987 to 1995.

Are there any other water quality concerns?

No. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

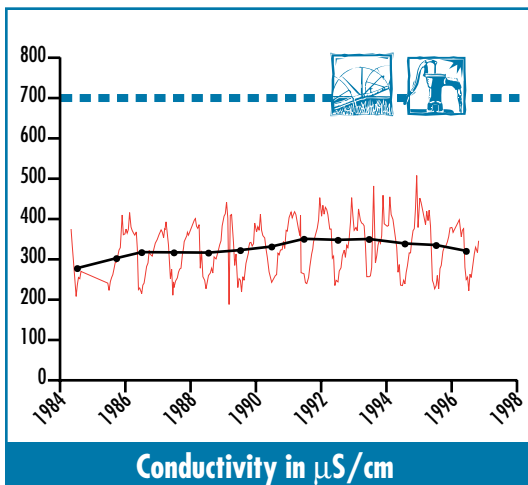
There were no apparent water quality concerns or changes from 1987 to 1995. Monitoring is continuing to detect any changes in water quality in Kootenay National Park, as well as to serve as a relatively pristine control station for the Kootenay watershed.

Kootenay River at Canal Flats

What are the water quality trends?

There were no environmentally significant changes, although a slight increasing trend in conductivity, a measure of dissolved ions, was observed.

No changes



What are the main attributes of the Kootenay River at Canal Flats?

The Kootenay River at Canal Flats drains 5,390 km² of the Rocky Mountains, with much of the northern half of the basin in Kootenay National Park and Mount Assiniboine Park. The upper Kootenay River has good potential for streamside camping, fishing and viewing wildlife.

What are the main human influences on water quality?

Most of the southern half of the basin has been used for timber harvesting.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every two weeks from 1985 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes over the decade from 1985-95. A slight increasing trend in conductivity, a measure of the dissolved ions in water, was detected, but the cause is unknown. This trend might be due to timber harvesting or may be nothing more than natural variation. In any case, the levels have begun to decline since 1995.

What is the environmental significance of the trend?

There were no environmentally significant changes, and the increasing trend in conductivity would have to persist at its present rate for about 50 years before it would reach the guidelines for drinking water and irrigation and become environmentally significant.

Are there any other water quality concerns?

No. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to maintain water quality?

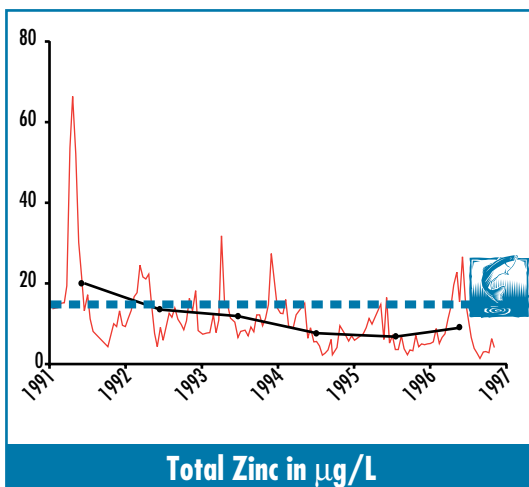
There are no apparent water quality concerns or environmentally significant changes at this time, and monitoring is continuing for a more limited suite of indicators. Conductivity will continue to be tracked to see if the increasing trend persists.

Kootenay River at Fenwick Station

What are the water quality trends?

The Kootenay River at Fenwick Station had an improving trend in zinc due to on-going abatement of acid rock drainage at the Cominco Ltd. Sullivan mine at Kimberley.

Improving trend



Total Zinc in µg/L

What are the main attributes of the Kootenay River at Fenwick Station?

The Kootenay River at Fenwick Station flows in the Rocky Mountain Trench, draining 12,000 km² of the Rocky Mountains to the east and the Purcell Mountains to the west. It is a transboundary river, which joins the Elk River in B.C. and flows into Kootenay Lake. This reach of the Kootenay River supports significant fisheries and is used for irrigation.

What are the main human influences on water quality?

The Cominco Ltd. Sullivan mine, concentrator and former fertilizer complex at Kimberley in the St. Mary River watershed, and the Crestbrook Forest Industry Ltd. kraft pulp mill at Skookumchuck have been the main influences on water quality.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1984. Flow has been monitored continuously about 16 km upstream at Fort Steele, where the drainage area is 11,400 km².

What are the water quality trends and what caused them?

The Kootenay River at Fenwick Station had an improving trend in total zinc as shown on the graph. The zinc measurements before 1991 are not reliable due to artificial contamination and were not plotted. Zinc levels have declined since the early 1990's due to the on-going abatement of acid rock drainage at Cominco's Sullivan mine at Kimberley.

What is the environmental significance of the trend?

Zinc levels often exceeded safe levels for aquatic life in the Kootenay River in the early 1990's, but have declined to safe levels for most of the time since 1994.

Are there any other water quality concerns?

No. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to further improve water quality?

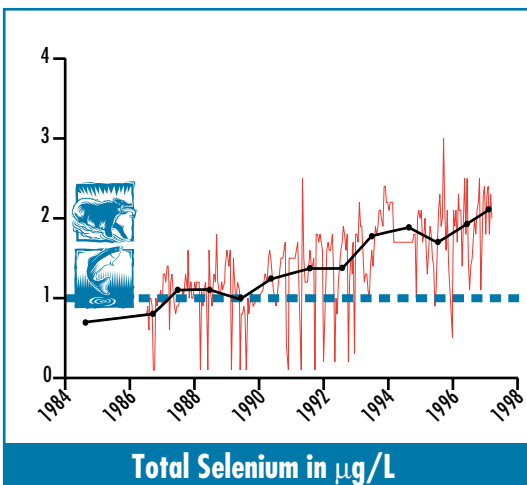
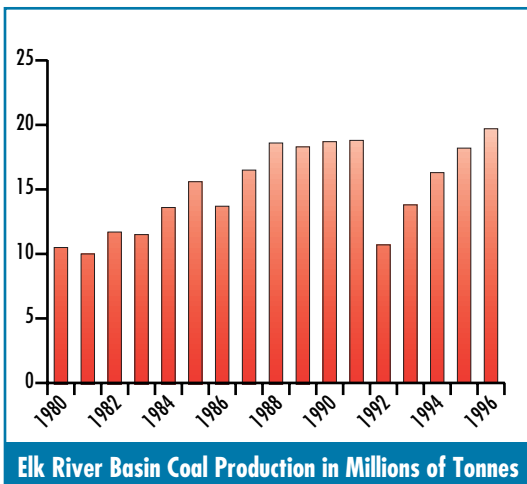
Acid rock drainage abatement is continuing at Cominco's Sullivan mine to reduce zinc levels in the St. Mary and Kootenay rivers to consistently acceptable levels, as the mine works towards permanent closure by 2002. Monitoring of the Kootenay River at Fenwick Station is continuing and regular monitoring of the St. Mary River has been started.

Elk River at Highway 93

What are the water quality trends?

The Elk River had deteriorating trends for selenium and nitrogen. Increasing selenium levels may affect aquatic life and wildlife. BC Environment is investigating this possibility.

Deteriorating trends



What are the main attributes of the Elk River?

The Elk River drains 4,450 km² of the Rocky Mountains into Kootanusa Lake on the Kootenay River just before it enters Montana. It is the most heavily-fished river in the Kootenays, with large populations of westslope cutthroat trout, bull trout and whitefish.

What are the main human influences on water quality?

There is widespread coal mining in the upper Elk River basin, and the output of coal from the basin doubled during the 1980's as shown on the graph.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature have been monitored once every two weeks since 1984 in the Elk River just upstream from Kootanusa Lake. Flow has been monitored continuously about 6 km upstream.

What are the water quality trends and what caused them?

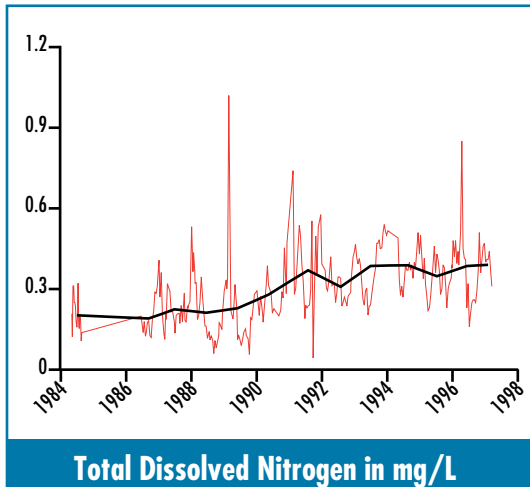
Selenium and nitrogen levels increased over the decade. The selenium increase appears to have been caused by the increased disturbance of selenium-bearing soils during coal mining. Nitrogen increased due to the increased use of nitrogen-based explosives as coal production expanded.

What is the environmental significance of the trends?

Selenium levels often exceeded the safe level for aquatic life and wildlife in recent years. The current guideline, however, was developed from information for wetlands where selenium readily accumulates in fish and birds, causing reproductive failures. Fast-flowing streams like the Elk River do not appear to be as susceptible to these effects. Levels farther upstream in the basin, below surface coal mines, also occasionally exceeded the safe level for drinking water, but the water is not used for drinking at this time. Nitrogen levels were well below safe levels for drinking water and aquatic life (10 mg/L), but there was an ample supply for algal growth at all times of the year. This would increase the risk of algal blooms if phosphorus, which limits the growth of algae, was to increase.

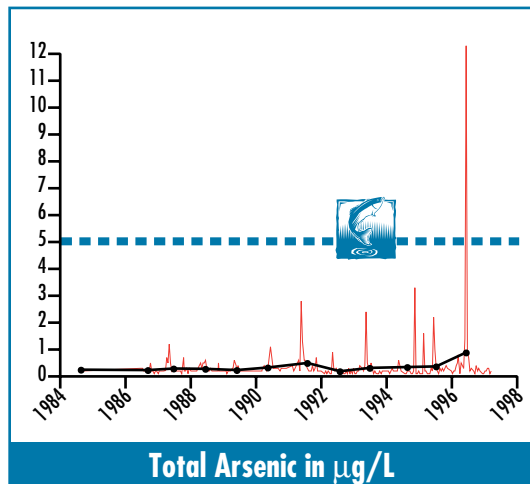
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Elk River at Highway 93 (continued)



Are there any other water quality concerns?

There was an apparent increasing trend in peak total arsenic, but it was not statistically significant. The arsenic peaks were correlated with high flows and suspended solids during spring floods. One value exceeded the safe level for aquatic life, but the arsenic was probably bound in suspended solids and thus was likely not available to aquatic life. The water quality of the Elk River was not evaluated in the 1996 B.C. Water Quality Status Report.



What will be done to improve water quality?

BC Environment and the coal mining companies have investigations underway to determine the sources of selenium and their potential environmental effects. The results of these investigations will help to show the type of corrective action that may be needed to reduce selenium levels. Monitoring of water quality is continuing on the Elk River, including dissolved arsenic and selenium to assess their availability to aquatic life.

Moyie River at Kingsgate

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Moyie River?

The Moyie River is a transboundary stream, draining 1,480 km² of the Purcell Mountains in southern B.C., crossing the international boundary and entering Idaho at Kingsgate. The Moyie River joins the Kootenai River in Idaho before it re-enters B.C. as the Kootenay River near Creston. The Moyie River is used for fishing, recreation and irrigation. The hardness of Moyie River water was quite low compared to most other East Kootenay rivers, making it more sensitive to metal pollution, should mining ever occur in the basin.

What are the main human influences on water quality?

These include timber harvesting and a little agriculture.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about six times per year from 1979 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?

No. The water quality of the Moyie River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

No. There were no apparent water quality changes or concerns at this time or in the foreseeable future. Monitoring was suspended in 1995.

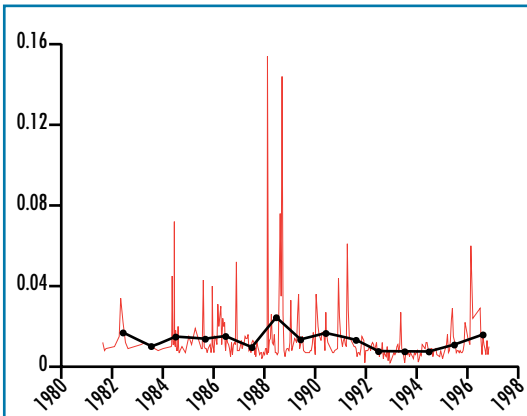


Kootenay River at Creston

What are the water quality trends?

The Kootenay River at Creston had a declining trend in total phosphorus. This is viewed as a deteriorating trend because Kootenay Lake, downstream from Creston, has a shortage of phosphorus, which has contributed to declining fisheries production. Fertilization of Kootenay Lake with phosphorus began in 1992 to boost fish production, and has been highly successful.

Deteriorating trend



Total Phosphorus in mg/L

What are the main attributes of the Kootenay River at Creston?

The Kootenay River is a transboundary stream that flows south from B.C. into Kootenay Lake, which is the reservoir of the Libby Dam in Montana. After leaving the dam, the river swings northward through Montana and Idaho, re-entering B.C. south from Creston. Just north from Creston, the river enters Kootenay Lake, forming the main inflow to the southern arm of the lake. The Kootenay River near Creston has a drainage area of 36,700 km² and is used for irrigation and waterfowl conservation, while Kootenay Lake is an important fishery and recreation area.

What are the main human influences on water quality?

The watershed upstream from Creston has been influenced to varying degrees over the years by hydroelectric development at the Libby Dam, a kraft pulp mill at Skookumchuck, a mine, concentrator and fertilizer complex at Kimberley, coal mines in the Elk River basin, treated sewage discharges, agriculture, and forestry.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, temperature, and fecal coliform bacteria have been monitored once every two weeks since 1979. Flow has been monitored continuously 15 km upstream at the Canada – USA border.

What are the water quality trends and what caused them?

Total phosphorus levels have continued to decline during the 1980's and 1990's. This downward trend began in the 1970's with the completion of the Libby Dam in 1972, which trapped phosphorus in the Kootenay Lake reservoir, and with the reduction in phosphorus discharge from the Cominco fertilizer plant near Kimberley during 1969 to 1979 and with its closure in 1987.

The downward trend during 1982–96 is very subtle, but it is statistically significant. It was most obvious during 1982–94, but increasing levels in 1995–96 have lessened the magnitude of the overall trend.

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What is the environmental significance of the trend?


There are no water quality objectives or guidelines for phosphorus in the Kootenay River, but Kootenay Lake fisheries production has been limited by the lack of phosphorus entering the lake. Phosphorus is needed for growth by algae, which are food for small animals, which, in turn, are eaten by fish. Too much phosphorus causes objectionable algal blooms, but too little phosphorus limits fish production, and a careful balance is needed.

In the 1970's, there was too much phosphorus entering Kootenay Lake and objectionable algal blooms occurred. The reduction of phosphorus from the Cominco fertilizer plant was necessary to improve water quality, but the Libby Dam has further reduced phosphorus below natural levels and Kootenay Lake is now starved for phosphorus.

Are there any other water quality concerns?

Yes. There is concern that the Libby Dam in Montana could cause high levels of total dissolved gases in the Kootenay River near Creston, should it be necessary to spill water at the dam due to a flood or other emergency. The dam has been operated to avoid spilling water, and has not spilled since 1985. The water quality of the Kootenay River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to improve matters?



BC Environment began fertilizing Kootenay Lake with phosphorus in 1992, and it has been continued since 1995 by the Columbia Basin Fish & Wildlife Compensation Program, a joint venture of BC Environment and BC Hydro. Fertilization has resulted in significant increases in kokanee abundance. For example, adult kokanee escapement to the Meadow Creek Spawning Channel and Lardeau River has increased from 270,000 in 1991 to 2.2 million fish in 1998. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia-Kootenay River basin in Canada and the U.S. Monitoring of water quality is continuing at the Kootenay River at Creston, and more monitoring of total dissolved gases will be done in the event of a spill at the Libby Dam.

Flathead River at US Border

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Flathead River?

The Flathead River drains 1110 km² of the Rocky Mountains in southern B.C. into Montana. The river supports a diversity of fish species, including westslope cutthroat trout, mountain whitefish, bull trout and kokanee.

What are the main human influences on water quality?

These include timber harvesting, coal mine exploration, and road building.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored weekly or once every two weeks from 1979 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?

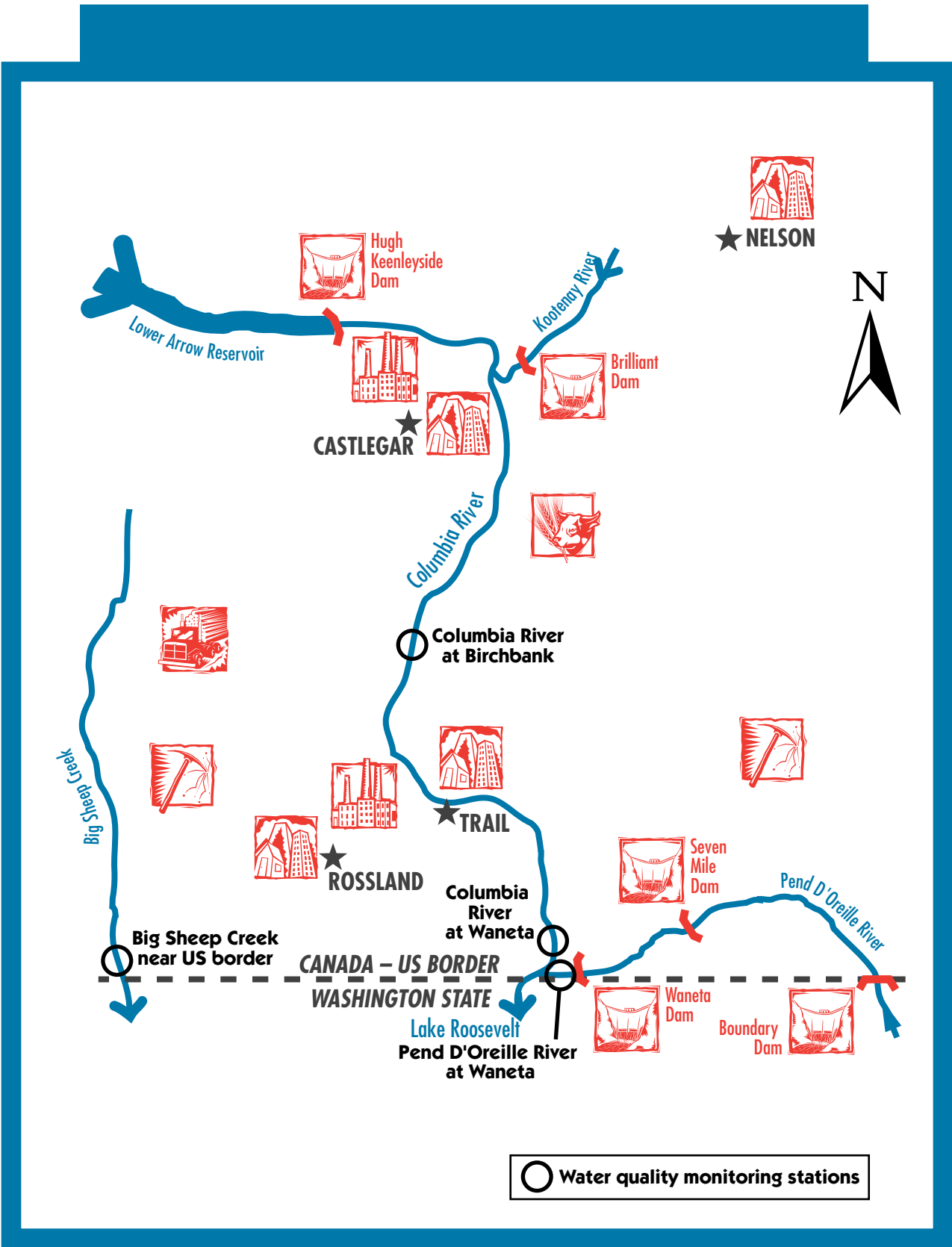
There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?

No. The water quality of the Flathead River was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

No. There were no apparent water quality changes or concerns from 1979 to 1995. Monitoring was suspended in 1995, but there is a good baseline of data available should concerns arise in the future.



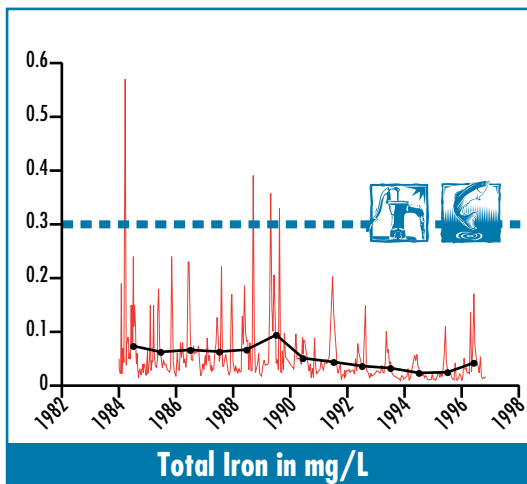
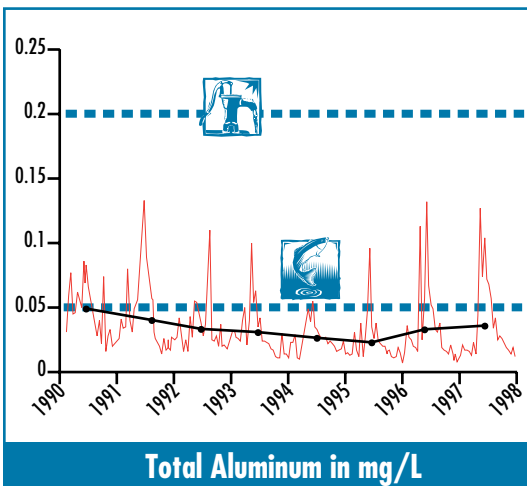
Lower Columbia River Area

Columbia River at Birchbank

What are the water quality trends?

The Columbia River at Birchbank had improving trends in iron and aluminum. Total gas pressure continued to exceed water quality objectives due to the Keenleyside Dam.

Improving trends



What are the main attributes of the Columbia River at Birchbank?

The Columbia River at Birchbank is downstream from the confluence with the Kootenay River, and drains 88,100 km² of the Kootenay-Columbia basin. This reach of the river is used for municipal, industrial and agricultural water supplies, and supports significant fisheries. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?

These include the Hugh Keenleyside Dam (1967) upstream from Castlegar, the Libby Dam (1972), the Mica Dam (1976), the Revelstoke Dam (1983), the Celgar pulp mill at Castlegar, and treated sewage discharges from the Nelson-Castlegar area.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, temperature, and fecal coliform bacteria have been monitored once every two weeks since 1983. Total phosphorus was also monitored about monthly during 1968–78. Flow has been monitored continuously and total dissolved gas pressure has been monitored periodically.

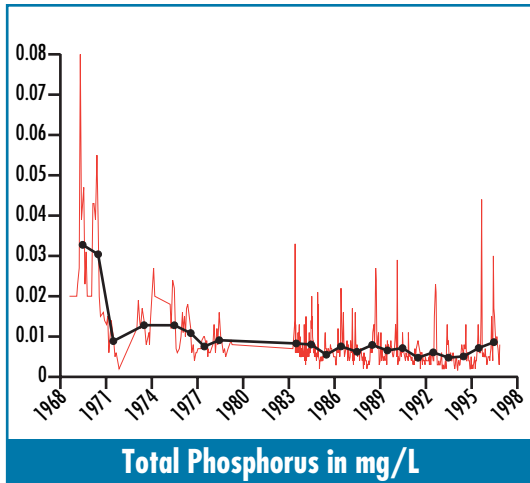
What are the water quality trends and what caused them?

Iron and aluminum levels declined over the years, but what caused the declines is uncertain. These elements may have been trapped by upstream dams and reservoirs. Total phosphorus records were checked for trends because of concerns that upstream reservoirs and waste abatement may have reduced phosphorus levels.

The graph on the next page shows that phosphorus levels declined during 1968–78. This trend may have been caused by erroneously high values in 1968–70 due to less sensitive measurement methods, but it is also possible that the construction of dams (Keenleyside–1967, Libby–1972, and Mica–1976) and waste abatement at the Cominco fertilizer plant at Kimberley during 1969–79 may have contributed. Nevertheless, phosphorus levels appear to have reached a steady state during 1983–97, because the evidence for a declining trend was weak (less than 95% confidence) and contradictory for this period.

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Columbia River at Birchbank (continued)

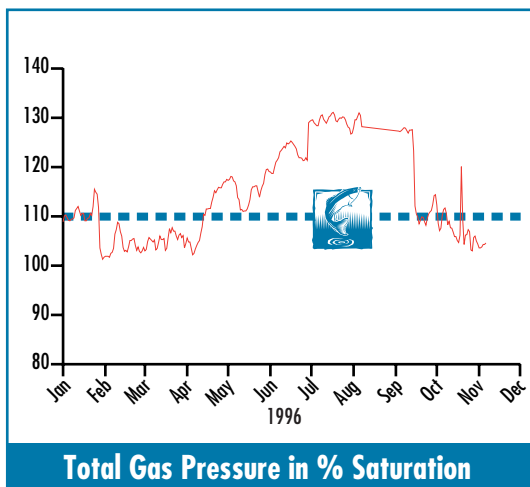


What is the environmental significance of the trends?

Lower iron meant that the water was better for drinking water aesthetics and for aquatic life, while lower aluminum may have improved the water for aquatic life.

Are there any other water quality concerns?

The 1996 BC Water Quality Status Report rated the water quality of the Columbia River between Keenleyside and Birchbank as fair, because objectives for organic carbon in sediments, total dissolved gas pressure, and dioxins and furans in sediment and fish were exceeded during 1991-1993. This continued to be the case at Birchbank in 1994-1995. The total dissolved gas pressure levels exceeded safe levels for fish due to air entrainment at the Keenleyside Dam Spillway during 1996 (see graph opposite).



What will be done to improve water quality? Improvements at the pulp mill have lowered the levels of dioxins and furans in the effluent, and the levels in fish are dropping. The discharge of organic carbon (pulp mill fines) has also been reduced. The installation of a power plant at the Keenleyside Dam is underway and will reduce the dissolved gas levels. Water use planning is being conducted with B.C. Hydro for all dams in the Columbia basin to address total dissolved gas concerns. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia basin in Canada and the U.S. Monitoring is continuing on the Columbia River at Birchbank and total gas pressure monitoring has been started at the Columbia River at Waneta.

Columbia River at Waneta

What are the water quality trends?

The Columbia River at Waneta had improving trends for metals, phosphorus, and major ions due to waste abatement.

Improving trends

What are the main attributes of the Columbia River at Waneta?

The Columbia River at Waneta is just upstream from the confluence with the Pend d'Oreille River and the US border. It drains 88,800 km² of the Kootenay-Columbia basin. This reach of the river is used for municipal, industrial and agricultural water supplies, and supports significant fisheries. The Columbia River was declared a B.C. Heritage River in 1998.

What are the main human influences on water quality?

These include the Hugh Keenleyside Dam (1967) upstream from Castlegar, the Libby Dam (1972), the Mica Dam (1976), the Revelstoke Dam (1983), the Celgar pulp mill at Castlegar, treated sewage discharges from the Nelson-Castlegar-Trail area, and the Cominco smelter-fertilizer complex at Trail.

What water quality indicators were monitored?

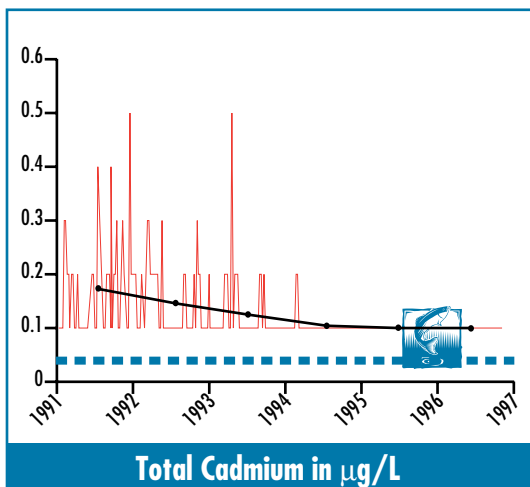
Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, temperature, and fecal coliform bacteria have been monitored weekly since 1983. Flow has been monitored continuously at Birchbank which is 25 km upstream, where the drainage area is 88,100 km².

What are the water quality trends and what caused them?

Water quality indicators that declined over time were cadmium, chromium, iron, lead, zinc, fluoride, phosphorus, and sulphate. The plots show the trends for the most important indicators. These declines were due to waste abatement at the Cominco smelter and fertilizer plant, while upstream dams may have contributed to the decline in iron. The fecal coliform record was checked for trends, but the evidence for a declining trend was weak and contradictory.

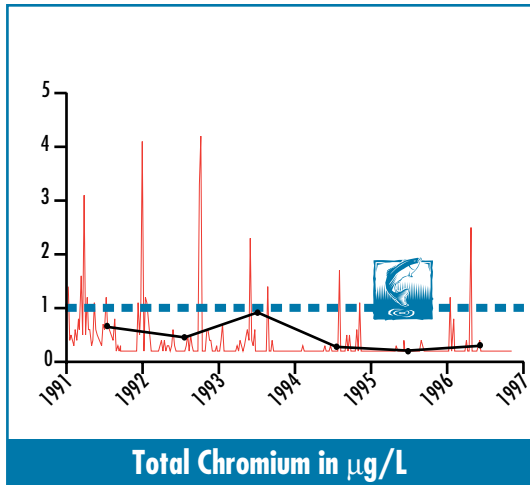
What is the environmental significance of the trends?

The declining trends in cadmium, chromium, iron, lead, zinc, fluoride, and sulphate are improving trends, because they made the water safer for aquatic life, drinking water, recreation and irrigation. The aesthetic appeal of the water for drinking was also improved. Further improvement is needed to reduce cadmium, chromium,



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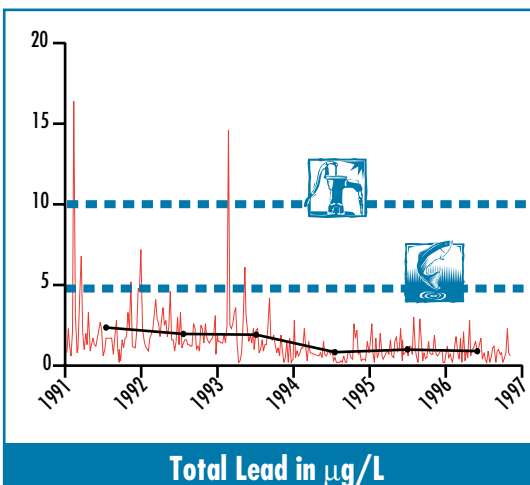
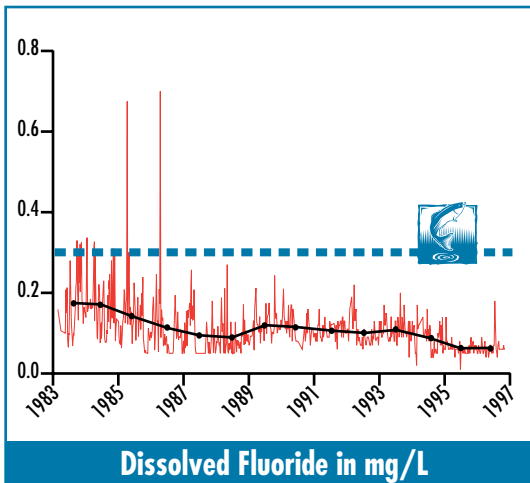
Columbia River at Waneta (continued)



copper, and zinc to safe levels for aquatic life consistently. The declining trend in phosphorus due to waste abatement at the Cominco fertilizer plant improved water quality because the levels were high enough to cause objectionable algal blooms, and there were other pollutants discharged with the phosphorus.

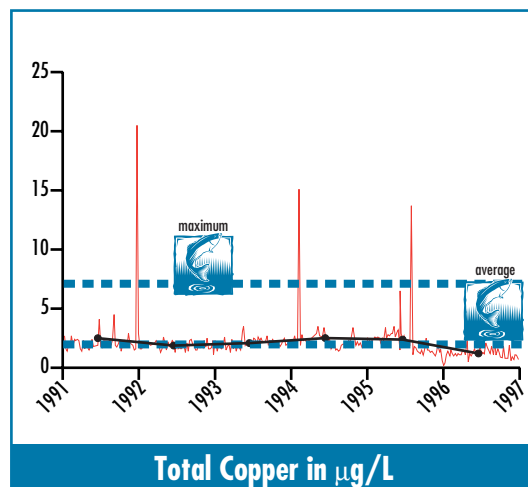
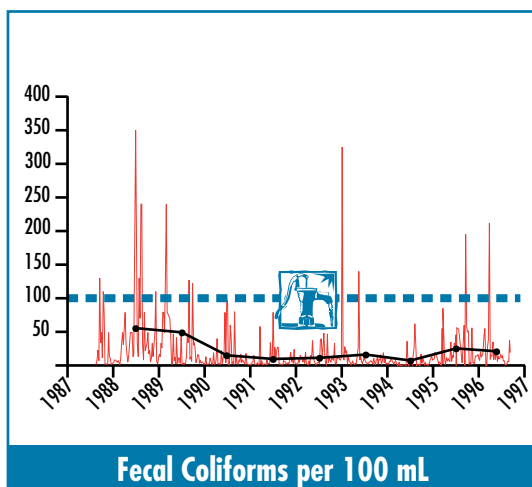
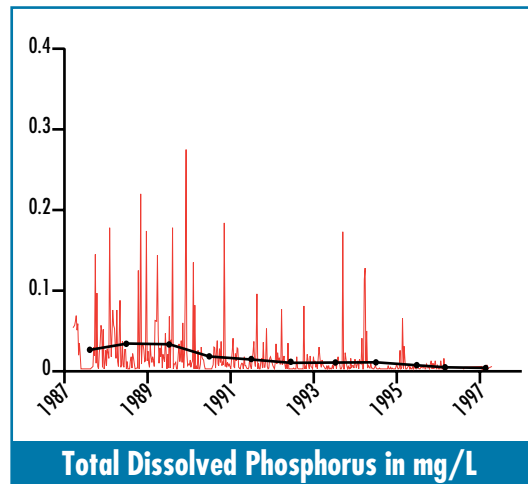
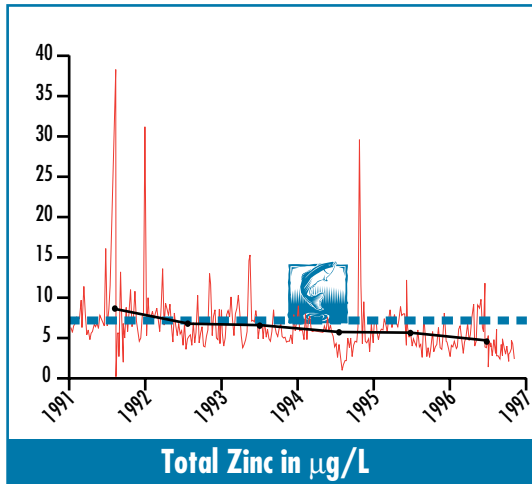
Are there any other water quality concerns?

Yes. There are concerns about total dissolved gas pressure levels that exceeded the safe level for fish as outlined for the Columbia River at Birchbank. The water quality of the Columbia River between Birchbank and Waneta was not evaluated in the 1996 B.C. Water Quality Status Report.



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Columbia River at Waneta (continued)



What will be done to further improve water quality?

Further improvement is needed to reduce cadmium, chromium, copper, and zinc consistently to levels that are safe for aquatic life. Waste abatement at the Cominco smelter is on-going to achieve this. Action is underway to reduce total dissolved gases in the Columbia River basin as outlined for the Columbia River at Birchbank. Monitoring is continuing at the Columbia River at Waneta and total gas pressure monitoring has been started.



Pend D'Oreille River at Waneta

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of the Pend d'Oreille River at Waneta?

The drainage area of the Pend d'Oreille River at Waneta is about 66,600 km², 98% of which is in the United States. Only the last 22 km of the river before it joins the Columbia River at Waneta lies in B.C. This reach of the river is dominated by hydroelectric facilities.

What are the main human influences on water quality?

We know little about the influences on water quality in the US portion of the watershed, except that there were two lead-zinc mines along the river in Washington State. There are two closed lead-zinc mines in the B.C. portion of the watershed. Three hydroelectric dams influence the B.C. reach of the river: Boundary Dam at the US-Canada border, Seven Mile Dam, and Waneta Dam just upstream from the Pend d'Oreille's confluence with the Columbia River.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored once every four weeks since 1980. Flow has been monitored continuously where the river enters B.C.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1980 to 1995.

Are there any other water quality concerns?

Yes. The levels of total dissolved gases exceeded the safe level for fish downstream from the dams on the Pend d'Oreille River at times. The water quality of the Pend d'Oreille River was not evaluated in the 1996 B.C. Water Quality Status Report.

What will be done to improve water quality?

Water use planning is being conducted with B.C. Hydro for all dams in the Columbia basin to address total dissolved gas concerns. The Upper Columbia River International Task Force is investigating means to reduce total dissolved gases throughout the Columbia basin in Canada and the U.S. Monitoring is continuing at the Pend d'Oreille River at Waneta and a new site has been added where the river enters B.C. Total dissolved gases will be monitored regularly.



Big Sheep Creek Near US Border

What are the water quality trends?

There were no environmentally significant changes.

No changes

What are the main attributes of Big Sheep Creek?

Big Sheep Creek is a transboundary stream, draining 347 km² of the Monashee Mountains in B.C. before entering Washington State, where it joins the Columbia River six kilometres south from the border. There are no licensed water withdrawals from Big Sheep Creek, although it is used for cattle watering. The creek has resident populations of eastern brook trout and rainbow trout.

What are the main human influences on water quality?

These include timber harvesting and some cattle grazing. This area has mining potential, and a molybdenum mine and concentrator operated in Little Sheep Creek, a tributary of Big Sheep Creek, from 1966 to 1972. Little Sheep Creek enters Big Sheep Creek downstream from the water quality monitoring station, and thus this station served as an upstream control for the mining.

What water quality indicators were monitored?

Major ions, trace elements, nutrients, colour, dissolved and suspended solids, pH, and temperature were monitored about five times per year from 1979 to 1995. Flow has been monitored continuously.

What are the water quality trends and what caused them?

There were no environmentally significant changes from 1979 to 1995.

Are there any other water quality concerns?

No. The water quality of the Big Sheep Creek was not evaluated in the 1996 B.C. Water Quality Status Report.

Does anything need to be done?

No. There were no apparent water quality changes or concerns during 1979–95, and monitoring was suspended in 1995.

