Water Quality

Ambient Water Quality Objectives For The Upper Columbia River Area

Overview Report

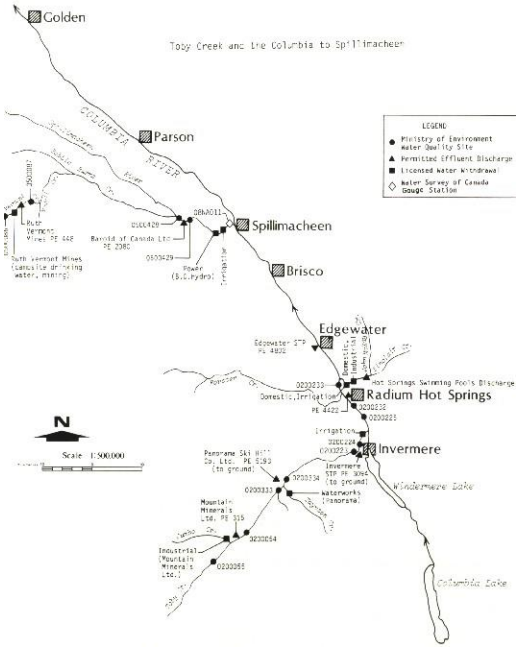
Water Management Branch
Environment And Resource Division
Ministry Of Environment, Lands And Parks

Prepared Pursuant To Section 2(E) Of The
Environment Management Act, 1981

Original Signed By Ben Marr
Deputy Minister
Environment And Lands Hq Division
November 25, 1985

Figure 1.

Map of Toby Creek and the Columbia River to Spillimacheen



PREFACE
Purpose of Water Quality Objectives

Water quality objectives are prepared for specific bodies of fresh, estuarine and coastal marine surface waters of British Columbia as part of the Ministry of Environment, Lands and Parks' mandate to manage water quality. Objectives are prepared only for those waterbodies and water quality characteristics that may be affected by human activity now or in the near future.

How Objectives Are Determined

Water quality objectives are based the BC approved and working criteria as well as national water quality guidelines. Water quality criteria and guidelines are safe limits of the physical, chemical, or biological characteristics of water, biota (plant and animal life) or sediment which protect water use. Objectives are established in British Columbia for waterbodies on a site-specific basis. They are derived from the criteria by considering local water quality, water uses, water movement, waste discharges, and socioeconomic factors.

Water quality objectives are set to protect the most sensitive designated water use at a specific location. A designated water use is one that is protected in a given location and is one of the following:

- raw drinking water, public water supply, and food processing
- aquatic life and wildlife
- agriculture (livestock watering and irrigation)
- recreation and aesthetics
- industrial water supplies.

Each objective for a location may be based on the protection of a different water use, depending on the uses that are most sensitive to the physical, chemical or biological characteristics affecting that waterbody.

How Objectives Are Used

Water quality objectives routinely provide policy direction for resource managers for the protection of water uses in specific waterbodies. Objectives guide the evaluation of water quality, the issuing of permits, licences and orders, and the management of fisheries and the province's land base. They also provide a reference against which the state of water quality in a particular waterbody can be checked, and help to determine whether basin-wide water quality studies should be initiated.

Water quality objectives are also a standard for assessing the Ministry's performance in protecting water uses. While water quality objectives have no legal standing and are not directly enforced, these objectives become legally enforceable when included as a requirement of a permit, licence, order, or regulation, such as the Forest Practices Code Act, Water Act regulations or Waste Management Act regulations.

Objectives and Monitoring

Water quality objectives are established to protect all uses which may take place in a waterbody. Monitoring (sometimes called sampling) is undertaken to determine if all the designated water uses are being protected. The monitoring usually takes place at a critical time when a water quality specialist has determined that the water quality objectives may not be met. It is assumed that if all designated water uses are protected at the critical time, then they also will be protected at other times when the threat is less.

The monitoring usually takes place during a five week period, which allows the specialists to measure the worst, as well as the average condition in the water.

For some waterbodies, the monitoring period and frequency may vary, depending upon the nature of the problem, severity of threats to designated water uses, and the way the objectives are expressed (*i.e.*, mean value, maximum value).

INTRODUCTION

The assessment of water quality in the Upper Columbia River area is divided into two reports. A separate report deals with the headwaters of the Columbia River, including Columbia Lake, Windermere Lake and the Columbia River between the lakes. This report deals with the Columbia River further downstream. It includes the Columbia River between Toby Creek and Edgewater and three tributaries to the Columbia River including Toby Creek, Sinclair Creek and the Spillimacheen River.

The purpose of this report is to assess the state of water quality and develop water quality objectives where designated water uses are threatened, either now or in the future. A detailed technical appendix was prepared and forms the basis for the conclusions presented in this report.

The sub-basins studied include: Toby Creek which enters the Columbia River from the west just downstream from Windermere Lake; a 20 km stretch of the Columbia River between Toby Creek and Edgewater; Sinclair Creek which enters the Columbia River from the east about 10 km downstream from Toby Creek; and the Spillimacheen River, entering the Columbia River from the west about 30 km downstream from Edgewater (see attached map).

These sub-basins were chosen as priority areas for study because water uses could be affected by waste discharges. An assessment of the water quality in each sub-basin is presented and is followed by a summary of provisional water quality objectives and proposed monitoring programs.

HYDROLOGY

Toby Creek

Toby Creek originates in the Purcell Mountains and enters the Columbia River from the west, just downstream from Windermere Lake. Important tributaries are Jumbo Creek near the headwaters and Taynton Creek located midway in the basin. Flows recorded near Athalmer at the mouth of Toby Creek have ranged from a maximum of 106 m^3/s in June to a minimum of 1.3 m^3/s in February.

Sinclair Creek

Sinclair Creek drains the southeast corner of Kootenay National Park and flows into the Columbia River near Radium Hot Springs. Flows near the mouth have ranged from 0.14 m^3/s during the winter to 11 m^3/s during freshet.

Columbia River between Toby Creek and Edgewater

Daily flows in the Columbia River near Edge water have ranged from 280 m^3/s during freshet to 11.3 m^3/s during the winter. The low river-flow estimates during May to November, the permitted period for discharge from the sewage treatment plant at Edgewater, is 15.5 m^3/s. Monthly low-flow estimates for the Columbia River at Radium Hot Springs are 7.2 m^3/s during the winter (October-April) and 80 m^3/s during the summer (August).

Spillimacheen River

The Spillimacheen River originates in the Purcell Mountains and flows into the Columbia River from the west at the town of Spillimacheen, located about 35 km downstream from Radium Hot Springs. Flows at the mouth have ranged from 3.0 m^3/s during the winter to 312 m^3/s during freshet.

WATER USE

Toby Creek

Licensed water use includes an irrigation license near the mouth of Toby Creek, a waterworks license on Taynton Creek and an industrial license on Jumbo Creek for a mine (Mountain Minerals). Toby Creek is unlikely to ever be used as a source of domestic supply for Invermere, the largest population centre in the area, located at the mouth of Toby Creek.

A fishery of moderate value exists for cutthroat trout and Dolly Varden above Invermere during the summer, and year-round mountain whitefish near the confluence with the Columbia River. Recreational use of Toby Creek is medium to high and includes kayaking and rafting as well as fishing. Increased recreational demand is predicted following the growth of Invermere and of the Panorama Ski Resort, which is located near the confluence of Taynton and Toby Creeks.

Sinclair Creek

The major development within the basin is a recreational centre which includes a golf course, motels, the Radium Hot Springs Lodge, and the hot springs swimming pools which discharge to Sinclair Creek about 6 km from its confluence with the Columbia River. Drinking water for Kootenay National Park comes from a tributary, John McKay Creek. Drinking water for Radium Hot Springs comes from Forster Creek, which flows into the Columbia River from the west; the Kootenay National Park water supply is used when turbidity in Forster Creek renders it unsuitable for domestic use. All licensed water use of Sinclair Creek is below the hot springs pools, and consists of domestic and irrigation licenses, as well as industrial license s(lawn watering and water supply to a campground). There is a cutthroat trout fishery in Sinclair Creek within Kootenay National Park, and a limited number have been stocked successfully behind the dam on John McKay Creek.

Columbia River between Toby Creek and Edgewater

There are three licensed water withdrawals on this reach of the Columbia River, including: two industrial withdrawals for the processing of gypsum and watering of a golf course, and a domestic/industrial license currently used for supplying water to a children's amusement park.

There is high recreational value for boating, angling and viewing. Marshes are extensively used by waterfowl. Wilmer Sough, located between Toby and Horsethief Creeks, is a Canadian Wildlife Service reserve for waterfowl and ungulate winter range preservation. There is a low to moderate fishery for Dolly Varden, rainbow trout and mountain whitefish, although spawning in the Columbia River is minimal.

Spillimacheen River

Three water licenses on the Spillimacheen River include one for irrigation, one for power generation (BC Hydro), and one industrial (campsite drinking water)/mining license (Ruth Vermont Mines Ltd.). There is a winter fishery for burbot and mountain whitefish and a spring-summer fishery for rainbow trout and Dolly Varden. Neither the importance of fisheries nor recreational use have been evaluated.

WASTE WATER DISCHARGES

Toby Creek

The three waste discharges under waste management permit are described briefly.

The Village of Invermere discharged treated sewage to Toby Creek near the mouth until 1981. After this time discharge was to ground although an emergency discharge to Toby Creek has frequently been used. If the discharge to ground follows permit conditions there should be no adverse effects, and past algal growth problems in Toby Creek should disappear.

The Panorama Ski Resort discharges treated domestic sewage to ground, near the confluence of Taynton and Toby Creeks. Although the discharge is not expected to affect surface water, too few data on effluence and ground water quality have been collected to evaluate the system.

Mountain Minerals Ltd. discharge tailing pond effluent to Toby Creek, near the confluence with Jumbo Creek. The operation ceased in September, 1980 and there are no firm plans to reopen. The mine reprocessed tailings from the old Mineral King silver-lead-zink mine at the same location, to obtain barium sulphate. Although at the time of closure several contaminants including iron, lead and zinc exceeded permit limits for the effluent, dilution in Toby Creek during the period of discharge (May to November) reduced ambient concentrations to below levels significant to aquatic life.

Sinclair Creek

There are no waste discharges under waste management permit. The two chlorinated swimming pool discharges are under federal jurisdiction. The Radium sewage-lagoon discharges to Sinclair Creek was supplanted in 1976 by a treatment plant discharging directly to the Columbia River (discussed in the following section on the Columbia River between Toby Creek and Edgewater).

Columbia River between Toby Creek and Edgewater

The two waste discharges under waste management permit are discussed briefly. These include the sewage treatment plants at Radium Hot Springs and Edgewater.

Radium Hot Springs, located on the Columbia River at the confluence with Sinclair Creek, discharges treated (but unchlorinated) sewage to the Columbia River. Maximum permitted effluent flow is 2090 m3/d. Minimum, worst case dilution of this effluent in the Columbia River after complete mixing is about 300:1 during the winter and 3300:1 during the summer; actual dilutions at present are greater, as the treatment plant is not loaded to capacity. Although effluent characteristics have exceeded permit limits on a regular basis, only small increases in BOD5, suspended solids, nitrogen, phosphorus and fecal coliforms in the Columbia River are predicted due to high effluent dilution. The present and future impact of the sewage discharge on these aspects of water quality is not believed to be significant, although the impact should be checked by further ambient monitoring.

Edgewater, a small community located about 8 km north (downstream) from Radium Hot Springs, similarly discharges treated (but unchlorinated) domestic sewage to the Columbia River. Discharge is permitted for two periods of two weeks between May 1 and November 30. Primary and secondary treatment lagoons are used for storage. Although data on actual effluent discharge rate, BOD5 and suspended solids loadings are few, estimates have been made that predict no significant impact on Columbia River water quality for these characteristics. The restricted discharge period (May through November) during high river flow assures high dilution. Effluent flows, loadings, and minimal environmental impact should be similar in 1991 as the population projection is for limited or no growth.

Spillimacheen River

The two waste discharges under waste management permit are described briefly.

Ruther Vermont Mines, a lead-zinc ore dressing plant, has been shut down since 1975 although a small amount of work was done in 1981. The mine is located on Vermont Creek in the headwaters of the

Spillimacheen River. Vermont Creek flows into Bobbie Burns Creek, a tributary to the Spillimacheen River near its mouth. Cyanide levels in the discharge were frequently above permit limit while the mine was operating. To protect the fishery, Waste Management Branch will not allow the mine to reopen unless the new effluent characteristics as specified in the 1981 permit amendment can be met.

The Baroid of Canada mine is a barite concentrating plant which discharged effluent to the Spillimacheen River just downstream from the junction with Bobbie Burns Creek. There has been no effluent discharge since 1979. Of the characteristics monitored, only lead and zinc exceed permit limits while the mine was operational.

WATER QUALITY ASSESSMENT

Toby Creek

Water quality data for Toby Creek are fairly limited. Suspended solids and turbidity tended to be high, often above drinking water standards. This result was due to drainage from glaciers in the headwaters, especially during freshet. Nutrients and heavy metals tended to be at low levels throughout Toby Creek, with the possibly exception of barium which increased downstream from the Mountain Minerals Mine. The creek should be monitored for barium if the water is ever used as a source of domestic supply.

Sinclair Creek

Sinclair Creek water is very hard, primarily due to hot springs water, and is considered unsuitable for domestic purposes. Before any ground water or surface water in the Sinclair Creek basin is used for drinking, approval should be sought from the British Columbia Ministry of Health because of the naturally high arsenic levels. Users of drinking water should also be alerted to potentially high sodium levels, and to turbidity that may have to be removed during freshet to meet Ministry of Health requirements. The chlorinated pool discharges to Sinclair Creek are not expected to change its drinking water suitability with respect to fecal coliforms. There may, however, be a problem in Sinclair Creek downstream from the pool discharge due to levels of residual chlorine. Parks Canada should be informed that further investigation may be required. If there is a significant cutthroat trout fishery below the pool discharge, a dechlorination facility may be needed to reduce levels to less than 0.002 mg/L in Sinclair Creek to protect the fish.

Columbia River between Toby Creek and Edgewater

Data have not been collected for this reach of the Columbia River since 1978.

Suspended solids and turbidity were quite high during freshet, and this particulate matter would need removal prior to drinking water use, to meet Ministry of Health standards. Nutrient levels were low. Fecal coliform levels were within primary-contact recreation critera, as well as irrigation and livestock watering criteria, and suggest that disinfection of raw water would have been adequate treatment prior to domestic use. More data are required to check that this level of treatment is currently adequate. The water in this reach of the Columbia River was suitable for all known uses with respect to other characteristics

measured pervious to 1978. Limited sampling showed no significant impacts on water quality downstream from the sewage treatment plants at Radium Springs and Edgewater.

Spillimacheen River

Freshwater aquatic life criteria for cyanide were most likely exceeded on some occasions in Vermont Creek downstream from the Ruth Vermont mine when it was operational. Should the mine reopen, analysis of creek water should be for weak-acid and strong-acid dissociable cyanide so that the potential impact on aquatic life can be determined. Levels of total copper, lead, and zinc frequently exceeded aquatic life criteria both upstream and downstream from the Ruth Vermont mine, suggesting local copper-lead-zinc mineralization. A single water sample was taken downstream from the permitted discharge point of the closed mine (site 0500087, Vermont Creek) by Water Management Branch in 1983; levels of copper, lead, zinc and arsenic were as high as when the mine was operational, corroborating a report that tailings pond decant water was flowing into Vermont Creek. Further monitoring is required to ensure that the mine is not impacting Vermont Creek and the Spillimacheen River.

Water quality upstream and downstream from the Bariod of Canada mine on the lower Spillimacheen River suggests sources of lead and copper in the drainage basin other than the Ruth Vermont mine upstream. High cyanide concentrations in the lower Spillimacheen River may have been due to the upstream Ruth Vermont mine. As in Vermont Creek, future sample

---

WATER QUALITY OBJECTIVES

Provisional water quality objectives are proposed for Toby Creek and the Columbia River between Toby Creek and Edgewater.

The objectives are based on preliminary working criteria for water quality and on available data on ambient water quality, waste discharges, water uses and river flows. The objectives will remain provisional until receiving water monitoring programs provide adequate data, and the Ministry has established approved water quality criteria for the variables of concern.

The objectives can be considered as policy guidelines for resource managers to protect water uses in the specified water bodies. For example, they can be used to draw up waste management permits and plans, regulate water use of plan fisheries management. They can also provide a reference against which the state of water quality in a particular water body can be checked.

Water quality objectives have no legal standing and their direct enforcement would not be practical. This would be due to the difficulty of accurately measuring contaminants in receiving water and attributing the contamination exceeding the objective to particular sources for legal purposes, and thus or proving violations and their causes. Hence, although water quality objectives should be used when determining effluent permit limits, they should not be incorporated as part of the conditions in a waste management permit.

Depending on the circumstances water quality objectives may already be met in a water body, or may describe water quality conditions which can be met in the future. To limit the scope of the work, objectives are only being prepared for waterbodies and for water quality variables which may be affected by man's activity, now and in the foreseeable future.

The proposed objectives are summarized in Table 1. In Toby Creek they are intended to protect aquatic life, wildlife, recreation, drinking water use (after disinfection) and irrigation throughout. In the Columbia River, objectives will protect aquatic life, wildlife, irrigation and recreation between Toby Creek and Edgewater and drinking water use (after disinfection) between Toby Creek and Sinclair Creek. Fecal coliforms are the only known concern at the moment in this reach of the Columbia River.

No objectives were set for Sinclair Creek since contamination can only occur at the present time from natural hotsprings. In the case of the Spillimacheen River, objectives are not required because the only potential problem was two mines which have been closed for five years or more, and will not reopen in the foreseeable future.

The provisional objectives will apply to all parts of Toby Creek and the stretch of the Columbia River under consideration. These objectives do not apply to the initial dilution zone of a water discharge. The objectives apply to either any discrete sample taken at any time or place in the waterbody, or to an average or percentile over a given time or season, as shown in Table 1.

WATER QUALITY MONITORING

Recommendations for effluent and receiving water monitoring for the Upper Columbia River area are summarized in Table 2. This monitoring will assess the effects of waste discharges on water quality in Toby Creek and downstream in the Columbia River to Edgewater, and will determine whether the water quality objectives are being attained. It is recommended that monitoring stations be established upstream and downstream from Edgewater.

Recommendations are based on technical considerations and the extent of monitoring will be determined by project priorities and the availability of funds.

TABLES

Table 1. Provisional Water Quality Objectives for Toby Creek and the Columbia River

Water Bodies	**Toby Creek**	**Columbia River Toby Creek to Radium Hot Springs**	**Columbia River Radium Hot Springs to Edgewater**

Designated Water Uses	**drinking water, aquatic life, wildlife, recreation, irrigation**	**aquatic life, wildlife recreation, irrigation**
fecal coliforms	**less than or equal to 10 MPN/100mL 90th percentile**	**less than or equal to 200 MPN/100mL geometric mean ..... less than or equal to 400 MPN/100mL 90 th percentile**
turbidity	**5 NTU maximum increase when u/s is less than or equal to 50 NTU ..... 10% maximum increase when u/s is greater than 50 NTU**	**not applicable**
suspended solids	**10 mg/L maximum increase when u/s is less than or equal to 100 mg/L ..... 10% maximum increase when u/s is greater than 100 mg/L**	**not applicable**
periphyton growth	**25% max. increase biomass per unit area**	**not applicable**
un-ionized ammonia nitrogen	**0.007 mg/L mean 0.030 mg/L maximum**	**not applicable**
nitrite nitrogen	**0.020 mg/L mean 0.060 mg/L maximum**	**not applicable**
total lead	**0.005 mg/L when**	**not applicable**

	hardness is less than or equal to 95 mg/L ..... 0.01 mg/L when hardness is greater than 95 mg/L	
total barium	1.0 mg/L maximum	not applicable
total cadmium	0.0002 mg/L maximum	not applicable
total zinc	0.05 mg/L maximum	not applicable
dissolved copper	0.002 mg/L maximum	not applicable

Return To The Table of Contents

Table 2a. Recommended Routine Water Quality Monitoring for Toby Creek

Toby Creek Sampling Sites	Frequency and Timing	Characteristics to be Measured
Mountain Minerals pond effluent PE 315	twice per year October to November if the mine reopens	flow, pH, suspended solids, temperature, Ba, Cd, Cu, Pb, Zn
Panorama STP effluent-PE 5193	Three times per year in the winter	fecal coliforms, flow, BOD_5, suspended solids, turbidity, NO_3-N, NO_2-N, NH_3-N, organic-N, dissolved ortho-P, total dissolved-P, total-P
Toby Creek sites 0200055 u/s from Mountain Minerals 0200054 d/s from Mountain Minerals	Once in the winter once in the summer	flow, pH, suspended solids, temperature, Ba, Cd, Cu, Pb, Zn
ground water wells near Panorama STP	Three times per year in the winter	fecal coliforms, pH, NO_3-N, NO_2-N, NH_3-N, dissolved ortho-P, total

		dissolved-P, total-P, temperature
Toby Creek sites 0200333 u/s from Panorama 0200334 d/s from Panorama	Three times per year in the winter	fecal coliforms, pH, NO_3-N, NO_2-N, NH_3-N, dissolved ortho-P, total dissolved-P, total-P, temperature, flow, suspended solids, turbidity
Invermere STP effluent-PE 3094	every 2 months all year	fecal coliforms, flow, BOD_5, suspended solids, turbidity, NO_3-N, NO_2-N, NH_3-N, organic-N, dissolved ortho-P, total dissolved-P, total-P
ground water wells near Invermere STP	every 2 months all year	fecal coliforms, pH, NO_3-N, NO_2-N, NH_3-N, dissolved ortho-P, total dissolved-P, total-P, temperature
Toby Creek sites 0200223 u/s from Invermere 0200224 d/s from Invermere	every 2 months all year	visual monitoring for periphyton. If P breakthrough or direct discharge occurs then: fecal coliforms, pH, NO_3-N, NO_2-N, NH_3-N, dissolved ortho-P, total dissolved-P, total-P, temperature, flow, suspended solids, turbidity

Note: Sampling frequency may be changed to check objectives, depending on circumstances.

Table 2b. Recommended Routine Water Quality Monitoring for the Upper Columbia River

Upper Columbia River Sites	Frequency and Timing	Characteristics to be Measured
Columbia River site 0200225 d/s from Toby Creek	Once in the winter once in the summer	fecal coliforms

Radium Hot Springs STP effluent-PE 4422	**Once in the winter once in the summer**	**fecal coliforms, flow, BOD_5, suspended solids**
Columbia River sites 0200232 u/s from Radium Hot Springs STP 0200233 d/s from Radium Hot Springs STP	**Once in the winter once in the summer**	**fecal coliforms**
Edgewater STP effluent-PE 4802	**Twice per year May to November**	**fecal coliforms, flow, BOD_5, suspended solids**
Columbia River sites u/s and d/s from the Edgewater STP discharge	**Twice per year May to November**	**fecal coliforms**

Note: Sampling frequency may be changed to check objectives, depending on circumstances.

Robert Nijman
Water Quality Branch
Environmental Protection Department
Ministry of Environment, Lands and Parks