

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 socio-economic 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

This assessment deals with the Pine River mainstem, one of seven priority sub-basins in the Peace River area for which water quality assessments are being prepared. The largest tributary of the Pine River is the Murray River and its water quality is examined in a separate report. A detailed technical appendix was prepared and forms the basis for the conclusions presented here.

This report is the product of data evaluations undertaken during 1983. In general, the study was designed to examine the status of existing and future water quality with respect to existing and future water uses and waste discharges. Included in this report are provisional water quality objectives to protect designated water uses and a recommended monitoring program. The goal of this assessment is to guide water and waste management in the Pine River mainstem.

HYDROLOGY

The Pine River originates near Pine Pass in the Rocky Mountains and flows eastward past the Village of Chetwynd entering the Peace River at Taylor (see [Figure 1.](#)).

The hydrologic cycle in the Pine River is characterized by lowest flows during the winter months, peak flows during the spring and declining flows in the late summer. The extreme low flows (7-day average, 10-year return period) expected in the Pine River near Chetwynd are 4.7 m³/s during midwinter and 21 m³/s during August.

WATER USES

Present licenced water use consists of public water supply for Chetwynd and public water supply and industrial water supply for the Westcoast Transmission Co. Ltd. Willow Flats subdivision. Licenced water use total 2365 m³/d or 0.03 m³/s. Neither present withdrawals not future anticipated withdrawals will have a significant effect on downstream flows.

The Pine River mainstem supports significant sportfish populations requiring water quality protection. Recreational use of the Pine River includes angling and boating. Swimming is not known to occur in the Pine River to any significant extent.

WASTE DISCHARGES

Most of the Pine River watershed is in a natural state with minimal land disturbance. Agriculture and logging contribute diffuse sediment loading to the river but this is masked by a naturally high suspended solids load during spring flood and summer rain events. Sources that were studied include the small Westcoast Transmission Co. Ltd. subdivision at Willow Flats, the natural gas plant at Hasler Flats, the proposed Willow Creek coal mine and the Village of Chetwynd.

The major influence on Pine River water quality is the year-round discharge of treated sewage (3000m³/d or 0.035 m³/s) from the Village of Chetwynd. Effluent monitoring data for this discharge show that the treatment system generally produced good quality effluent in compliance with permit conditions. Available water quality data did not show any serious impairment of water quality although the data base was not adequate to provide a good analysis of the situation. Additionally, the site of the outfall was changed from Centurion Creek to the Pine River and there are presently few data analyzing its direct effect on the river.

The Westcoast Transmission Co. Ltd. natural gas processing plant at Hasler Flats emits contaminants into the air from the sweetening of natural gas. Contaminants include NO_x, SO_x and H₂S. The effects of these acidic contaminants on the Pine River watershed have not been measured but are not expected to be significant. Reliable precipitation and pH data are required to assess fully whether acid precipitation is a regional problem.

The small underground coalmine (0.6 million tonnes per year) proposed for Willow Creek by David Minerals Ltd. is not expected to degrade the water quality of the Pine River. The mine does not entail extensive terrain disturbance not will there be any preparation or washing of the coal product. A water management plan which includes diversion ditches and a series of settling ponds should ensure that discharged wastewater will meet Provincial effluent objectives for suspended solids, the only constituent of concern for this project. Presently, the mine proposal is on indefinite hold due to depressed market conditions.

The Westcoast Transmission Co. Ltd. Willow Flats subdivision consists of 15 houses discharging domestic effluent into a lagoon system. Monitoring data for this discharge show that effluent characteristics generally exceeded permitted levels, although the number of samples was small. The Willow Flats subdivision has discharged treated sewage to the Pine River only once since the issuance

of the permit in 1971. Given the high dilution available in the Pine River, and the intermittent nature of this small discharge, no degradation of water quality is expected.

WATER QUALITY

As a result of the high dilution available in the Pine River, BOD₅ and suspended solids from the Chetwynd discharge are not expected to have a significant effect on Pine River water quality (outside of the initial dilution zone) over the next 10 years (to 1992).

Effluent dilution will remain above 60:1 even during severe winter low flows. There is, however, evidence that sewage input from Chetwynd is altering the natural nutrient balance in the Pine River. Phosphorus levels in August, downstream from Chetwynd, are projected to be double ambient concentrations and the nitrogen:phosphorus ratio is predicted to be 5:1 under certain conditions. At these projected nutrient levels algal growth could reach nuisance proportions over the next 10 years, downstream from the Chetwynd outfall. Excess growth of periphyton could affect the fish population in several ways: by smothering spawning substrates, by reducing food availability and by localized dissolved oxygen reductions.

Fecal coliform concentrations in the Pine River are projected to be 26 to 40 MPN/100 mL during the August low flow and 4000 MPN/mL during the winter low flow, under present conditions of maximum effluent flow and maximum effluent concentration. Future concentrations are projected to range for 684 to 4654 MPN/100 mL for the same low flow periods. Some of these levels exceed the BC Ministry of Health criterion for primary contact recreational waters, (*i.e.*, 200 to 400/100 mL).

PROVISIONAL WATER QUALITY OBJECTIVES

Provisional water quality objectives are proposed for the Pine river upstream and downstream from Chetwynd'd municipal effluent discharge. The objectives are based on preliminary working criteria for water quality and on available data on ambient water quality, waste discharges, water iuses 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 characteristics 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 or 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 of 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 water bodies and water quality characteristics which may be affected by man's activities, now and in the foreseeable future.

Provisional water quality objectives are summarized in [Table 1](#). They apply to discrete samples taken at any time, at any point in the river, either upstream or downstream from Chetwynd, but outside the initial dilution zone of a waste discharge. The objectives apply year round except for the fecal coliform objectives downstream from Chetwynd which apply only during the recreation season (June to September inclusive).

Samples to check coliform and nitrogen objectives are taken over a 30-day period at weekly intervals. This frequency would only be used if less frequent routine monitoring or other factors suggested that the objectives may be exceeded.

a) Upstream from Chetwynd

Upstream from Chetwynd there is the potential for elevated levels of suspended solids and turbidity originating from the Willow Creek Coal Project and for elevated levels of fecal coliform bacteria from the West Coast Transmission Co. Ltd. Willow Flats subdivision effluent. Although it is unlikely that either discharge would impact the Pine River water quality it is proposed that the following designated water uses be protected: drinking water supplies (Westcoast Transmission Co, Ltd. Willow Flats subdivision, Village of Chetwynd), recreation (*i.e.*, canoeing, swimming, angling) and aquatic life. The provisional objectives appear to be met according to the few data available.

b) Downstream from Chetwynd

Downstream from the Chetwynd municipal discharge there is the potential for depressed levels of dissolved oxygen and for elevated levels of suspended solids, turbidity, un-ionized ammonia-nitrogen, fecal coliform bacteria and nutrients. Although there is high effluent dilution available even during low flow periods, significant increases in the above constituents are possible outside the initial dilution zone before complete mixing occurs. Water quality objectives are recommended to protect the following designated water uses: recreation (*i.e.*, canoeing, swimming, angling) and aquatic life.

Downstream from Chetwynd projections of present effluent concentration suggest problems with nutrients and fecal coliform bacteria although there are no water quality data to confirm this. Future growth of Chetwynd's population could increase coliform levels and algal growth at points downstream.

MONITORING RECOMMENDATIONS

Recommendations for effluent and receiving water monitoring in the Pine River sub-basin are summarized in [Table 2](#). This is a minimum program based on technical considerations. The amount of monitoring that can be done will depend on project priorities and availability of funds.

A fish sampling program is also recommended in the vicinity of present and potential effluent discharges. This sampling would determine fish species distribution and habitat use in the Pine River mainstem for the purpose of gaining information on the value of the resource to be protected.

It would be useful if a gauging station were established on the Pine River at the Chetwynd outfall to substantiate the low flow estimates used to predict effluent dilution ratios.

TABLES

Table 1. Provisional Water Quality Objectives for the Pine River

Water Body	Pine River u/s from Chetwynd	Pine River d/s from Chetwynd
designated water uses	drinking water, aquatic life and recreation	aquatic life and recreation
fecal coliforms	less than or equal to 10 MPN/100 mL as a 90th percentile	less than or equal to 200 MPN/100 mL as a geometric mean less than or equal to 400 MPN/100 mL as a 90th percentile
turbidity	5 NTU maximum increase when the upstream value is less than or equal to 50 NTU 10% maximum increase when the upstream value exceeds 50 NTU	
suspended solids	10 mg/L maximum increase when the upstream value is less than or equal to 100 mg/L 10% maximum increase when the upstream value exceeds 100 mg/L	
total chlorine residual	not applicable	0.002 mg/L maximum
periphyton growth	not applicable	25% maximum increase in biomass/unit area
un-ionized ammonia-nitrogen	not applicable	0.03 mg/L maximum less than or equal to 0.007 mg/L mean

nitrite-nitrogen	not applicable	0.06 mg/L maximum less than or equal to 0.020 mg/L mean
dissolved oxygen	not applicable	7.75 mg/L minimum

Note: The objectives apply to discrete samples from all parts of the water bodies, except from initial dilution zones of effluents. These excluded dilution zones are defined as extending 100 m downstream from the discharge point and no more than 50 percent across the width of the stream, from the surface to the bottom.

- 1. The fecal coliform geometric mean and 90th percentile are calculated from at least 5 weekly samples taken in a period of 30 days. The recreation objectives apply during the recreation season only; the drinking water objectives apply year round.**
- 2. For turbidity, suspended solids and periphyton growth the increase, in NTU, mg/L or %, is over levels measured at a site upstream from a discharge or series of discharges, and as close to them as possible, and applies to downstream levels. Periphyton growth should be measured at sites subject to similar light and flow conditions.**
- 3. Since the total chlorine residual objective is equal to the minimum detectable concentration, it may be necessary to estimate the receiving water concentration using effluent loading and streamflow. The objective applies only if sewage effluent is chlorinated.**
- 4. The ammonia and nitrite means are calculated from at least 5 weekly samples taken in a period of 30 days.**

Table 2. Recommended Routine Water Quality Monitoring for the Pine River

sites	frequency and timing	characteristics
Chetwynd effluent (PE 1167)	monthly	flow, BOD ₅ , suspended solids, fecal coliforms
Chetwynd effluent (PE 1167)	4 to 6 times per year initially	flow, BOD ₅ , suspended solids, fecal coliforms, ammonia-nitrogen, pH, total and dissolved phosphorus

Pine River u/s and d/s from Chetwynd	4 to 6 times per year initially and low river flow	flow, pH, dissolved oxygen, suspended solids, fecal coliforms, ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen, total phosphorus, temperature, specific conductivity, turbidity
Westcoast Transmission effluent (PE 410)	upon discharge	flow, suspended solids, fecal coliforms, BOD ₅
Pine River u/s and d/s from Westcoast Transmission	as required	flow, pH, dissolved oxygen, suspended solids, fecal coliforms, ammonia-nitrogen, nitrate-nitrogen, nitrite-nitrogen, total phosphorus, temperature, specific conductivity, turbidity

Sampling may need to be increased to check objectives, depending on circumstances.

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