Water Quality

Ambient Water Quality Objectives For The Tributaries To Okanagan Lake Near Kelowna

Overview Report

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

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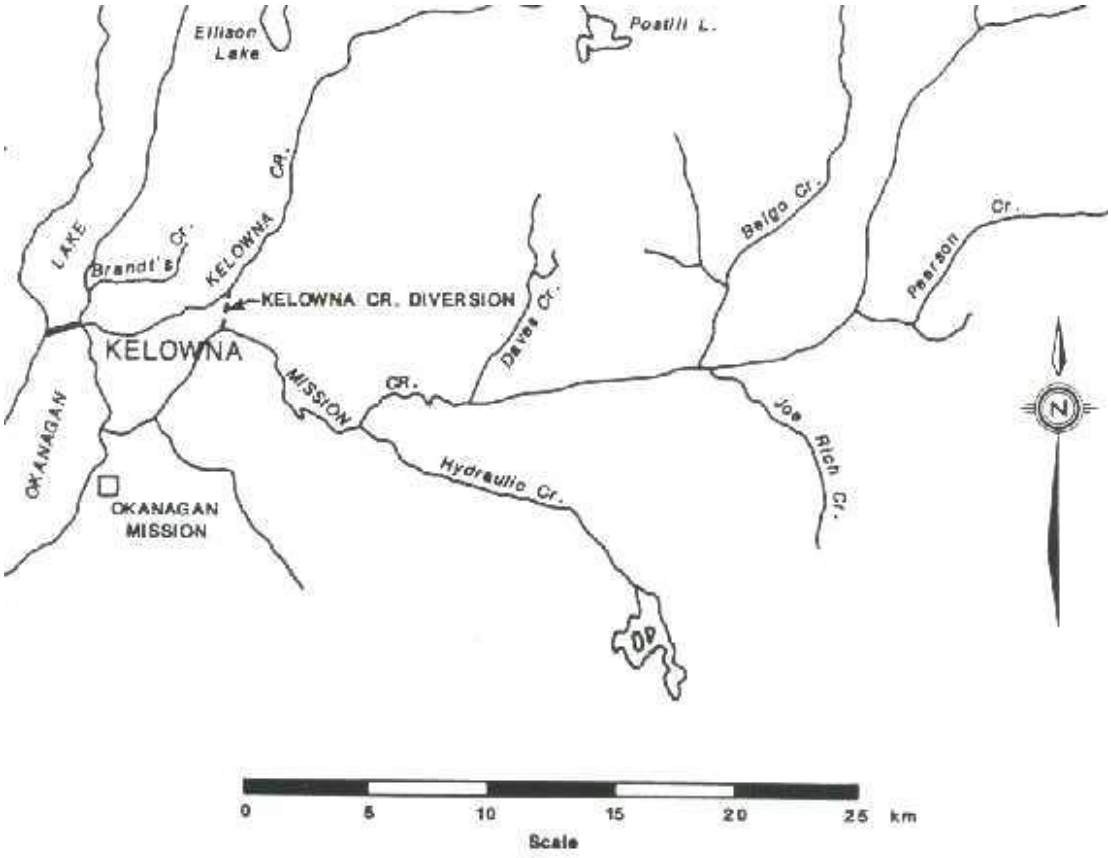
SUMMARY
This report assesses the water quality of three tributaries to Okanagan Lake: Mission, Kelowna (Mill), and Brandt's creeks. Provisional water quality objectives are set to protect wildlife and irrigation in all the tributaries. In addition, livestock, aquatic life, and drinking water will be protected in Mission and Kelowna (Mill) creeks and primary-contact recreation in Mission Creek.

Salmonid species are present in both Mission and Kelowna (Mill) creeks, and the water quality objectives in this report are to form part of a fisheries management plan for tributaries to Okanagan Lake.

Most water contamination comes from urban stormwater or agricultural runoff entering the water bodies. As a result, some metals concentrations in Kelowna (Mill) Creek increase to levels which exceed criteria to protect aquatic life. Also, ammonia and nitrite concentrations can increase to concentrations below but approaching criteria to protect aquatic life, and bacteriological levels increase so that water must receive at least partial treatment plus disinfection before domestic use.

Provisional water quality objectives have been set for bacteriological indicators, specific conductivity, pH, nutrients, metals and dissolved oxygen. Attainment of these objectives will protect aquatic life and other designated users of these waters. Modifications to stormwater systems discharging to Mission and Kelowna (Mill) creeks may be necessary if these objectives are to be achieved consistently.

Figure 1. Location Map for the Okanagan Lake tributaries near Kelowna



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

Mission, Kelowna (Mill), and Brandt's creeks are tributaries to Okanagan Lake on the east shore and enter near Kelowna (see Figure 1). The purpose of this report was to develop water quality objectives in these water bodies for use by Water Managers, including the development of a fisheries management plan for tributaries to Okanagan Lake.

HYDROLOGY

The three streams have different flow patterns from each other. In Mission Creek, low flows generally occur between December and February, although they have occurred in most months of the year. In Kelowna (Mill) Creek, low flows generally occur in July or August and less frequently in January or February. Low flows in Brandt's Creek appear to occur from June to August. Flows in the lower reaches of Mission Creek can be augmented by flows from Kelowna (Mill) Creek, through diversion works.

Seven-day low flows have ranged from 0.125 m^3/s to 0.299 m^3/s (mean 0.217 m^3/s) in Mission Creek, from 0.067 m^3/s to 0.105 m^3/s (mean 0.084 m^3/s) in Kelowna Creek, and from 0.012 m^3/s to 0.034 m^3/s (mean 0.023 m^3/s) in Brandt's Creek. All these flows were recorded at sites in the water bodies located near their confluence with Okanagan Lake. Return periods could not be calculated for these low flows due to incomplete data bases

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WATER USE
Of the three water bodies, Brandt's Creek has the fewest water uses; it is used for only irrigation and wildlife.

Both Mission and Kelowna (Mill) creeks are used for irrigation, livestock watering, wildlife, aquatic life, and drinking water supplies. Primary-contact recreation occurs only in Mission Creek since the catchment for Kelowna (Mill) Creek is too built up within Kelowna itself.

WASTE WATER DISCHARGES
Since all the tributaries are to a degree surrounded by an urban environment towards their mouths, and have low flows, each is sensitive to spills which can enter them through separated sewer systems. Such spills are not discussed due to a lack of data, however, it should be kept in mind that these can potentially have a more significant impact than most of the discharges discussed below.

There are no direct discharges to Mission Creek. Near Kelowna (Mill) Creek in its upper reaches, a car wash facility discharges to two exfiltration ponds located about one kilometre west from the creek. This discharge is not likely to affect Kelowna (Mill) Creek.

The City of Kelowna Tradewaste Treatment facility treats wastewater from Sun-Rype Products and Calona Wines. This treated wastewater is discharged directly to Brandt's Creek, where it increases nutrients and turbidity, and decreases pH. No impacts are of enough significance to affect current water uses.

Urban stormwater runoff enters Brandt's Creek and Kelowna (Mill) and Mission creeks in their lower reaches. It was determined that these discharges can increase concentrations of aluminum, copper, lead, zinc, total nitrogen, total phosphorus, and suspended solids. In Kelowna (Mill) Creek, these increases (except for suspended solids) were big enough to potentially impair use of the creek by aquatic life.

Both Mission and Kelowna (Mill) creeks and their upstream tributaries may be impacted by logging activities. Strips of trees are maintained along the banks of the affected watercourses, the actual width of the strips depending on topographic considerations. The impact of these logging operations on ambient water quality has not been determined.

Cattle are located near both Mission and Kelowna (Mill) creeks. The potential nutrient loadings from this source is high enough to impact water uses.

WATER QUALITY
Mission and Kelowna (Mill) creeks had an alkaline pH, with a generally low sensitivity to acidic inputs. The water hardness was fairly high, which helps to protect aquatic life from high metals concentrations.

Most metals in Mission Creek were below criteria to protect aquatic life; however, aluminum, copper, lead, iron, manganese and zinc concentrations in Kelowna (Mill) Creek frequently exceeded the criteria. Nitrogen concentrations were low in Mission Creek and higher in Kelowan (Mill) Creek, occasionally approaching criteria. Phosphorus concentrations were high enough to cause algal growth in both creeks. Dissolved oxygen concentrations were high when measured, but percent saturation values varied to a degree which might stress aquatic life present in both creeks. Solids concentrations were generally low enough to protect aquatic life. Fecal coliforms were generally low in Mission Creek, although more data need to be collected to confirm this tentative conclusion. Values in Kelowna (Mill) Creek often exceeded drinking water criteria set for water supplies with partial treatment.

Concentrations of many characteristics were higher in Brandt's Creek than in Mission or Kelowna (Mill) creeks; however, this is not a major concern since the water uses of Brandt's Creek are significantly different and do not need as good a quality of water to provide protection for those uses. The water was alkaline and hard, with high metals concentrations which did not exceed water quality criteria to protect aquatic life, and the water had a high oxygen demand. Dissolved solids and fecal coliforms were at times elevated to the point that the use of the water for irrigation of some crops could be compromised.

PROVISIONAL WATER QUALITY OBJECTIVES

Provisional water quality objectives proposed for Mission, Kelowna (Mill), and Brandt's creeks are summarized in Table 1. The objectives are based on approved BC and working criteria for water quality and on available data on ambient water quality, waste discharges, water uses and stream flows. The objectives will remain provisional until receiving water monitoring programs provide adequate data, and the Ministry has established approved water quality critieria for all the characteristics of concern.

Water quality objectives have no legal standing and would not be directly enforced. The objectives can be considered as policy guidelines for resource managers to protect water uses in the specified water bodies. They will guide the evaluation of water quality, the issuing of permits, licenses, and orders, and the management of the fisheries and of the Province's land base. They will also provide a reference against which the state of water quality in a particular water body can be checked, and serve to make decisions on whether to initiate basin-wide water quality studies.

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 for water quality characteristics which may be affected by man's activity now and in the foreseeable future.

Designated water uses for all three water bodies are for wildlife and irrigation. In addition, for both Mission and Kelowna (Mill) creeks, aquatic life, livestock watering, and drinking water are also designated. Primary-contact recreation is designated for only Mission Creek.

Provisional objectives for bacteriological quality are based on Ministry criteria and the use of partial treatment of the water supply, for both Mission and Kelowna (Mill) creeks.

Provisional objectives have been prepared for specific conductivity in Brandt's Creek, since dissolved solids can be elevated at times to concentrations where irrigation of some crops can be compromised. The proposed objectives are based on working water quality criteria.

Agricultural runoff and urban stormwater runoff can impact ammonia and nitrite levels. Therefore objectives are proposed for these characteristics to protect aquatic life and are based on Ministry criteria. The objectives for nitrite are based on chloride concentrations since chloride can be elevated at times in Kelowna (Mill) Creek. Related to these objectives is the proposal of provisional objectives for periphyton chlorophyll-a for flowing waters. These are based on Ministry criteria which were developed on the basis of a mixed algal community.

Provisional objectives for dissolved oxygen have been prepared for Mission and Kelowna (Mill) creeks. These are based on CCREM (the CCREM is now known as the Canadian Council for Ministers of Environment [CCME]) criteria, but are more restrictive than the CCREM criteria, due to the presence in these systems of cold-water species.

An objective is proposed for pH as a range in both Mission and Kelowna (Mill) creeks. The upper value will protect aquatic life in both creeks, while in Kelowna (Mill) Creek it will also protect aesthetics of drinking water supplies. Since the pH in Mission Creek can be slightly higher than in Kelowna (Mill) Creek, and this is not due to any anthropogenic input, a slightly less restrictive upper pH limit is proposed for Mission Creek. This recognizes that at times aesthetics of drinking water supplies may be compromised.

The objectives proposed for dissolved aluminum, total copper and total lead in Kelowna (Mill) Creek are based upon Ministry criteria, while that for total zinc are based on working water quality criteria. These are proposed since high concentrations of these metals have been measured in the creek, mostly from stormwater, and the amounts of these metals from human activity should be minimized.

MONITORING RECOMMENDATIONS

A summary of recommended routine water quality monitoring is given in Table 5. Recommended monitoring is the minimum required to check that water quality objectives are being achieved, to finalize provisional objectives that have been proposed, or to increase the accuracy of the information collected.

The recommended montoring program is based upon technical considerations. Regional priorities and available resources are factors which could either limit or expand the program.

WATER QUALITY OBJECTIVES AND MONITORING TABLES

Table 1a. Provisional Water Quality Objectives for Tributaries to Okanagan Lake near Kelowna

Designated water uses are: aquatic life, wildlife, drinking water, livestock watering, irrigation, recreation.

Characteristic	Kelowna (Mill) and Mission Creeks
fecal coliforms	less than or equal to 100/100 mL, 90th percentile
Escherichia coli	less than or equal to 100/100 mL, 90th percentile
enterococci	less than or equal to 25/100 mL, 90th percentile
total ammonia nitrogen	AMMONIA (Total Ammonia Nitrogen to Protect Aquatic Life)
total nitrite nitrogen	NITRITE (Total Nitrite Nitrogen to Protect Aquatic Life)
periphyton chlorophyll-a	less than or eqiual to 100 mg/m^2 average
dissolved oxygen	8 mg/L minimum; 11.0 mg/L from November to April when salmonid embryoes and larvae are present
pH	6.5 to 9.0 in Mission Creek 6.5 to 8.5 in Kelowna Creek

Table 1b. Provisional Water Quality Objectives for Tributaries to Okanagan Lake near Kelowna

Designated water uses are: aquatic life, wildlife, drinking water, livestock watering, irrigation.

Characteristic	Kelowna (Mill) Creek
dissolved aluminum	0.1 mg/L maximum or 20% maximum increase whichever is greater

total copper	**less than or equal to values in micrograms/L hardness as mg/L $CaCO_3$ maximum: (0.094[hardness]+2) average: 0.04[hardness] or 20% maximum increase whichever is greater**
total zinc	**0.03 mg/L maximum or 20% maximum increase whichever is greater**
total lead	**less than or equal to values in micrograms/L hardness as mg/L $CaCO_3$ maximum: exp(1.273 ln[hardness]-1.460) average: 3.31 + exp (1.273 ln[hardness] -4.705) or 20% maximum increase whichever is greater 0.8 micrograms/g wet weight in edible fish muscle**

-The objectives apply to discrete samples from all parts of the water bodies, except from initial dilution zones of effluents. These excluded initial dilution zones are defined as extending up to 100 metres downstream from a discharge and occupying no more than 50% of the stream width around the discharge point, from the bed of the stream to the surface. This exclusion does not apply to objectives for fish as noted below.
-For fecal coliforms, enterococci, Escherichia coli and total lead and copper the mean and the 90th percentile are calculated from at least five weekly samples in a period of 30 days. For values recorded as less than the detection limit, the detection limit itself should be used in calculating the statistic.
-For total lead, copper and zinc the percent increase is over levels measured at a site upstream from the discharge or series of discharges and as close to them as possible and applies to downstream values.
-The maximum chlorophyll-a is based on an average calculated from a least five randomly located samples from natural substrates at each site on any sampling date
-Specific conductivity and pH measurements may be made in situ but must be confirmed in the laboratory if the objective is not achieved.
-For total lead eighty percent of the water samples must be less than or equal to 1.5 micrograms/L as a 30-day average.
-The only objective for Brandt's Creek is 1200 microS/cm as a maximum, from May to August, for wildlife and irrigation uses.

Table 5. Recommended Water Quality Monitoring for Tributaries to Okanagan Lake near Kelowna

Site Number	Location	Frequency and timing	Characteristics to be measured
0500045 0500046	Mission Creek	5 weekly samples in 30 days. Two periods: January to March and June to August	fecal coliforms, *Escherichia coli*, enterococci, total ammonia-N, nitrite-N, periphyton chlorophyll-a, pH, dissolved oxygen, chloride
0500038 0500039	Kelowna (Mill) Creek	5 weekly samples in 30 days. Two periods: January to March and June to August	fecal coliforms, *Escherichia coli*, enterococci, total ammonia-N, nitrite-N, periphyton chlorophyll-a, pH, dissolved oxygen, chloride, hardness, dissolved aluminum, total copper, lead and zinc
0500009 one site at the headwaters near the golf course	Brandt's Creek	5 weekly samples in 30 days. Two periods: January to March and June to August	fecal coliforms, *Escherichia coli*, enterococci, specific conductivity

-Sampling may need to be increased to check objectives, depending on circumstances
-Site numbers are those used by the Ministry of Environment in its computerized data

file.

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