ENVIRONMENTAL PROTECTION DIVISION

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MINISTRY OF ENVIRONMENT

Water Quality Assessment and Objectives for Kemp Lake Community Watershed

OVERVIEW REPORT

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SUMMARY

This document is one in a series that presents water quality objectives for British Columbia. This overview report summarizes the findings of the technical report, which is available as a separate document. The overview report provides general information about the water quality of Kemp Lake, which supplies drinking water to the Otter Point area on the western edge of Sooke, on the south coast of Vancouver Island in British Columbia. It is intended for both technical readers and for readers who may not be familiar with the process for setting water quality objectives. Separate tables listing water quality objectives and monitoring recommendations are included. The technical report presents the details of the water quality assessment for Kemp Lake, and forms the basis of the recommendations and objectives presented here.

The primary activities occurring within the watershed that could potentially impact water quality are rural residential, agricultural and light industrial land use, recreation, forestry and wildlife.

Water quality objectives are recommended to protect source water (raw drinking water supply), recreation, irrigation, wildlife and aquatic life.

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's (MoE) 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 future.

Authority to set Water Quality Objectives

The MoE has the authority to set water quality objectives under Section 5(e) of the *Environmental Management Act*. In addition, Section 150 of the *Forest and Range Practices Act* (FRPA) contains provisions for the MoE to establish objectives to protect water quality in designated community watersheds. This legislation is intended to protect consumptive uses of water in designated community watersheds within working Crown forests. For this reason water quality objectives developed for community watersheds generally focus on potential impacts from timber harvesting, range activities and forestry-related road construction.

Kemp Lake was designated as a community watershed in 1999, as defined under the *Forest Practices Code of British Columbia Act* ("the drainage area above the downstream point of diversion and which are licensed under the *Water Act* for waterworks purposes"). This designation was grandparented and continued under FRPA in 2004 and infers a level of protection. The purpose of this

designation is to conserve the quality, quantity and timing of water flow or prevent cumulative hydrological effects.

As most of the Kemp Lake community watershed is on private land, the FRPA does not apply to these parts of the watershed. However, the MOE uses other tools, such as water quality objectives, and legislation, such as the *Private Managed Forest Land Act* and the *Drinking Water Protection Act*, to encourage management and protection of water quality within these watersheds.

How Objectives Are Determined

Water quality objectives are the safe limits for the physical, chemical or biological characteristics of water, biota (plant and animal life) or sediment that protect all designated water uses in a given waterbody or a watershed. The water uses considered in this exercise are the following:

- source water for public water supply and food processing
- aquatic life and wildlife
- agriculture (livestock watering and irrigation)
- recreation and aesthetics
- industrial (e.g., food processing) water supplies.

Objectives are established in British Columbia for waterbodies on a site-specific basis taking into consideration provincial water quality guidelines, local water quality, water uses, water movement, waste discharges and socio-economic factors. 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 are not legally enforceable unless established under the Government Actions Regulation (B.C. Reg. 582/2004). Objectives are most commonly used to guide the evaluation of the state of water quality in a watershed, the issuance of permits, licenses and legal orders, and the management of fisheries and the province's land base. Water quality objectives are also a standard for assessing the ministry's performance in protecting water uses.

Monitoring Requirement

Monitoring of water quality objectives is undertaken to determine if the designated water uses are being protected. Monitoring usually takes place at a critical time when a water quality specialist has determined that the water quality objectives may not be met. In the case of forestry-related impacts, these critical times may be associated with periods of peak flows when the majority of suspended and dissolved particulates and other contaminants, such as bacteria, are introduced into a waterbody. Late summer periods of low flow could also be sensitive to impacts due to human disturbances. It is assumed that if all designated water uses are protected at the critical times, then they also will be protected at other times when the threat to water quality is less.

The monitoring usually takes place during a five-week period, twice during the calendar year which allows the specialists to measure the worst, as well as the average condition in the water. For some water bodies, the monitoring period and frequency may

vary, depending upon the nature of the problem, severity of threats to designated water uses and the way objectives are expressed (e.g. mean value, maximum value, 95th percentile, etc.). Lakes are generally sampled on a quarterly basis.

Vancouver Island Eco-Region Approach

There are over 60 community watersheds within the Vancouver Island Region of the Ministry of Environment. Rather than develop water quality objectives for each of these watersheds on an individual basis, an ecoregion approach has been implemented, whereby Vancouver Island has been split into six ecoregions based on similar climate, geology, soils and hydrology. Representative lake and stream watersheds within each ecoregion are selected and a three year monitoring program is implemented to collect water quality and quantity data, as well as biological data. Watershed objectives will be developed for each of the representative lake and stream watersheds based on this data, and these objectives will also be applied on an interim basis to the remaining lake and stream watersheds within that ecoregion. Over time, other priority watersheds within each ecoregion will be monitored for one year to verify the validity of the objectives developed for each ecoregion and to determine whether the objectives are being met for individual watersheds.

INTRODUCTION

This report examines the existing water quality of the Kemp Lake watershed and recommends water quality objectives for this watershed based on potential impacts of certain key water quality parameters of concern.

The Kemp Lake watershed provides drinking water to over 450 residences, or approximately 1,000 people, and has important fisheries values. Anthropogenic land uses within the watershed include rural residential, agricultural, light industrial, recreation and forestry. These activities, as well as natural erosion and the presence of wildlife, all potentially affect water quality in the Kemp Lake watershed.

The purpose of this report is to develop water quality objectives specific for Kemp Lake to help ensure long-term sustainability of the water resource.

BASIN PROFILE

Watershed Description

The Kemp Lake watershed, at approximately 620 ha in area, is relatively small. The lake itself has a surface area of 26 ha, a maximum depth of 11 m and a mean depth of 4.7 m. The lake is fed by Crossbow Creek and another small unnamed tributary and drains into Kemp Stream, a small creek about 1 km in length that empties into Juan de Fuca Strait. The elevation of Kemp Lake is 38 m, with elevations within the watershed ranging from approximately 280 m at its highest point, to sea level where it enters Juan de Fuca Strait (Figure 1).

Kemp Lake falls within the Leeward Island Mountains (LIM) ecoregion established for Vancouver Island by MOE staff.

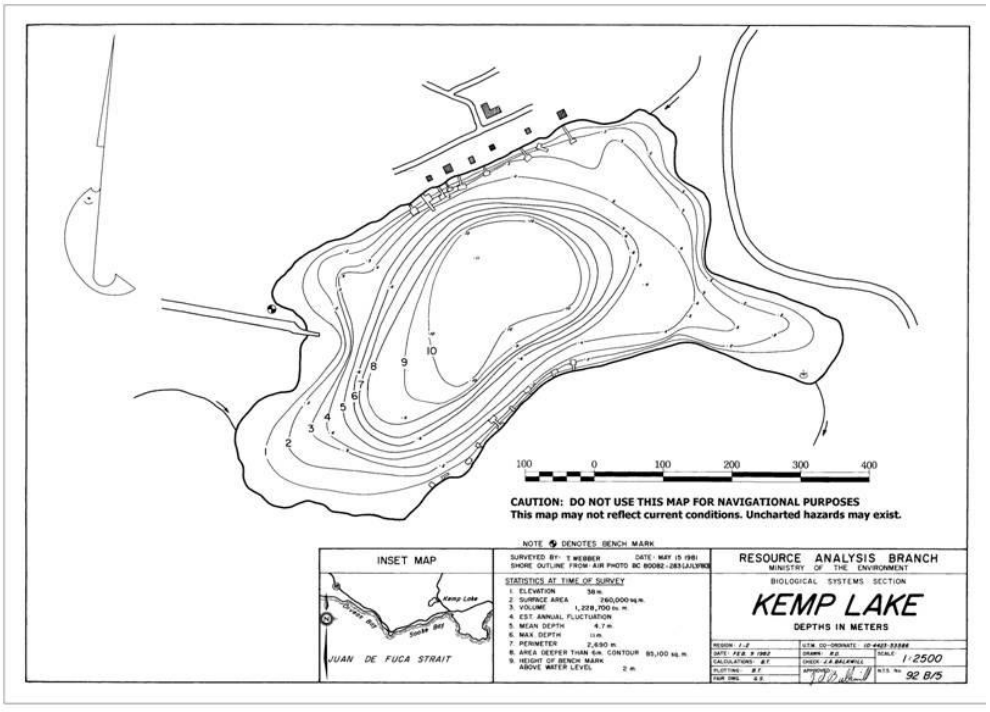

Figure 1. Overview Map of Kemp Lake, including sampling locations.

Hydrology

Water Survey Canada (WSC) operated a hydrometric station on Kemp Lake between 1982 and 1989. Water levels ranged from 1.245 m to 2.341 m, with an average of 1.600 m. Mean monthly discharge for Kemp Stream ranged from 3 litres/second to 449 litres/second with a mean annual discharge of 186 litres/second. Peak flows occurred during the winter corresponding to high rainfall.

Climate

The nearest climate station to the watershed for which climate normal data (1971-2000) are available is the Victoria Marine station (elevation 31.7 m) (Environment Canada Climate Station 1018642). Average daily temperatures range from 4.4°C in January to 14.3°C in August. Average total annual precipitation is 1,266 mm, with only 32 mm (water equivalent) (3%) of this falling as snow. Most precipitation (1,008 mm, or 80%) falls between October and March, resulting in peak water levels during this period.

Water Uses

Water Licenses

Six water licenses have been issued for Kemp Lake, two to the Kemp Lake waterworks district, three for domestic use, and one for irrigation. The waterworks district is licensed to withdraw 165.9 dam^3/yr, and in 2008 they pumped approximately 104.2 dam^3 of water. The domestic licenses allow a total withdrawal of 3.3 dam^3/yr and the irrigation license allows 6.2 dam^3/yr.

Recreation

Kemp Lake is easily accessible by road and supports a recreational fishery for cutthroat trout, rainbow trout and smallmouth bass. There is a boat launch, but only non-motorized vessels are permitted on the lake. There are designated public access areas as well, utilized during the summer months.

Fisheries

Kemp Lake supports a recreational fishery, and cutthroat trout, rainbow trout, prickly sculpin, threespine stickleback and smallmouth bass are present. The non-native smallmouth bass were introduced illegally to the lake sometime after 1983. Both cutthroat trout and rainbow trout have been stocked regularly in the lake.

Flora and Fauna

The Kemp Lake watershed provides habitat to a variety of species typical of west coast Vancouver Island, including blacktail deer, black bear, cougar, and numerous other small mammals and birds. The BC Conservation Data Centre reports the presence of one blue-listed vertebrate species, the Anguinae subspecies of ermine (*Mustela erminea anguinae*).

Designated Uses

Based on the information presented here, the water uses to be protected should include drinking water, irrigation, primary-contact recreation, aquatic life and wildlife.

Influences on Water Quality

Land Ownership

Most of the land within the Kemp Lake watershed is privately owned, with a small portion on crown land. There are a number of private residences within the watershed, some hobby farms, as well as a light industrial area.

A risk assessment of the watershed as a drinking water supply, completed in 2003, suggests that the highest potential risks to water quality are related to run off from mixed land use including roads, light industrial activities, agriculture, and failing or poorly designed septic fields. The light industrial area is subject to a covenant that lists activities that will only be permitted if it is proven that the activities will not discharge or release substances into the storm water which would have an adverse effect on the quality of drinking water in Kemp Lake.

The drainage for the western portion of the watershed, which is primarily rural residential and agricultural use, has been channeled into road-side ditches that flow into Crossbow Creek near its drainage into Kemp Lake.

Water Licenses

Water licenses can impact aquatic habitat downstream from the withdrawal, especially during low-flow periods. There are six licensed water withdrawals from Kemp Lake, with an overall maximum volume of 175.4 dam^3/yr. Outflow from the lake into Kemp Stream is minimal during the summer months and the Sooke Water Allocation Plan recommends water withdrawals only when

flows exceed 60% of mean annual discharge. In the case of Kemp Stream, this would mean that withdrawals would only be permitted between the months of October and April, inclusive. It is likely that Kemp Stream has low summer flows either naturally or due to factors other than licenced water withdrawals, as the water withdrawals during May to September total less than 6% of the lake's volume.

Forest Harvesting and Forest Roads

Forestry activities can impact water quality both directly and indirectly in several ways. The removal of trees can decrease water retention times within the watershed and result in a more rapid response to precipitation events and earlier and higher spring freshets. The improper construction of roads can change drainage patterns, destabilize slopes and introduce high concentrations of sediment to streams.

Because most of the land base within the Kemp Lake watershed is privately owned, any logging activity would be primarily by private land owners; this could potentially affect water quality in Kemp Lake. However, the risk assessment conducted in 2003 ranks the potential impacts to drinking water quality in Kemp Lake from these types of activities as low.

Recreation

Recreational activities can affect water quality in a number of ways. Erosion associated with 4-wheel drive and ATV vehicles, direct contamination of water from vehicle fuel, and fecal contamination from human and domestic animal wastes (*e.g.*, dogs or horses) are typical examples of potential effects.

Activities such as camping, ATV use, fishing and hunting may occur at various times of the year throughout the watershed. These land based activities increase the risk of forest fires within the watershed, and their associated impacts on water quality, such as sediment fluxes and an increase of nutrient loads. Activities such as swimming and fishing on Kemp Lake can potentially impact water quality in a number of ways. Microbiological contamination can be associated with swimmers and pets. The prohibition of motorized vessels on Kemp Lake lessens the risk posed by recreational fishing, although the potential for spills from batteries or other equipment does exist.

Wildlife

Warm-blooded animals can carry microorganisms such as *Giardia lamblia* and *Cryptosporidium*, which are harmful to humans, causing gastrointestinal disease.

The Kemp Lake watershed contains valuable wildlife habitat, and provides a home for a wide variety of warm-blooded species including large numbers of waterfowl. Therefore, a risk of fecal contamination from natural wildlife populations within the watershed does exist.

WATER QUALITY ASSESSMENT AND OBJECTIVES

Water Quality Assessment

One sampling site was established at the deepest part of the lake, near the centre. Physical, chemical and biological parameters were collected on a quarterly between February and November from 2005 to 2010.

The monitoring results for Kemp Lake show that water quality is generally quite good. All chemical, physical and biological parameters met provincial water quality guidelines with the exception of temperature, dissolved oxygen, pH, turbidity, total organic carbon, total phosphorus and some metals, which exceeded the drinking water and/or aquatic life guidelines on occasion.

Summer surface water temperatures were relatively high in Kemp Lake, which would typically require fish to stay at or below the thermocline to avoid physiological stress associated with higher water temperatures. To maintain a refuge for fish, a water quality objective for temperature is proposed. As summer surface temperatures exceed the aesthetic drinking water guideline, placing water intake below the thermocline depth would allow this guideline to be met.

Dissolved oxygen levels remained high in the surface waters, but when the lake was stratified the dissolved oxygen concentration decreased with depth to levels that did not meet the aquatic life guideline. As dissolved oxygen concentrations may be a concern, an objective is proposed.

All extinction depth (Secchi) readings met the recreational guideline. To ensure that Secchi depths are maintained, a water quality objective is proposed.

Occasional low pH appears to be a natural phenomenon in Kemp Lake and it is not likely that anthropogenic activities will impact pH in this lake. No objective is proposed.

Turbidity values were consistently low in Kemp Lake, except for three values measured near the lake bottom. The high turbidity values may have been related to a cycle of algae die-off, depleted oxygen and potentially nutrient re-release during the late summer and early fall. A water quality objective is proposed.

Colour and total organic carbon both exceeded the drinking water guidelines on many occasions. It is believed that these exceedances are largely natural, however it is possible that anthropogenic activities such as agricultural and rural residential land use are further increasing these parameters by contributing nutrients to the lake, which causes algae blooms and subsequent late summer and early fall die-offs. As such, water quality objectives are proposed.

Specific conductivity values measured in Kemp Lake were typical of coastal systems. No objective is proposed.

Nitrate and nitrite concentrations were well below the aquatic life guidelines and no objective is proposed for these parameters.

Total phosphorus concentrations occasionally exceeded the drinking water and recreation guidelines. It is possible that anthropogenic land use is contributing to elevated measurements, and that the lake

experiences late summer and early fall algae die-off, low oxygen at depth, and nutrient re-release into the water column. An objective is proposed.

Concentrations of total iron, total copper and total cadmium occasionally exceeded the aquatic life guidelines. Although dissolved aluminum was not measured, total aluminum occasionally exceeded the dissolved aluminum guideline for aquatic life. It is possible that the elevated iron concentrations may be related to low-oxygen conditions and the release of iron bound to phosphorus during anoxic conditions, however there is not enough information to develop an objective for iron at this time. Elevated aluminum levels appear to be a natural occurrence on Vancouver Island, and the result in Kemp Lake is unlikely a concern. The total cadmium exceedance is difficult to interpret due to a detection limit that is too near to the guideline, and the total copper exceedance appears to be an anomaly. No objectives are proposed for metals in Kemp Lake.

Chlorophyll *a* measured in Kemp Lake was generally low, with the exception of one anomalous value. The low dissolved oxygen and high phosphorus at depths in the summer and fall suggest that the lake is being affected by land use and experience internal nutrient loading. For this reason, a chlorophyll *a* objective is proposed.

Water Quality Objectives

Water quality objectives have been set for key drinking water and aquatic life characteristics for Kemp Lake (Table 1). These objectives will also protect wildlife, irrigation and recreation for these characteristics. The water quality objectives recommended here take into account background conditions, impacts form current land use and any potential future impacts that may arise within the watershed. The objectives are required to ensure that inputs from rural residential, agricultural, light industrial, recreational and forestry land use do not impair water uses. The objectives apply to the watershed above the community water supply intake.

Table 1. Summary of proposed water quality objectives for Kemp Lake.

Variable	Objective Value
Water temperature	≤ 15°C summer maximum hypolimnetic temperature (> 5 m depth)
Dissolved oxygen	≥ 5 mg/L > 2 m above lake bottom ≥ 2 mg/L ≤ 2 m above lake bottom (May-August)
Secchi depth	≥ 4 m annual average
Turbidity	≤ 2 NTU maximum < 1 NTU 95% of the time
True colour	≤ 20 TCU maximum
Total organic carbon	≤ 6 mg/L maximum
Total phosphorus	≤10 µg/L maximum during spring overturn
Chlorophyll *a*	1.5 µg/L to 2.5 µg/L (May-August)

Monitoring Recommendations

The recommended minimum monitoring program for Kemp Lake is summarized in Table 2. In order to capture the periods where water quality concerns are most likely to occur (i.e., winter rains and summer low-flow, as well as spring overturn) we recommend quarterly sampling for a one year period. In addition, microbiological and general water

chemistry samples should be collected at the intake site once weekly for five consecutive weeks within a 30-day period both in late summer and mid-fall. Samples collected during the fall months should coincide with rain events whenever possible. In this way, the two critical periods (minimum dilution and maximum turbidity) will be monitored.

Table 2. Proposed schedule for future monitoring in Kemp Lake.

Frequency and timing	Characteristic to be measured
Deep station site (3 depths per site) - quarterly sampling (March, May, August, October)	pH, specific conductivity, turbidity, colour, TOC, DOC, nitrogen species, total phosphorus, total and dissolved metals including iron and hardness (spring overturn only), *chlorophyll a,* DO, temp profiles and Secchi disk
Intake site – 5-in-30 sampling in summer and fall	Turbidity, TOC, total and dissolved metals including iron, hardness, *E. coli*
Deep station site - twice per year (spring overturn and summer)	Phytoplankton and zooplankton