



ENVIRONMENTAL PROTECTION DIVISION
ENVIRONMENTAL SUSTAINABILITY DIVISION
MINISTRY OF ENVIRONMENT

**Water Quality Assessment and Objectives
for the Mercantile Creek 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 Mercantile Creek, a community watershed supplying drinking water to the community of Ucluelet on 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 Mercantile Creek, and forms the basis of the recommendations and objectives presented here.

The primary activities within the watershed that could potentially impact water quality are recreation and historical timber harvesting.

Water quality objectives are recommended to protect source water (raw drinking water supply), 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.

Mercantile Creek was designated as a community watershed in 1995, 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.

In the 2011 ratification of the Maa-nulth Treaty, ownership of the watershed was transferred to the Ucluelet First Nation, and the standards and objectives under the community watershed designation still apply. In addition, 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 ensure that water quality within these watersheds is protected and managed in a consistent manner.

How Objectives Are Determined

Water quality objectives are the safe limits for the physical, chemical, and biological characteristics of water, biota (plant and animal life), and 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, and waste discharges. 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, and biological characteristics affecting that waterbody.

How Objectives Are Used

In certain cases, objectives are used to address specific legislative requirements (e.g., *Water Act*, Municipal Sewage Regulation, Private Managed Forest Land Council Regulation). However, compliance with water quality objectives is often not directly 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.).

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 Mercantile Creek community watershed and recommends water quality objectives for this watershed based on potential impacts of certain key water quality parameters of concern.

Mercantile Creek provides a significant source of drinking water to the local community and has important fisheries values, with chum and coho, resident cutthroat and Dolly Varden char all present at some point during the year. Anthropogenic land uses within the watershed include timber harvesting and recreation. These activities, as well as natural erosion and the presence of wildlife, all potentially affect water quality in Mercantile Creek.

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

BASIN PROFILE

Watershed Description

Mercantile Creek is a second-order stream 8.89 km in length, draining into the Ucluelet Inlet near the community of Ucluelet, BC. The community watershed portion of the Mercantile Creek watershed is 7.5 km long, 1,142 ha in area, and ranges from 40m at the intake to 774 m elevation at Mount Frederick in the upper watershed (Figure 1). There are no lakes within the watershed boundaries.

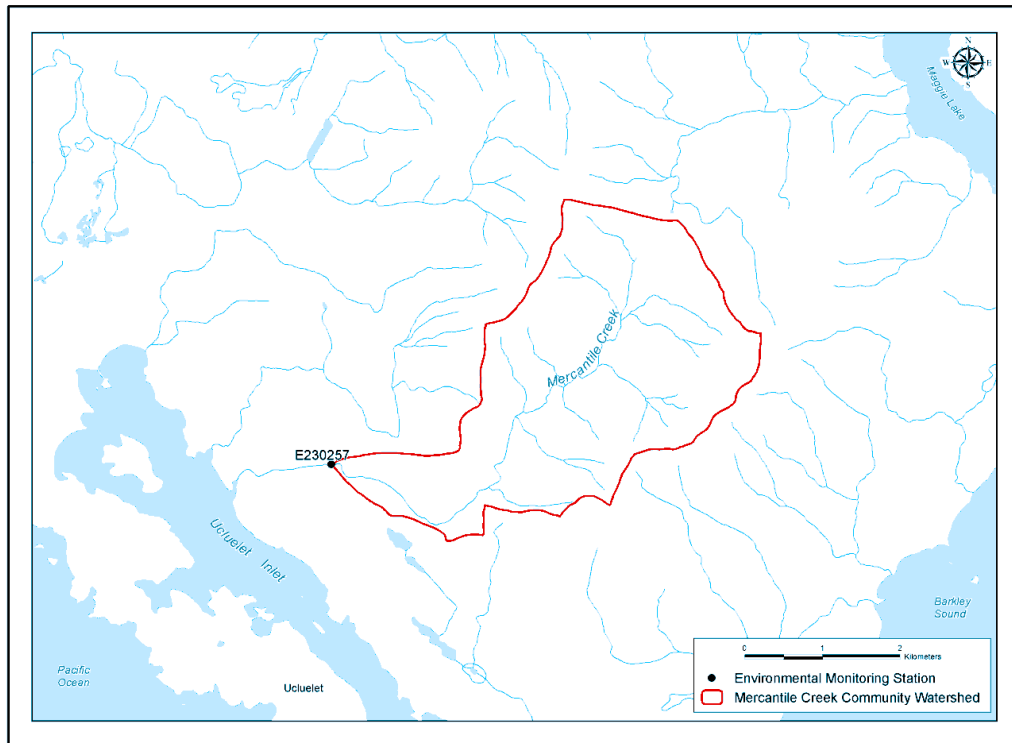


Figure 1. Map of Mercantile Creek watershed, with sampling location

The entire watershed falls within the Coastal Western Hemlock (submontane very wet maritime, CWHvm1) biogeoclimatic zone. Mercantile Creek falls within the Windward Island Mountain (WIM) ecoregion established for Vancouver Island by MOE staff. The bedrock of the area consists of granodioritic intrusive rock, calc-alkaline volcanic rock and undivided intrusive rock.

Hydrology

Water Survey Canada (WSC) operated a hydrometric station on Mercantile Creek between 1979 and 1984. While no hydrometric data were available for this site between December and April, it is expected that water levels are generally high during this period due

to high rainfall at lower elevations in the watershed. Peak flows measured between 1979 and 1984 were approximately 20.300 m³/s, while minimum flows were approximately 0.106 m³/s.

Climate

The nearest climate station to the watershed for which climate normal data are available is the Tofino A station (elevation 24.1 m) (Environment Canada Climate Station 1038205). Average daily temperatures between 1971 and 2000 ranged from 4.5°C in January to 14.8°C in August. Average total annual precipitation between 1971 and 2000 was 3,305.9 mm, with only 42.8 mm (water equivalent) (1%) of this falling as snow. Temperatures at higher elevations in the watershed would be cooler than recorded at sea level. A larger portion of the annual total precipitation occurs as snowfall in the higher-elevation terrain of the watershed. Most precipitation (2,449.6 mm, or 74%) fell between October and March.

Water Uses

Water Licenses

Seven water licenses have been issued for Mercantile Creek, allowing for the withdrawal of 1,467.73 dam³/a annually. The District of Ucluelet supplies water to approximately 2,200 users and also utilizes groundwater from the Wellfield aquifer when turbidity is elevated in Mercantile Creek.

Recreation

A logging road runs parallel with, and near, the mainstem of Mercantile Creek, and allows access to most of the watershed.

Though there are no sanctioned camping areas in the watershed, the proximity of the watershed to the community of Ucluelet, coupled with the high number of tourists that visit the area during the summer and the fact that access to the watershed is unrestricted, results in recreational use of the watershed. This use includes hiking, mountain biking, and ATV riding, as well as hunting in the fall.

Fisheries

Mercantile Creek has high fisheries values, and is utilized by coho (*O. kisutch*) and chum (*O. keta*) salmon below a set of falls, with chum as the dominant species. Cutthroat trout (*O. clarkii*) and Dolly Varden char (*Salvelinus malma*) inhabit the creek above the falls.

Flora and Fauna

The Mercantile Creek watershed provides habitat to a variety of species typical of west coast Vancouver Island, including blacktail deer (*Odocoileus hemionus columbianus*), black bear (*Ursus americanus*), cougar (*Puma concolor*), and numerous other small mammals and birds. However, the BC Conservation Data Centre does not show any sensitive species occurrences within the watershed boundaries.

Designated Uses

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

Influences on Water Quality

Land Ownership

In the 2011 ratification of the Maa-nulth Treaty, ownership of the watershed was transferred to the Ucluelet First Nation, which now has governance power over the land. The community watershed designation remains in effect and the standards and objectives associated with that designation continue to apply. The community watershed portion of Mercantile Creek contains no private households located within its boundaries. Thus, potential sources of contamination associated with households (such as runoff, septic fields, fertilizers and pesticides) will not impact water quality in the Mercantile Creek.

Water Licenses

Water licenses can impact aquatic habitat downstream from the withdrawal, especially during low-flow periods. There are seven licensed water withdrawals from Mercantile Creek with an overall maximum volume of 1,467.73 dam³/a. Assuming water was withdrawn from Mercantile Creek at a constant rate throughout the year (an unlikely scenario), the average withdrawal rate would be about 0.047 m³/s. As average daily flows between 1979 and 1984 ranged from 0.106 m³/s during the mid-summer to 20.300 m³/s during spring rain on snow events, water withdrawals are likely to impact downstream flows in Mercantile Creek only during summer low-flow periods when water consumption is highest.

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 rain on snow events. The improper construction of roads can change drainage patterns, destabilize slopes and introduce high concentrations of sediment to streams.

Extensive forest harvesting has occurred within the Mercantile Creek watershed, primarily between the mid-1950s and early 1960s, with a number of small blocks harvested in the 1980s and 1990s. As of 1996, 78% of the watershed had been harvested. Hazard indices calculated for the watershed as part of the 1996 Coastal Watershed Assessment show that the watershed has been highly impacted by logging activities and road construction, with all indices exceeding 0.93 (below 0.5 indicates a low potential impact, 0.5 to 0.7 indicates a moderate potential impact, and a value greater than 0.7 indicates a high potential impact).

Contributing to these high hazard indices for Mercantile Creek are the large percentage (78%) of the watershed that has been harvested and several of the activities associated with timber harvesting. In 1996 the weighted equivalent clearcut area (ECA) remained at 61%. In addition, 36 km of roads have been constructed in this small watershed, resulting in a concentration of 3.17 km of road per square kilometer of watershed. Of this, 0.33 km/km² are on erodible soils and 1.09 km/km² are located near streams (increasing the likelihood of suspended sediments associated with runoff from the roads entering the stream). Finally, there are 1.48 stream crossings per square kilometer of watershed, which is considered high. Of the total stream bank (including tributaries), 77% was logged as of 1996, including 66% of the fish-bearing portion of the stream. In all, 51% of the mainstem was logged. There were also a large number of landslides noted within the

watershed (17 as of 1996), resulting in a concentration of 1.3 slides/km², also considered high. Further contributing to potential landslides is the fact that 0.33 km/km² of roads are constructed on unstable terrain, and 12% of the watershed is logged on unstable or potentially unstable terrain.

In January 2005, a large debris torrent swept down one of the lower tributaries to Mercantile Creek, carrying huge volumes of rock, soils, vegetation and other debris to the mainstem of Mercantile Creek. This resulted in the water intake being closed due to extremely high suspended sediment and turbidity levels, and the District of Ucluelet was forced to rely on groundwater from the Wellfield aquifer for their drinking water.

Significant impacts have occurred to the watershed from historic road building and forest harvesting activities. Due to the relatively high concentration of roads within the watershed, and especially adjacent to the creek, runoff from these roads has the potential to impact turbidity levels in the creek, particularly during periods of road grading or road construction. Potential impacts from these roads may continue for some time but will decrease as roads are deactivated and reclaimed.

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. While no specific studies have been conducted on recreation within the Mercantile Creek watershed, limited seasonal impacts are likely (primarily during the

summer months) but remain relatively insignificant compared with other impacts that have occurred.

Wildlife

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

Mercantile Creek contains valuable wildlife habitat, and provides a home for a wide variety of warm-blooded species. Therefore, the risk of contamination from endemic wildlife exists.

Mining and Mineral Claims

Mining activities can impact water quality by introducing high concentrations of metals to the watershed, depending on the location, and can also contribute to acidification of the water.

There is one mineral prospect in the Mercantile Creek watershed, located in the far upper reaches of the watershed, and has not been developed.

WATER QUALITY ASSESSMENT AND OBJECTIVES

Water Quality Assessment

One water quality monitoring location was established within the Mercantile Creek community watershed: Site E230257 is located near the District of Ucluelet water intake. To represent the worst case scenario, water samples were collected at the site on a weekly basis for five consecutive weeks during the summer low flow and fall high flow periods from 2002 to 2005, and usually on a monthly basis for the remainder of the year between 2002 to early 2006.

An automated water quality station was also installed at the site from June 2004 to May 2005 to measure turbidity, conductivity, temperature and water level.

The monitoring results for Mercantile Creek show that water quality has been consistently good over the period of study. There are a few exceedances (temperature, turbidity, aluminum, fecal coliforms and *Escherichia coli*) which have been associated either with rainfall events or summer low flows. Parameters of importance include temperature, true colour, total organic carbon, metals, microbiological indicators, turbidity, and total suspended solids (TSS).

Water temperatures exceeded the aesthetic drinking water guideline for a few days in July and August 2004. Temperatures were below the salmonid spawning guideline during the fall period when chum and coho spawn. Temperature data were only collected for one summer period, but it is likely that the aesthetic drinking water guideline is exceeded occasionally each year.

Turbidity levels in Mercantile Creek were generally good throughout the year, with an average of 0.8 NTU for the 42 samples collected throughout the monitoring program. Turbidity was higher in Mercantile Creek than in McKelvie Creek, the representative watershed for background conditions in the Windward Island Mountains ecoregion. The higher turbidity in Mercantile Creek is likely related to forestry impacts. Elevated levels generally occurred between November and February, and were usually associated with rainfall.

Total suspended solids concentrations (also referred to as non-filterable residue) were typically low with elevated values generally occurring after rain events.

Both true color and total organic carbon (TOC) values remained below the BC drinking water and aesthetic guidelines. However there are a few elevated measurements for each parameter. The District of Ucluelet currently disinfects with chlorine, which can result in disinfection byproducts such as trihalomethanes when raw water has high colour or TOC. As such, these parameters should continue to be monitored.

Nutrient values were generally low. MoE is working towards a phosphorous objective for Vancouver Island streams. Phosphorous data should continue to be collected, and the need for a phosphorous objective should be re-evaluated after the next attainment monitoring period.

Due to natural geography of the area, coupled with increased sediment transport rates related to previous forestry activities in the watershed, Mercantile Creek has occasional exceedances of the aquatic life and drinking water guidelines for dissolved aluminum.

Attainment monitoring should show a decrease in aluminum as the watershed recovers from forestry impacts.

Naturally occurring organics in the watershed can bind substantial proportions of the metals which are present, forming metal complexes which are not biologically available. To aid in the future development of metals objectives, monitoring levels of organics, as measured by dissolved organic carbon (DOC), has been recommended. As increasing water hardness can affect the toxicity of some metals to some organisms, hardness has also been included in the Mercantile Creek monitoring program.

Concentrations of microbiological indicators were at times elevated during the low flow and high flow sampling periods. The drinking water guideline for water receiving disinfection only was exceeded in three of the five sample sets (five samples in 30 days) for *E. coli*. While the source of these coliforms is not known and may not be related to anthropogenic activities within the watershed, the increased sediment transport rates associated with previous forestry activities may be contributing to elevated microbiological concentrations. *E. coli* should continue to be monitored and assessed. These exceedances demonstrate the need to treat water for human consumption to prevent potential health risks.

Water Quality Objectives

Water quality objectives set for TSS (or non-filterable residue) and dissolved aluminum are for the protection of aquatic life, while the remaining objectives are for the protection of drinking water (Table 1). These objectives will also protect wildlife and aquatic life for these characteristics. Objectives are often developed using the background concentration approach, where data collected reflect natural or background conditions in the watershed. As the

watershed has shown significant impacts from previous forestry activity, any parameters that were likely influenced by forestry-related impacts (turbidity, TSS, dissolved aluminum and *E. coli*) were based instead on McKelvie Creek, the representative watershed for background conditions in the Windward Island Mountains ecoregion. The objectives are required to ensure that inputs from forestry activities and recreation do not impair water uses. The objectives apply to the watershed above the community water supply intake.

Monitoring Recommendations

The recommended minimum monitoring program for the Mercantile Creek watershed is summarized in Table 2. In order to capture the periods where water quality concerns are most likely to occur (i.e., summer low-flow and fall flush) we recommend that a minimum of five weekly samples be collected within a 30-day period between July and August, as well as during the first heavy rainfall in the fall. Samples collected during the fall should coincide with rain events whenever possible. In this way, the two critical periods (minimum dilution and maximum turbidity) will be monitored. Benthic invertebrate monitoring is proposed to provide a better understanding of the overall ecosystem health.

Table 1. Summary of proposed Water Quality Objectives for the Mercantile Creek community watershed.

Variable	Objective Value
Temperature	15°C (max)
Turbidity	5 NTU (max) 2 NTU (mean)
Non-filterable Residue (TSS)	26 mg/L (max) 6 mg/L (mean)
True Colour	15 TCU (max)
Total Organic Carbon	4.0 mg/L (max)
Dissolved Aluminum	0.10 mg/L (max) 0.05 mg/L (mean)
<i>Escherichia coli</i>	≤60 CFU/100 mL (90 th percentile)

Note: all calculations are based on a minimum of 5 samples in 30 days

Table 2. Proposed schedule for future water quality and benthic invertebrate monitoring in Mercantile Creek.

Frequency and timing	Parameters to be measured
Mid-July to mid-August (low-flow season): five weekly samples in a 30-day period	pH, specific conductivity, TSS, turbidity, true colour, DOC, TOC, total phosphorus, dissolved metals, hardness, <i>E. coli</i> , and temperature
Approximately October to November (fall flush): five weekly samples in a 30-day period	pH, specific conductivity, TSS, turbidity, true colour, DOC, TOC, total phosphorus, dissolved metals, hardness, <i>E. coli</i> , and temperature
Once every five years	Benthic invertebrate sampling