Drinking Water Source Quality Monitoring 2002-03

Lakelse Lake and Mountain Creek Surface Water, and Jackpine Flats Groundwater

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SUMMARY

Recent drinking water studies have noted source quality concerns at Lakelse Lake, and before this study there was very little information about groundwater quality in Jackpine Flats. Interest by the Regional District of Kitimat-Stikine (RDKS) and the Lakelse Watershed Stewards (LWS) have brought Lakelse/Jackpine Flats water quality concerns to the forefront and a comprehensive sampling program was designed in consultation with Northern Health Authority (NHA) and RDKS representatives. It was designed to provide information for both the Lakelse Lake Management Plan and the Liquid Waste Management Plan currently under development.

In August and October 2002, and April and August 2003, samples were collected to investigate the quality of water sources including Lakelse Lake, Mountain Creek, and groundwater in the aquifer under Jackpine Flats. The program started with six sites (three at Lakelse Lake, three in Jackpine Flats), and was expanded over the monitoring program to include 12 sites. Five samples were collected from each site within a 30-day period in each sampling season. The samples were analyzed for three microbiological indicators (fecal coliforms, *E. coli* and enterococci), colour and turbidity. In each season, one sample from each site was analyzed for a comprehensive range of physical and chemical parameters to determine overall water quality and to identify potential contamination by domestic sewage and agricultural waste.

Lab results were compared to WLAP approved and working guidelines for drinking water quality. At surface water sites (Lakelse Lake and Mountain Creek), 90th percentiles were calculated for the microbiological indicator concentrations, and the results were compared to the guideline level for water that will receive *Disinfection Only* (which is the minimum treatment requirement for surface water sources under the Drinking Water Protection Regulation). For groundwater sites (Jackpine Flats), the *No Treatment* guideline was applied.

- Lakelse Lake surface water was sampled at three locations to investigate potential contamination from malfunctioning sewage disposal systems on low-lying lakeshore lots.

    - All three microbiological indicators were detected. WLAP guidelines for fecal coliforms and *E. coli* were met at all times, but the enterococci guideline was not met in three of 20 sample sets.
    - Most samples met the WLAP guideline for turbidity. Colour values did not meet the guideline level in April 2003.
    - Iron exceeded the WLAP aesthetic guideline at all three sites in April 2003, and phosphorus exceeded the guideline at one site in April 2003. Neither element poses a health risk at observed concentrations. Other physical and chemical parameters were all below (WLAP) guideline levels on all dates at all sites.

- Mountain Creek serves as the water source for a large resort, and was sampled at the intake site to determine source water quality.

    - Fecal coliforms and enterococci were each found in one of 10 samples, and *E. coli* were not detected. WLAP *Disinfection Only* guidelines for all three indicators were met.
    - Turbidity, colour, and other physical and chemical parameters were well below guideline levels.

- Jackpine Flats groundwater was sampled at nine sampling sites to investigate possible contamination of groundwater from on-site sewage disposal systems and other land use activities.

    - Microbiological indicators were found in six of 94 samples (enterococci in five samples, fecal coliforms in one sample); these samples did not meet the WLAP (*No Treatment*) guidelines that apply for groundwater.
    - Most samples met the ≤ 5 NTU turbidity guideline, except at one site. Colour values were generally below the guideline level.
    - Iron and manganese exceeded aesthetic guidelines on isolated occasions. Observed concentrations are not expected to pose a health risk, but further sampling and research is suggested. Other physical and chemical parameters were below guideline levels.
    - Low specific conductance values suggest that surface water is being transmitted into the groundwater.
    - Generally, results do not suggest widespread contamination in the aquifer under the subdivision, and give no evidence of a "plume" of contamination in the groundwater.
    - Occasional low-level detections of nitrate, chloride and ammonia suggest possible localized influences on groundwater quality. Low levels of contamination, combined with the permeable ground and shallow depth to groundwater, are cause for concern and warrant ongoing consideration as to how safe drinking water may be consistently obtained.

Based on monitoring conducted in 2002-2003, we recommend that:

- WLAP should continue to collaborate with agencies interested in water quality, and periodic monitoring of Lakelse Lake and Jackpine Flats should continue at the established sampling sites.
- Through collaboration with NHA staff, residents should be informed of the need to disinfect surface water supplies prior to consumption.
- Residents should be educated about the risks that land use activities pose on nearby surface water sources and groundwater wells. Groundwater users should be reminded about the importance of adequate well head protection, and lake water users should be encouraged to extend intake their pipes further into the lake to avoid potential sources of contamination.

- Although sampling results have already been provided to those using each source, drinking water source quality data should be made available to other interested parties.
- Monitoring programs should continue to include sampling in different seasons to investigate seasonal water quality.
- Enterococci and *E. coli*. should remain in use and should be considered in water quality objectives development and updates.
- Groundwater flow patterns in Jackpine Flats should be determined, and if required, monitoring locations should be adjusted accordingly.

ACKNOWLEDGEMENTS

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Representatives from the Northern Health Authority (NHA) and Regional District of Kitimat-Stikine (RDKS) helped design the 2002-03 monitoring program for Lakelse Lake and Jackpine Flats. The Jackpine Flats sampling sites were recommended by Russell Seltenrich (Environmental Health Officer, NHA) and Roger Tooms (Works and Services Manager, RDKS).

Samples were collected by A.J. Downie, Julia Kokelj and Helen Joseph (Ministry of Water, Land and Air Protection) with the help of trained volunteers including Heather Lamson (Northwest Stewardship Society), Michael Bowen-Colhurst (Waterlily Bay Resort), and John How (Lakelse Watershed Stewards). Julia Kokelj also provided input and advice for this project, and Sean Sharpe, Jeannette Lough, Les Swain, Kevin Rieberger (all from WLAP) and Bob Watson and Ron Craig (NHA) helped edit the draft reports.

CONTENTS

Table of Contents

List of Tables

List of Figures

1.0 INTRODUCTION

This document is part of a series presenting results of the B.C. Ministry of Water, Land and Air Protection (WLAP) Skeena Region's 2002-03 drinking water source quality monitoring program. It assesses drinking water sources in the Lakelse Lake and Jackpine Flats area, outlines water quality monitoring conducted in 2002-03, and presents the results of this work. Recommendations for future monitoring in the Lakelse/Jackpine area are included.

1.1 Provincial Expanded Water Quality Monitoring Program

A safe and dependable supply of drinking water is critical to the health of all British Columbians. Recent reviews and reports have identified public health concerns relating to the quality of drinking water in B.C. and the provincial government has created a Drinking Water Action Plan to prevent contamination, identify potential risks and improve water quality. The Plan recognizes that while the safety of drinking water is a health issue, providing safe drinking water requires an integrated approach and source protection is critical (Province of B.C., Provincial Health Officer, 2001; Ministry of Health website, 2002). In 2003, the new Drinking Water Protection Act and regulations were brought into force to protect drinking water in B.C. WLAP is responsible for managing and regulating activities in watersheds that have a potential to affect water quality. It monitors water quality at the source, and is mandated to provide and promote improved monitoring related to the protection of drinking water sources. Additional information about the Drinking Water Action Plan, and the Act and regulations, can be found on the Ministry of Health website (http://www.healthservices.gov.bc.ca/protect/water.html).

1.2 Skeena Region Overview

The Skeena Region covers an area of 266,441 km^2 (29% of the province) in the northwest quadrant of British Columbia. It includes the geographic area between Endako (near Burns Lake) in the east to Haida Gwaii (Queen Charlotte Islands) in the west; from Kitimat and North Tweedsmuir in the south to the Yukon and USA borders in the north. The region is relatively unpopulated; there are no large urban centers, and few communities are populated by greater than 5,000 people. Most of the region's communities are located along the Highway 16 corridor.

Water is abundant in the Skeena Region, and most drinking water systems use surface water sources. Despite the fact that the Drinking Water Protection Regulation requires surface water sources to be disinfected, it is known many do not employ any or adequate forms of treatment. There are very few large water suppliers in the region, and small water suppliers and private (single connection) water systems serve most of the population.

Figure 1: Skeena Region showing location of Lakelse/Jackpine Flats

1.3 Lakelse/Jackpine Area Overview

Lakelse Lake is located on the eastern margin of the Coast Range Mountains, approximately 10 km south from the city of Terrace. The lake has relatively low nutrient concentrations and good water clarity, making it an important recreational and fisheries resource. In addition to a large park, there are approximately 200 developed waterfront lots around the lake. The eastern shore of the lake contains about 120 developed waterfront lots, many of which lie below the predicted 1 in 200 year flood elevation (Stantec, 2000). Lakelse Lake is a drinking water source for many lakeshore residents.

Jackpine Flats is a rural subdivision located between the city of Terrace and Lakelse Lake. It consists of approximately 100 parcels of land zoned as high and low-density rural lots (2-10 acre parcel size). Most of the lots contain single family residences, and there are a few "hobby farms" in the area. Much of the subdivision has been logged and what little topsoil existed has been lost in many areas. The underlying substrate is largely coarse gravel, stones and cobbles, and the water table is very shallow (Stantec, 2000). The primary drinking water source in Jackpine Flats is groundwater, and most lots have private wells.

Recent drinking water quality studies have noted source quality concerns at Lakelse Lake (Remington, 2002). Prior to this study, there was very little information about groundwater quality in Jackpine Flats. In 2002, WLAP prepared a Lake Management Plan (LMP) for Lakelse Lake, in partnership with the Regional District of Kitimat-Stikine (RDKS) and the Lakelse Watershed Society (LWS). Drinking water quality was identified as a priority issue in the Lakelse Lake watershed, and continued monitoring was recommended. The RDKS also recently began development of a Liquid Waste Management Plan (LWMP) for Lakelse Lake and Jackpine Flats to address sewage and drinking water concerns. As listed in the *Terms of Reference* for the LWMP, the principal issues (relating to drinking water) include:

- "Lakelse Lake septic tanks and disposal fields discharge to ground and surface water sources which supply water for residences. Should the RDKS be instituting any particular regulations or controls on the existing systems? For health reasons the opportunity to construct a community water supply system should also be investigated.
- What is the impact of the current Jackpine Flats septic tanks and disposal fields on the environment in general and on the groundwater in particular? (Stantec, 2000)"

This study provides important information needed to answer these questions about Lakelse Lake and Jackpine Flats.

2.0 B.C. DRINKING WATER QUALITY GUIDELINES

In British Columbia WLAP develops province-wide water quality guidelines (criteria) for assessing water quality data and preparing site-specific water quality objectives. Water quality guidelines are environmental benchmarks. They are considered to be safe levels of substances for the protection of a given water use, including drinking water, recreation, aquatic life, wildlife and agriculture. In most cases, B.C.'s drinking water source quality guidelines are based on Canadian guidelines developed by the Canadian Council of Ministers of the Environment (CCME, 1999 with periodic updates). The guidelines are intended to be a water quality-screening tool. If data do not exceed the guidelines, problems are unlikely. If data exceed the guidelines, then a detailed assessment is recommended to determine the extent of the problem.

Disease resulting from microbiological contamination of drinking water is widely recognized as a significant water quality issue, and detection of microbiological indicators is an important component of the multiple-barrier approach to safe drinking water. Indicator organisms, such as coliform bacteria, provide an estimate of the degree of fecal contamination from human and animal wastes that are in the water. If the indicator suggests that fecal contamination of the water has occurred, then disease-causing organisms may also be present.

Provincial (WLAP) monitoring protocols and water quality guidelines for microbiological indicators were published by Warrington in 1988. There are three guideline levels, which allow different concentrations of microbiological indicators in raw (untreated) drinking water, depending on the degree of treatment that will be applied. B.C. Health Authorities recommend that all drinking water supplies derived from surface water sources receive disinfection as a minimum treatment, and thus we assess surface water microbiological water quality using the ***Disinfection Only*** guideline level (this is also the minimum treatment requirement for surface water sources under the Drinking Water Protection Regulation). Groundwater quality is judged using the ***No Treatment*** guideline (Table 1).

Table 1: WLAP Water Quality Guidelines for Microbiological Indicators

Water Use	Fecal Coliform	*E. coli*	Enterococci
Raw Drinking Water – No Treatment (GROUNDWATER)	0/100 mL	0/100 mL	0/100 mL
Raw Drinking Water – Disinfection Only (SURFACE WATER)	Less than or equal to 10/100 mL 90^{th} percentile	Less than or equal to 10/100 mL 90^{th} percentile	Less than or equal to 3/100 mL 90^{th} percentile

Other B.C. (WLAP) approved and working guidelines for physical and chemical water quality parameters are listed in Table 2. Additional information is available in Province of B.C. (1998a and 1998b), or on the following websites:

- Canadian Guidelines
  - http://www.ec.gc.ca/CEQG-RCQE/English/Ceqg/Water/default.cfm
- B.C. Guidelines
  - http://wlapwww.gov.bc.ca/wat/wq/wq_guidelines.html

Table 2: WLAP Physical /Chemical Drinking Water Source Quality Guidelines
(Province of B.C., 1998a and 1998b)

Parameter	Guideline (mg/L)	Guideline Type
PHYSICAL		
pH	6.5-8.5	aesthetic objective
Colour	≤ 15 TCU	aesthetic objective
Specific conductance	≤ 700 µS/cm	maximum acceptable concentration
Turbidity	≤ 5 NTU[1]	maximum acceptable concentration
Hardness Total – T	≤ 500	maximum acceptable concentration
TOTAL ORGANIC CARBON		
T.O.C.	≤ 4[2]	maximum, to prevent THM formation
ANIONS		
Chloride Dissolved	≤ 250	aesthetic objective
Fluoride Dissolved	≤ 1.5	maximum acceptable concentration
NUTRIENTS		
Nitrate Nitrogen Dissolved	≤ 10	maximum acceptable concentration
Nitrite Nitrogen	≤ 1	maximum acceptable concentration
Phosphorus Total	≤ 0.01	maximum, to protect lakes from algae growth
SULFATE		
Sulfate	≤ 500	aesthetic objective
METALS TOTAL		
Aluminum	≤ 0.2	maximum acceptable concentration
Antimony	≤ 0.006	interim maximum acceptable concentration
Arsenic	≤ 0.025	interim maximum acceptable concentration
Barium	≤ 1	maximum acceptable concentration
Boron	≤ 5	maximum acceptable concentration
Cadmium	≤ 0.005	maximum acceptable concentration
Chromium	≤ 0.05	maximum acceptable concentration
Copper	≤ 1	aesthetic objective
Iron	≤ 0.3	aesthetic objective
Lead	≤ 0.01	maximum acceptable concentration
Magnesium	≤ 100	aesthetic objective
Manganese	≤ 0.05	aesthetic objective
Molybdenum	≤ 0.25	maximum acceptable concentration
Selenium	≤ 0.01	maximum acceptable concentration
Uranium	≤ 0.02[3]	maximum acceptable concentration
Vanadium	≤ 0.1	maximum acceptable concentration
Zinc	≤ 5	aesthetic objective

[1] Although some literature quotes a maximum acceptable level of 1 NTU, levels between 1 and 5 NTU do not typically pose a health concern. Depending on the origin of the turbidity (organic vs. inorganic), bacteria may be present and/or treatment system effectiveness may be compromised at levels between 1 and 5 NTU. Some site-specific Skeena Region reports apply a maximum level of 5 NTU and an average of 1 NTU. For this report, universal application of only the 5 NTU (max) guideline was decided by WLAP water quality specialists.

[2] No approved BC guideline, but US EPA guideline is 4 mg/L to prevent trihalomethane formation.

[3] BC interim max. acceptable concentration is ≤ 0.1 mg/L; Canadian guideline (≤ 0.02) is more stringent.

3.0 METHODS

3.1 Lakelse/Jackpine Area Sampling Program (2002-03)

The Lakelse/Jackpine area sampling program was designed in consultation with NHA Environmental Health Officers (EHOs) and RDKS representatives. The program included testing of three drinking water sources: Lakelse Lake surface water, Mountain Creek surface water, and Jackpine Flats groundwater. The Lakelse Lake sampling program was designed (in part) according to monitoring recommendations for the site-specific water quality objectives (McKean, 1986). The Jackpine Flats sampling program was expanded over the course of the study, from three to nine sampling sites. Sample locations were selected such that untreated water samples could be collected from taps at pump houses and residences.

Water samples were collected weekly for five weeks beginning in August 2002, October 2002, April 2003 and August 2003. The samples were analyzed for three microbiological indicators (fecal coliforms, *E. coli* and enterococci), turbidity and colour. In drinking water, turbidity and colour are most commonly aesthetic properties that tend to show a high degree of variability in the environment. Turbidity has also been shown to be correlated with bacterial contamination, and thus is a good indicator of overall water quality. In each season, one sub-sample from each site was analyzed for a comprehensive range of physical and chemical water quality parameters which have health and aesthetic implications in drinking water. The parameters measured included many that are indicators of contamination by domestic sewage and agriculture (for example, chloride, phosphorus, nitrate and ammonia).

3.2 Sampling Methods

Water samples were collected following a minimum 3 minute flushing of the water lines and sampling was conducted according to methods outlined in Clark (1996). Microbiological samples were collected in 500 mL sterilized bacteriology bottles (provided by Cantest Ltd. in 2002 or JR Laboratories Inc. in 2003). Total metals samples were collected in 250 mL acid-washed polyethylene bottles (provided by PSC Analytical Services). Samples for physical and chemical analysis were collected in 1 L or 250 mL polyethylene bottles that were rinsed three times prior to collection. Samples were immediately placed in a cooler with ice and shipped to the analytical laboratories in Burnaby. All samples were received by the laboratory within the recommended time limits.

3.3 Analytical Methods

Microbiological analyses were performed by Cantest Ltd. in 2002 and JR Laboratories Inc. in 2003. Analysis began within 48 hours of sample collection. Both laboratories use

the Membrane Filtration (MF) method of enumeration, and analyses are performed using approved procedures (Province of B.C., 1994; APHA, 1998).

PSC Analytical Services (now Maxxam Analytics Inc.) performed the analyses of physical and chemical parameters. Total metals samples were analyzed using the low-level ICPMS scan to detect low concentrations. PSC also follows standard methods provided in APHA (1998).

3.4 QA/QC

All three analysis labs (Cantest, JR and PSC) must meet numerous QA/QC (Quality Assurance, Quality Control) requirements such as analysis of reference samples, blanks and duplicates, and they are frequently audited. QA/QC information from individual batches of samples is reported with the results from each set of analyses. Other QA/QC procedures that were incorporated into our monitoring program include:

- Development of consistent sampling protocols,
- Training of field staff,
- Setting of data quality objectives, and
- Submission of QA samples (including field blanks and duplicates) to the lab.

Field blanks provide a test for potential contamination resulting from handling technique and from air exposure at the sampling location. A number of field blanks were collected during Lakelse area 2003 sampling sessions and results of the field blanks are included in the accompanying Data Appendix (Table 17). In Lakelse area blank samples:

- No microbiological indicators were detected in any samples, indicating that bacterial contamination during sampling, transport, and analysis is unlikely.
- Turbidity and colour values were low and sample contamination is unlikely.
- In the comprehensive sample for physical and chemical parameters (April 8, 2003), Nitrate+nitrite, dissolved phosphorus and total copper were detected at very low concentrations and other parameters were not detected. Because drinking water guidelines for these three parameters were easily met on all dates, sample contamination is not a concern.

Duplicate samples provide a rough estimate of the overall precision associated with the field technique and laboratory analysis. A number of duplicate samples for physical and chemical parameters were collected during 2003 sampling sessions. Duplicates were not collected for microbiological indicators because their occurrence in the natural environment is not expected to be uniform. Precision analysis of the duplicate results was calculated using the Relative Percent Difference (RPD, see the Data Appendix Table 17 for results and calculations).[4] The RPD for duplicate samples should be less than

[4] Precision is influenced by how close the analytical value is to the Method Detection Limit (MDL - the minimum amount of a substance that can be routinely detected by the analytical instrument or technique with a high degree of confidence), and the use of RPD is limited to values that are at least five times the

25%, and data with precision values greater than 25% should be interpreted with caution. In the Lakelse area duplicates:

- No colour values were greater than five times the Method Detection Limit (MDL) so RPD was not calculated. One pair of turbidity samples from site **JF6** had a RPD greater than the 25% data quality objective, but all observed turbidity values from this site are far below drinking water guidelines and data quality is not a concern.
- In the comprehensive duplicate samples from the surface water site (**LL2**), RPD values were less than 25% for all parameters except total aluminium, iron, manganese and zinc. Aluminum, manganese and zinc were only detected at low concentrations (far below guideline levels) throughout the 2002-03 sampling program and data quality is not a concern. The relatively high RPD for iron suggests that concentrations of this element are variable in the water source. Because measured iron concentrations are often close to the drinking water guideline, this parameter may periodically exceed the guideline level and elevated levels of this parameter should be interpreted with caution.
- In the comprehensive duplicate sample from the groundwater site (**JF6**), all RPD values were less than the 25% data quality objective.

3.5 Reporting

Microbiological water quality results are reported in colony forming units (CFU) per 100 mL of sample. A result of <1 indicates that no bacteria were detected in a sample of 100 mL and a result of <2 indicates that no bacteria were detected in a 50 mL sample.

- For each ***surface water*** sample set (five weekly samples), 90th percentiles were calculated for each indicator and the results were compared to the *Disinfection Only* WLAP guideline level (Table 1). The 90th percentile concentration is the concentration below which 90% of the samples lie. For computing 90th percentiles, values of <1 and <2 are assumed to be zero. The *Disinfection Only* guideline level was chosen because this is the minimum treatment requirement for surface water sources, under the Drinking Water Protection Regulation.
- For ***groundwater***, samples were compared to the *No Treatment* guideline of zero organisms per 100 mL.

Colour and turbidity were tested once per week for five weeks, and individual sample results were compared to WLAP guidelines. The Method Detection Limit (MDL) is the minimum amount of a substance that can be routinely detected by the analytical instrument or technique with a high degree of confidence. The MDL for colour is 5 Colour Units, and for turbidity is 0.1 Nephelometric Turbidity Units (NTU).

MDL. For parameters measured at or near the MDL, small differences that are not significant can result in large RPD's. Many parameters tested had concentrations below five times the MDL, so RPD was not calculated.

Other physical and chemical water quality parameters (including metals) from individual samples were compared to WLAP guidelines.

Individual sample results and statistical summaries are presented in the accompanying Data Appendix, and highlights are discussed in the results section (5.0) below.

4.0 PROFILE OF DRINKING WATER SOURCES AND SAMPLING LOCATIONS

Thirteen drinking water sampling sites were monitored in the Lakelse/Jackpine Flats area to collect water quality data on three drinking water sources.

4.1 Lakelse Lake

Lakelse Lake has a mean depth of 8.6 m, a maximum depth of 32 m, and an area of 14.2 km^2. Its 27 km of shoreline includes a large provincial campground and day use area, two private resorts, and many lakeshore residential lots. Site-specific water quality objectives for Lakelse Lake were established in 1986 by McKean, and over the past 15 years the lake has been sampled in various monitoring programs. Lakelse Lake is oligotrophic because of its relatively low phosphorus concentrations, low oxygen depletion rates, and low chlorophyll a concentrations. These attributes, in association with the lake's good water clarity, collectively determine the recreational and fisheries importance of the lake. Lakelse Lake site-specific water quality objectives are set to protect drinking and recreational waters, particularly from impacts associated with the rural residential developments around the lake. Additional information about the lake is available in Cleugh *et al*. (1978), McKean (1986), and Kokelj (2003).

Lakelse Lake is a common drinking water source for seasonal and permanent residences along the lakeshore. Drinking water sampling in 2001 revealed source quality concerns at Lakelse Lake (Remington, 2002). The *Terms of Reference* for the LWMP states that the water table is only a few feet below the ground surface on the east side of the lake, and "it is reported that during annual high lake levels, a number of septic disposal fields are flooded...and it is suspected that a number of waterfront homes do not have a functioning septic tank and the effluent is piped directly to the lake" (Stantec, 2000). In recent years some water users have abandoned their lake intakes in favour of groundwater wells and creek intakes; however, many water systems still draw water from Lakelse Lake for domestic uses. Most drinking water intakes are located close to the shoreline, leaving them vulnerable to contamination from malfunctioning sewage disposal systems. The 2002-03 sampling program investigated this source water contamination issue, and assessed other impacts to water quality from watershed activities.

In 2002 and 2003 Lakelse Lake source water was sampled from outside taps on residences at three locations (Figure 2).

- **LL1** is a year-round intake on the northwest side of the lake.
- **LL2** is a year-round intake on the northeast side of the lake.
- **LL3** is a seasonal intake on the southeast side of the lake. The site was sampled in 2002 only, and was replaced with an adjacent year-round intake in 2003.
- **LL5** is a year-round intake established as a replacement site for **LL3.**

4.2 Mountain Creek

Mountain Creek drains an area east of Lakelse Lake between Schulbuckhand (Scully) Creek and Hatchery Creek. Upstream from the highway, the creek is small and flows sub-surface in some reaches during low flow conditions. Between Highway 37 and First Avenue it flows through a low velocity wetland complex which contains an active beaver population. The creek flows under First Avenue through a series of culverts, and the channel downstream of First Avenue has an average wetted width of 1.8 m and an average bankfull depth of 0.43 m (Zimmerling et. al., 2001).

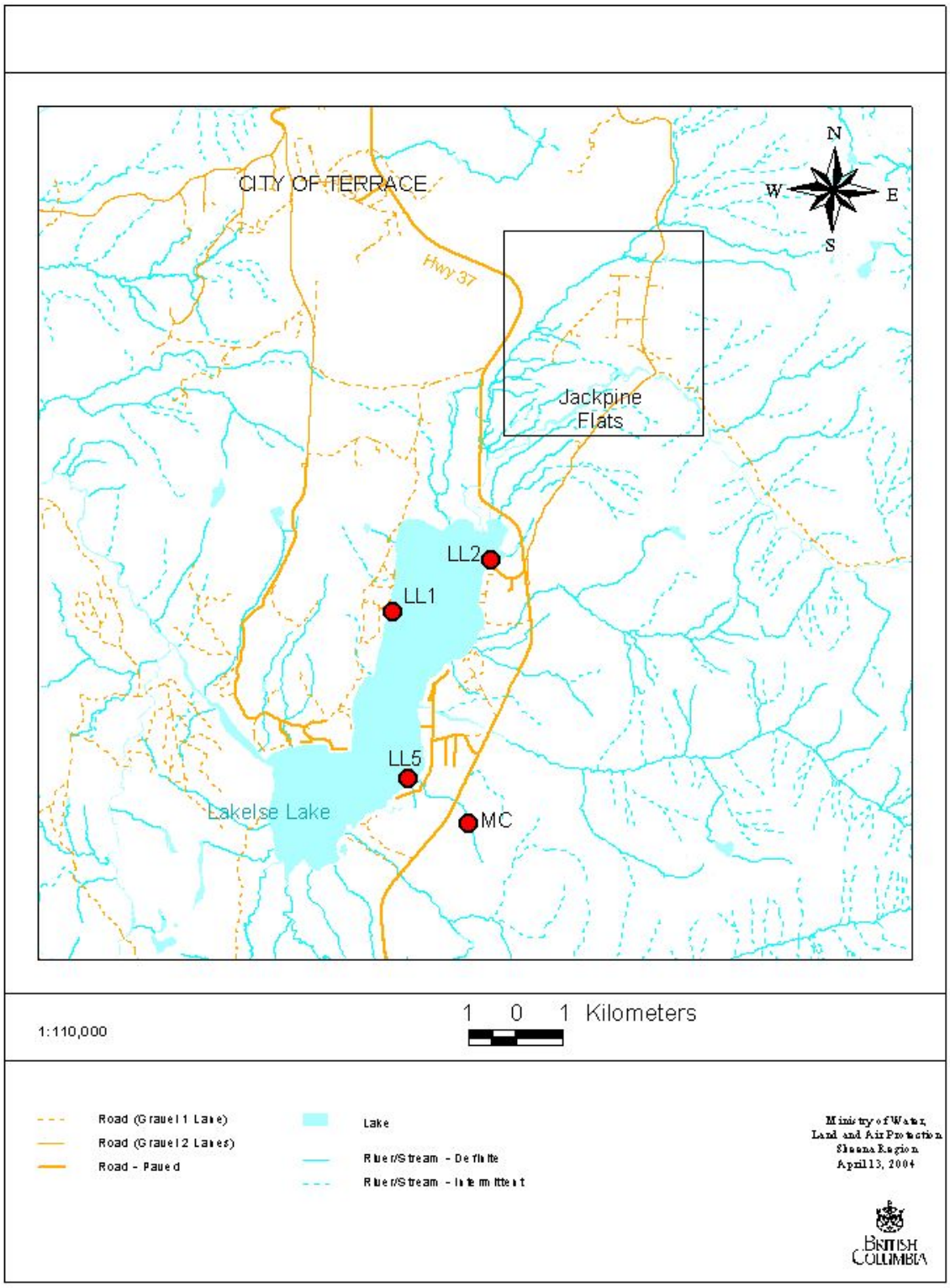
Mountain Creek serves as the water source for a year-round resort on Highway 37. The resort's intake site is located approximately 300 m upstream from the highway, at a concrete catchment dam that has been constructed across the creek. Water is drawn from a reservoir above the dam and piped under the highway to the resort for drinking and bathing. In October 2002 and April 2003 water quality samples were collected from the reservoir above the dam (**MC**) (Figure 2).

4.3 Jackpine Flats

Jackpine Flats subdivision consists of land zoned as high and low density rural. There are approximately 100 land parcels in the high density rural zoned area, and single family residences have been constructed on many of the lots. Drinking water supply in the subdivision is from groundwater with individual wells on each property. Most of the wells are quite shallow, with reported depths in the 5 – 20 m range. There are no large water suppliers in Jackpine Flats, and groundwater quality in the subdivision has not been formally monitored. While some water users have collected their own samples for lab analysis (for example, when they drilled their wells), most reported that they did not know the current quality of their drinking water.

The groundwater aquifer under Jackpine Flats was recently mapped and classified by the Water Protection Section (WLAP in Victoria) using the B.C. Aquifer Classification System developed by Berardinucci and Ronneseth (2002), and Kreye et al. (1994). Figure 2 shows the estimated boundaries of this aquifer (Aquifer #570). It is 4.92 km^2 in size, formed from recent fluvial sediments comprised of coarse sands and gravels (Province of B.C., WLAP, 2002). The overlying material is highly permeable, and it is likely that water wells are recharged from direct infiltration of precipitation at the ground surface. The aquifer is classified as a "IIA aquifer", with moderate productivity and high vulnerability to surface contamination due to the lack of an overlying confining layer (Province of B.C., WLAP, 2002).

Figure 2: Lakelse Lake & Mountain Creek Water Quality Sampling Sites

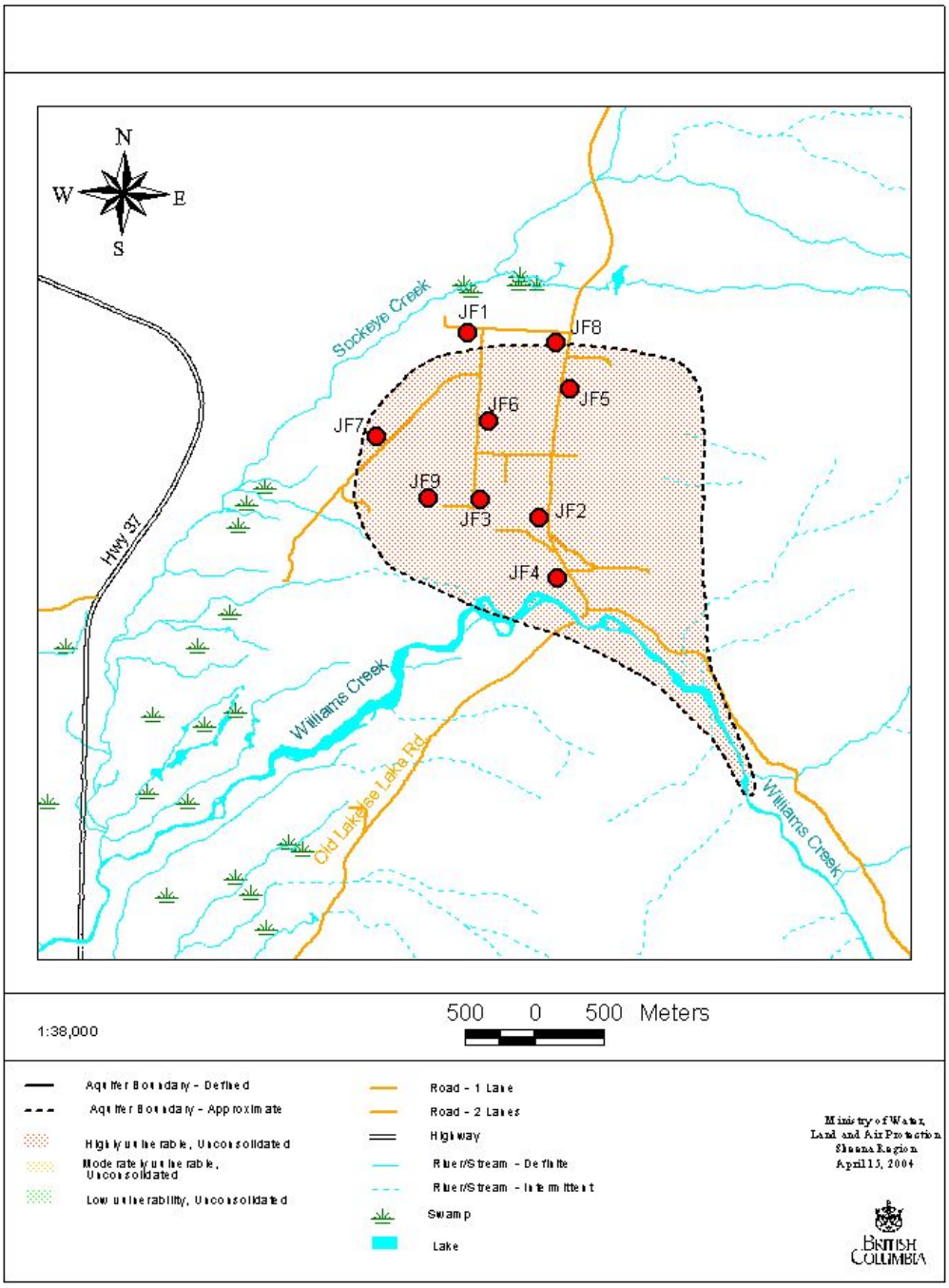


According to the *Terms of Reference* for the RDKS's LWMP, much of the subdivision has been logged and what little topsoil existed has been lost in many areas. Organic soil development is very poor, with fine sands or sandy loam and a very high proportion of coarse gravel, stones and cobbles. Sewage disposal is on-site using septic tanks and tile fields. Percolation rates are very high and the groundwater is reported to be 6 or 7 meters from the surface so there is a general concern that sewage disposal systems may contaminate groundwater (Stantec, 2000). In addition to possible sewage contamination, many property owners have imported large quantities of "hog fuel" for lawns and there is concern that this may leach into the groundwater. Furthermore, agricultural activities including hobby farms are potential sources of groundwater contamination. Water quality risks associated with these activities are amplified by the shallow depths of the wells. The 2002-03 sampling program investigated this source water contamination issue.

In August 2002, three sampling sites were created (**JF1** – **JF3**, Figure 3). Over the 2002-03 monitoring program, additional sites were established through consultation with the RDKS. The sites were chosen at a range of locations in the subdivision. Although groundwater flow patterns have not been established, this study assumes the general direction of groundwater flow matches surface drainage patterns (from the northeast to the southwest), and sampling sites are located in the upstream, middle and downstream parts of the aquifer.

- **JF1** is a well (5 m deep) serving a single residence. Sample was collected from an outside tap on the main house. The site is estimated to be somewhere near the edge of the aquifer, in an upstream area expected to be uninfluenced by the subdivision.
- **JF2** is a well (18 m deep) serving a single residence. Sample was collected from an outside tap on the main house, with the water filter turned off. The site is estimated to be near the middle/downstream part of the aquifer.
- **JF3** is a well (13 m deep) serving a single residence. The site was only sampled in the first 3 sample sets. Sample was collected from an outside tap on the pump house. The site is estimated to be in a downstream part of the aquifer.
- **JF4** is a well (6 m deep) serving numerous facilities at a seasonal camp. The site was added in the October 2002 sample set. Sample was collected from a tap inside the pump house. The site is estimated to be near the edge of the aquifer, and may be influenced by nearby Williams Creek.
- **JF5** is a well (18-24 m deep) serving a single residence. The site was added in the August 2003 sample set. Sample was collected from an inside tap in the main house, with water filter turned off. The site is estimated to be near the upstream/middle part of the aquifer.
- **JF6** is a well (12-18 m deep) serving a single residence. The site was added in the April 2003 sample set. Sample was collected from an outside tap on the main house. The site is estimated to be near the middle of the aquifer.

Figure 3: Jackpine Flats Water Quality Sampling Sites



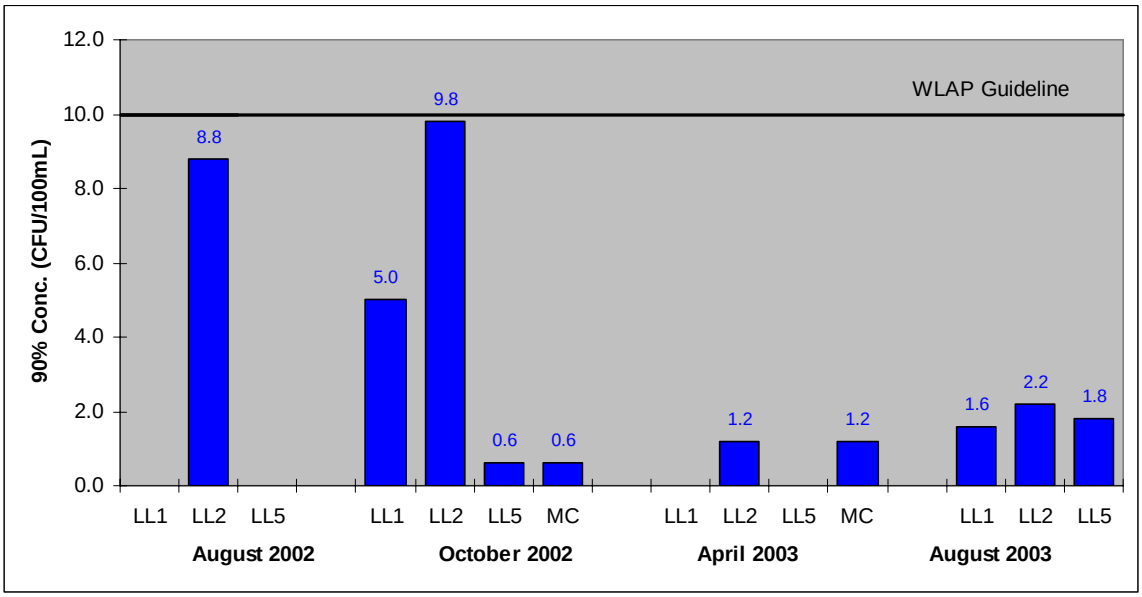
- **JF7** is a well (estimate 15 m deep) serving a single residence and hobby farm. The site was added in the August 2003 sample set, but was only sampled once. Sample was collected from an outside tap on the main house. The site is estimated to be near the edge of the aquifer near the downstream end.
- **JF8** is a well (17 m deep) serving a single residence. The site was added in the April 2003 sample set. Sample was collected from an outside tap on the main house, where the water filter is bypassed. The site is expected to be near the edge of the aquifer in an upstream location.
- **JF9** is a well (10 m deep) serving a single residence. The site was added in the August 2003 sample set to replace JF3. Sample was collected from an outside tap on the greenhouse, where the water filter is bypassed. The site is estimated to be in a downstream part of the aquifer.

5.0 RESULTS AND DISCUSSION

Complete results of water quality sampling in the Lakelse/Jackpine area are included in the accompanying Data Appendix. Also included in the Appendix is a statistical summary of the microbiological indicator data for each site, and a statistical summary of the other physical/chemical water quality parameters for each source.

Figures 4-6 summarize microbiological indicator results from Lakelse area surface water sites (**LL1**, **LL2**, **LL5** and **MC**). Summer and fall 2002 results from **LL3** are reported and discussed under the replacement site name (**LL5**). ***The microbiological indicator guidelines used for surface water sources in this study (and shown in the Figures) assume that the raw water will receive disinfection prior to consumption.*** The results from Jackpine Flats are summarized and discussed separately in Section 5.3 because the *No Treatment* guideline of zero organisms applies to microbiological indicators in groundwater samples.

Figure 4: Fecal Coliform 90th Percentile Concentrations[5] at Lakelse Sampling Sites



[5] The 90th percentile concentration is the concentration below which 90% of the samples lie. For computing 90th percentiles, values of <1 and <2 are assumed to be zero.

Figure 5: *E. Coli* 90th Percentile Concentrations at Lakelse Sampling Sites

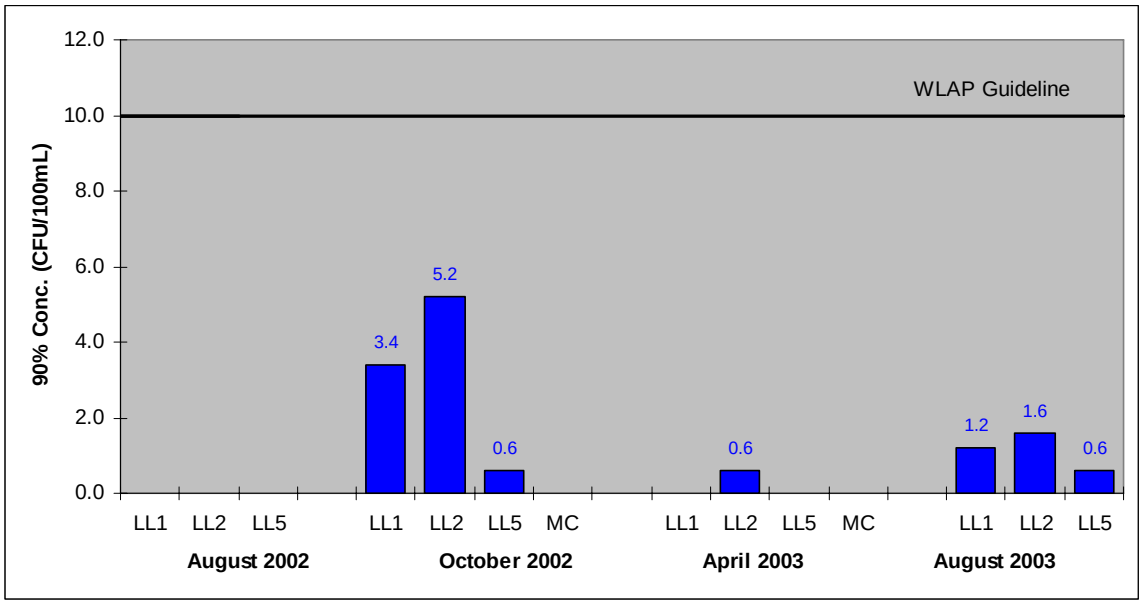
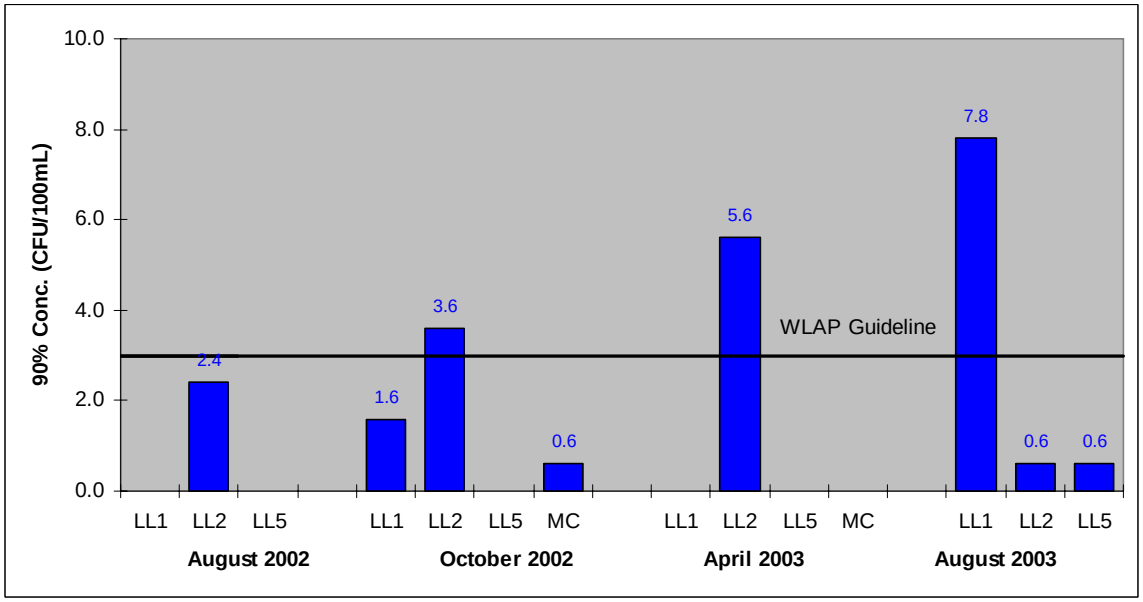


Figure 6: Enterococci 90th Percentile Concentrations at Lakelse Sampling Sites



5.1 Lakelse Lake (LL1, LL2, LL5)

Lakelse Lake sampling sites had low to undetectable levels of fecal coliforms, *E. coli*, and enterococci in 2002-03. Two sampling sites (**LL1** and **LL2**) had above average

bacteria concentrations in the October 2002 sample set than they did in other sample sets. Overall, bacteria concentrations at **LL2** were higher than at **LL1** and **LL5**.

The 90th percentile concentrations for fecal coliforms and *E. coli* (Figures 3 and 4) met WLAP guidelines during all sample sets. Enterococci 90th percentile concentrations did not meet the guideline at **LL2** in the October 2002 and April 2003, and at **LL1** in the August 2003 sample set (Figure 6).

Turbidity at Lakelse Lake intakes ranged from 0.39 to 7.84 NTU. All samples from summer sample sets (August 2002 and August 2003) met the WLAP guideline of ≤ 5 NTU. Over the entire 2002-03 program, two of 20 samples from **LL2** and one of 20 samples from **LL1** did not meet the guideline level. It should be noted that many samples had turbidity values greater than the recommended level of 1 NTU for water entering a distribution system, indicating that treatment system effectiveness may be compromised by suspended material in the water. In April 2003, many colour values from Lakelse Lake did not meet the WLAP aesthetic guideline. Four of five samples from **LL1**, three of five samples from **LL2**, and two of five samples from **LL5** exceeded the guideline. Colour values were below the guideline level in other seasons.

Table 3 below summarizes other physical and chemical parameter guidelines that were not met at Lakelse Lake sampling sites:

Table 3: Summary of Guideline Exceedences at Lakelse Lake

Site	Parameter	WLAP Guideline	Observed Concentration (Date)
LL1	Iron	≤ 0.3 mg/L (aesthetic)	0.343 mg/L (Apr 8)
LL2	Iron	≤ 0.3 mg/L (aesthetic)	1.13 mg/L (Apr 8)
	Phosphorus	≤ 0.01 mg/L	0.016 mg/L (Apr 8)
LL5	Iron	≤ 0.3 mg/L (aesthetic)	0.426 mg/L (Apr 8)

Iron concentrations in Lakelse Lake were above the guideline in April and slightly below the guideline in October. The Lakelse area blank sample from April did not indicate iron contamination (see Section 3.4), so it can be assumed that the measured concentrations represent guideline exceedences. In drinking water, iron does not typically pose a health risk and the guideline is applied for aesthetic purposes. It can collect and block pipes and plumbing fixtures, and produce colour, taste, and rust flakes in water (Health Canada, 2003). Overall, iron sample results suggest that this element shows spatial and seasonal variability in Lakelse Lake; differences in the **LL2** duplicate samples from April further support this assumption. Sample results close to the guideline level (such as October 2002 samples from all sites) should be viewed with caution (see Section 3.4).

The phosphorus drinking water guideline applies only to lakes, and has been set to protect the water from excessive algae growth, and thus minimize treatment costs and reduce the risk of taste and odour from algae (Nordin, 1985). Past sampling at Lakelse Lake indicates that phosphorus concentrations are generally below the guideline level, and the single exceedence at **LL2** is not a concern.

5.2 Mountain Creek (MC)

Mountain Creek was sampled in October 2002 and April 2003 only, and microbiological indicator results are summarized in Figures 4 – 6 with the Lakelse Lake results. Fecal coliforms were detected in one of five samples in each sample set. *E. coli* were not detected at **MC**, and enterococci were detected in one of five samples in October 2002. Ninetieth percentile concentrations for all three indicators met WLAP guidelines in both seasons.

Turbidity in Mountain Creek was very low and easily met the WLAP guideline. The colour guideline was also met at all times, and other physical and chemical parameters were below WLAP guideline levels.

5.3 Jackpine Flats (JF1 – JF9)

Groundwater results from Jackpine Flats sampling sites are summarized in Table 4. ***Because the No Treatment guideline (no organisms detected) applies to microbiological indicators in groundwater samples, every detection represents a guideline exceedence.***

Overall, microbiological indicator concentrations were low or undetectable, and only two samples had concentrations greater than 2 CFU/100mL. Enterococci were detected five times in Jackpine Flats groundwater, so the WLAP (*No Treatment*) guideline for enterococci was not met in five of 94 samples (Table 3). Fecal coliforms were only detected once (**JF1** sample on April 23, 2003 had a concentration of 46 CFU/100 mL) and the guideline was not met in one of 94 samples. *E. coli* were not detected in any samples so the WLAP (*No Treatment*) guideline for this indicator was met at all times.

In most cases, turbidity in Jackpine Flats wells was low and met the WLAP (maximum) guideline of ≤ 5 NTU. An exception is **JF3,** where turbidity was consistently very high and the 5 NTU guideline was not met in nine of ten samples from this site. The results from **JF3** suggest this site has a chronic low-level input of turbidity, and is prone to episodic high levels, shown in the colour and turbidity spikes on October 8. One sample from **JF9** did not meet the turbidity guideline because it had a turbidity of 7.80 NTU. Other wells met the guideline, but occasionally exceeded the recommended level of 1 NTU for water entering a distribution system, indicating that treatment system effectiveness may be compromised by suspended materials in the water. Colour met the 15 TCU guideline on all sampling dates at all sites, except October 8, 2002 at **JF3** (where it was measured as 300 TCU).

Table 4: Summary of Microbiological Indicator Guideline Exceedences in Jackpine Flats Groundwater

Site	# Samples (n)	# Guideline Exceedences (blank square = 0)		
		Fecal Coliforms	*E. coli*	Enterococci
JF1	19	1		1
JF2	20			2
JF3	10			
JF4	15			
JF5	5			
JF6	10			1
JF7	1			
JF8	10			1
JF9	4			
ALL SITES	94	1		5

Table 5 below summarizes other physical and chemical parameter guidelines that were not met at Jackpine Flats sampling sites:

Table 5: Summary of Guideline Exceedences at Jackpine Flats

Site	Parameter	WLAP Guideline	Observed Concentration (Date)
JF2	Manganese	≤ 0.05 mg/L (aesthetic)	1.38 mg/L (Apr 8)
JF3	Iron	≤ 0.3 mg/L (aesthetic)	26.2 mg/L (Oct 8) 1.73 mg/L (Apr 8)
	Manganese	≤ 0.05 mg/L (aesthetic)	0.27 mg/L (Oct 8)
JF4	Iron	≤ 0.3 mg/L (aesthetic)	0.477 mg/L (Apr 8)
JF6	Iron	≤ 0.3 mg/L (aesthetic)	0.418 mg/L (Apr 8)

Manganese and iron are found naturally in groundwater in all regions of B.C. They are common in groundwater with little or no oxygen, typically in deeper wells, in areas where groundwater flow is slow, and in areas where groundwater flows through soils rich

in organic matter (Province of B.C., WLAP, 2002). Manganese and iron are not typically health concerns in drinking water and the B.C. guidelines are for aesthetic purposes. Manganese is among the elements least toxic to mammals, but at concentrations above the 0.05 mg/L aesthetic guideline, it can stain plumbing fixtures and laundry, and produce undesirable tastes and odours (Health Canada, 2003). Similar effects are possible with high iron concentrations. The World Health Organization (WHO) has stated that although manganese toxicity through drinking water has not been documented and a formal guideline does not exist, "a provisional health-based guideline value of 0.5 mg/L should be adequate to protect public health" (WHO, 1993). The manganese value at **JF2** which exceeded the aesthetic drinking water guideline also exceeded the WHO provisional health-based guideline, indicating a possible health concern. Further sampling and additional research regarding this issue is suggested.

Profile of Jackpine Flats Wells

The following discussion describes groundwater conditions in Jackpine Flats by examining the results from each sample site. The Jackpine Flats water quality sampling program was designed to investigate possible groundwater contamination from domestic sewage, hobby farms, and "hog fuels". The water table under the subdivision is known to be very shallow, and large numbers of onsite sewage disposal systems have been developed in poor soil conditions. There was concern expressed that bacteria and/or contaminants may be percolating into the soil under the subdivision and travelling underground in the groundwater. If this is the case, a water quality gradient should be evident, with wells in upstream locations having better water quality than wells in downstream locations.

JF1: JF1 is estimated to be in an *upstream* part of the aquifer, and groundwater is unlikely to be influenced by the subdivision. The well is 5 meters deep, and was the shallowest tested in Jackpine Flats. The specific conductance of water from **JF1** was measured as less than 50 µS on all dates. These values are low for groundwater, and suggest that surface water is being transmitted into the groundwater. This is possible given the permeability of the substrate, and suggests a high risk of contamination as infiltration of surface waters is a known source of groundwater contamination. The detection of microbiological indicators at **JF1** was infrequent (two of 19 samples) and the concentrations were lower than would be expected if sewage contamination was occurring. In addition, nitrogen (ammonia and nitrate) was at or below the Method Detection Limit (MDL), and chloride was only detected at low concentrations. Overall, sample results do not suggest that sewage (or other contaminants) has been in contact with groundwater. However, the shallow well depth and the possibility that surface water may be entering the groundwater leave this well vulnerable to localized influences on water quality.

JF2: JF2 is estimated to be in a *middle/downstream* part of the aquifer, so the chance of contamination from the subdivision is greater. The well is 18 m deep, and was the deepest one tested in the area. As expected, specific conductance was higher than it was

in shallower wells, suggesting less influence by surface water. At times, chloride and nitrate were detected at slightly-elevated levels. Nitrate leaches easily, and concentrations greater than 3 mg/L in groundwater usually reflect impacts from agriculture or sewage disposal systems. The concentrations observed at **JF2** are much less than 3 mg/L and are not sufficient to indicate impacts from human activities. The absence of ammonia and the low bacteria concentrations (microbiological indicators were only detected in two of 20 samples, at low concentrations) do not suggest sewage is contaminating the groundwater. However, further sampling should be conducted to determine the source of enterococci, and to investigate if the nitrate concentrations are a result human activities (for example: lawn fertilizing).

JF3: JF3 is estimated to be in a *downstream* part of the aquifer, so if contamination exists under Jackpine Flats, it should be detected here. The well is 13 m deep, and (as expected) had specific conductance values between those of the shallower and deeper wells. The turbidity variation observed over the sampling period is uncharacteristic of groundwater. These observations, when combined with the specific conductance values, suggest a definite surface water influence at this site (Odense, 2003 pers. comm.). The detection of ammonia in the well in October suggests that some kind of organic material (such as sewage, fertilizer, or even decaying plant matter) may be leaching into the groundwater. The absence of bacteria and the relatively low concentrations of chloride and nitrate suggest decaying plant matter is a more likely cause than sewage or agricultural waste. This material could easily have caused anoxic conditions that mobilized metals such as manganese and iron that were observed in higher concentrations. Further sampling should be conducted at **JF3** to investigate the variation in turbidity, and to monitor overall water quality.

JF4: JF4 was added in October 2002 at the request of the owner (a commercial camp operator). The site is estimated to be at edge of the aquifer and may or may not be impacted by activities in the subdivision. It is close to Williams Creek, and may be influenced by surface water from this source. The well is 6 meters deep and its specific conductance was low, matching the trend observed at other Jackpine Flats sampling sites. Low to undetectable levels of bacteria, chloride and nitrogens do not suggest any contamination from sewage or other sources. Periodic monitoring should continue in the future because of the risk that exists from the shallow depth of the well and its close proximity to the creek.

JF5: JF5 was added in August 2003 at the request of the RDKS, which needed additional information for its LWMP. The site is estimated to be in a *middle/upstream* part of the aquifer. The exact well depth is not known, but it is between 18 and 24 meters deep. Its higher specific conductance value suggests less surface water influence. Low to undetectable levels of bacteria, chloride, nitrate and ammonia suggest no contamination from sewage or other sources.

JF6: JF6 was added in April 2003 at the request of the RDKS. The site is estimated to be near the middle of the aquifer. The exact well depth is not known, but it is between 12 and 18 meters deep. **JF6** had an isolated low-level detection of enterococci, and low to

undetectable levels of other sewage indicator parameters. Current results do not suggest contamination is occurring.

JF7: JF7 was added in August 2003 at the request of the RDKS, but was only sampled once. It is suspected to be at edge of the aquifer, and may or may not be at a location that could be impacted by activities in the subdivision. Its location on a hobby farm, however, leaves it more vulnerable to contamination than other sites. The depth of this well is estimated to be approximately 15 m deep, and its high specific conductance suggests this is a reasonable estimate. No bacteria were found in the water sample, but slightly elevated levels of chloride and nitrate indicate possible impacts on groundwater quality, perhaps from the hobby farm. Further sampling is required to confirm that bacteria are absent at this site, and additional monitoring may be desirable because of the risks associated with the hobby farm.

JF8: JF8 was added in April 2003 at the request of the RDKS. The site is suspected to be located in an *upstream* part of the aquifer and the well is 17 meters deep. Enterococci were detected in a relatively high concentration on May 5, 2003, but other samples showed no microbiological indicators. Low to undetectable levels of chloride, nitrate and ammonia, and the absence of other microbiological indicators suggests that ongoing contamination from sewage or other sources is unlikely. Periodic monitoring should continue to confirm that the enterococci detection was an isolated occurrence and does not represent a health risk.

JF9: JF9 was added in August 2003 as a replacement site for **JF3**. The site is suspected to be in a *downstream* part of the aquifer. The well is approximately 10 meters deep and its specific conductance was low, matching the trend observed at other Jackpine Flats sampling sites. Low to undetectable levels of bacteria, chloride, nitrate and ammonia suggest no contamination from sewage or other sources.

Jackpine Flats Summary

Water quality results from 2002-03 do not suggest widespread contamination in the aquifer under Jackpine Flats, and give no evidence of a "plume" of contamination in the groundwater. The microbiological indicator results are much lower than would be expected if contamination from domestic sewage or hobby farms was occurring. The two locations expected to be upstream in the aquifer (**JF1** and **JF8**) had more microbiological indicators than the two locations expected to be downstream (**JF3** and **JF9**), but further study is required to determine actual groundwater flow patterns. No site had consistently poor results for any indicator, and there was no correlation between detections of bacteria, chloride, nitrate and ammonia.

Random occurrences of bacteria and isolated low-levels of chloride, nitrate and ammonia suggest possible localized influences on groundwater quality. Specific conductance values in Jackpine Flats groundwater are not characteristic of groundwater sources and suggest that surface water is entering the aquifer in this area. This may explain some of

the variation from one site to the next, as some compounds and contaminants may be carried to nearby wells from infiltrating surface water. Differences in observed water quality may possibly be accounted for by the different well depths, or by varying qualities of well construction and well head protection. Homeowners should be warned about the risks that land use activities pose on nearby wells, and be reminded about the importance of adequate well head protection. The subdivision also warrants ongoing consideration as to how safe drinking water may be consistently obtained

5.4 Seasonal Variations in Water Quality

The results and guideline comparisons discussed above reflect conditions at the time of sampling and do not necessarily represent all conditions in Lakelse/Jackpine area drinking water sources. Remington (2002) found that monitoring in mid-summer only does not reflect the range of year-round source water quality in the Skeena Region. She recommended that a more varied temporal schedule be devised for drinking water quality monitoring of surface water sources, which includes spring and fall periods. This study has been designed to gather information from different seasons, and this data represents the first data sets for Mountain Creek and Jackpine Flats, and the first spring data sets for Lakelse Lake. Future sampling programs should be designed to confirm that the results from 2002-03 are representative of seasonal conditions in these drinking water sources.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Recent sampling done by WLAP has noted that drinking water quality in some Skeena Region surface water sources including Lakelse Lake may be deteriorating (see Remington, 2002). Interest on behalf of the RDKS and the LWS has brought Lakelse/Jackpine Flats water quality concerns to the forefront, and a comprehensive sampling program was implemented. Results of sampling in 2002-03 are summarized below:

Lakelse Lake

- All three microbiological indicators were detected. Fecal coliform and *E. coil* 90th percentiles met WLAP guidelines all times, but the enterococci guideline was not met in three of 20 sample sets. ***The surface water guideline used in this study assumes that the raw water will receive disinfection prior to consumption. When the guideline is met, water users should be cautioned that water is not assumed safe for consumption without disinfection.***
- Turbidity ranged from 0.39 to 7.84 NTU and the WLAP guideline was not met in three of 60 samples.
- Colour values did not meet the WLAP aesthetic guideline in April 2003.
- Iron did not meet the aesthetic drinking water guideline at all three sites in April 2003, and phosphorus exceeded the guideline at one site in April 2003. Neither element poses a health risk at observed concentrations. Other physical and chemical parameters were all below (WLAP) guideline levels on all dates at all sites.

Mountain Creek

- Fecal coliforms and enterococci were each found in one of 10 samples, and *E. coli* were not detected. WLAP guidelines for all three indicators were met.
- Turbidity, colour, and other physical and chemical parameters were well below guideline levels.

Jackpine Flats

- Enterococci were detected most often, and *E. coli* were not found in any samples. Overall, observed microbiological indicator concentrations were low.
- Six samples did not meet WLAP (*No Treatment*) guidelines that apply for groundwater. The remaining 88 samples had no microbiological indicators.
- Turbidity values met the ≤ 5 NTU guideline at all sites except at **JF3** and **JF9**. **JF3** samples consistently exceeded the guideline level.

- Colour exceeded the guideline once at **JF3**.
- Iron exceeded the drinking water aesthetic guideline in three samples, and manganese exceeded the drinking water guideline in two samples. In most cases, the observed concentrations do not pose a health risk. However, one well had a manganese concentration above the WHO's provisional health-based guideline and further investigation of this issue is suggested. Other physical and chemical parameters were below (WLAP) guideline levels.
- Low specific conductance values suggest that surface water is being transmitted into the groundwater (this is possible given the permeability of the substrate, and suggests a high risk of contamination as infiltration of surface waters is a known source of groundwater contamination).
- Generally, results do not suggest widespread contamination in the aquifer under the subdivision, and give no evidence of a "plume" of contamination in the groundwater.
- Occasional low-level detections of nitrate, chloride and ammonia suggest possible localized influences on groundwater quality. Low levels of contamination, combined with the permeable ground and shallow depth to groundwater, are cause for concern and warrant ongoing consideration as to how safe drinking water may be consistently obtained.

6.2 Recommendations

Based on monitoring conducted in 2002-2003, we recommend that:

- WLAP should continue to collaborate with agencies (such as the NHA, RDKS, and LWS) interested in water quality in the Lakelse/Jackpine area, and periodic monitoring of Lakelse Lake and Jackpine Flats should continue at the established sampling sites.
- Through collaboration with NHA staff, residents should be informed of the need to disinfect surface water supplies prior to consumption.
- Residents should be educated about the risks that land use activities pose on nearby surface water sources and groundwater wells. Groundwater users should be reminded about the importance of adequate well head protection, and lake water users should also be encouraged to extend intake pipes further into the lake to avoid potential sources of contamination.
- Although sampling results have already been provided to those using each source, drinking water source quality data should be made available to other interested parties.
- Monitoring programs should continue to include sampling in different seasons to investigate seasonal water quality.
- Enterococci and *E. coli*. should continue to be used in monitoring programs (in conjunction with fecal coliforms) and should be considered in water quality objectives development and updates.
- Groundwater flow patterns in Jackpine Flats should be determined, and if required, monitoring locations should be adjusted accordingly.

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LIST OF ACRONYMS

CCME – Canadian Council of Ministers of the Environment

CFU – Colony Forming Unit

EHO – Environmental Health Officer

ICPMS – Inductively Coupled Plasma - Mass Spectrometry

LWS – Lakelse Watershed Stewards

MDL – Method Detection Limit

MF – Membrane Filtration

MoE – Ministry of Environment (previously called Ministry of Water, Land and Air Protection (WLAP) from June 2001 – June 2005)

NHA – Northern Health Authority

NTU – Nephelometric Turbidity Units

QA/QC – Quality Assurance / Quality Control

RDKS – Regional District of Kitimat-Stikine

RPD – Relative Percent Difference

TCU – True Colour Units

WLAP – Ministry of Water, Land and Air Protection (ministry name from June 2001 – June 2005; now called Ministry of Environment (MoE))

GLOSSARY

Aesthetic objective: The substance concentration or characteristic of drinking water that can affect its acceptance by consumers. Where an aesthetic objective is specified, the values are below those considered to constitute a health hazard.

Aquifer: A geological formation that consists of saturated permeable materials that yield economical quantities of water to wells and springs.

Bacteria: Single-celled, microscopic organisms, some of which cause diseases in plants or animals.

Blank sample: A sample of distilled, de-ionized water that has been exposed to the sampling environment at the sample site and handled in the same manner as the actual sample (e.g., preserved, filtered). It provides information on contamination resulting from the handling technique and from exposure to the atmosphere.

Colour (True): A measure of the dissolved colouring compounds in water, attributed to the presence of organic and inorganic materials. Reported in true colour units (TCU).

Coliform bacteria: A bacteria carried in human and animal wastes. The presence of coliforms in water may indicate contamination from human or animal wastes.

Disinfection: The process of destroying microorganisms in water by the application of a chemical agent (disinfectant) such as chlorine.

Duplicate sample: Two samples taken at the same time and place, designed to provide a rough estimate of the overall precision associated with the field technique and laboratory analysis.

Eutrophic: Describes a lake with high nutrient concentrations resulting in elevated productivity.

Eutrophication: The process of physical, chemical and biological changes associated with nutrient, organic matter and silt enrichment of a water body that cause it to age.

Groundwater: Water below the surface of the ground.

Hardness: A property of water which causes an increase in the amount of soap that is needed to produce foam or lather and that also produces scale in hot water pipes, heaters, boilers and other units in which the temperature of water is increased. Hardness is generally due to the presence of calcium and magnesium in the water. Reported in milligrams per liter (mg/L) as calcium carbonate ($CaCO_3$); greater than 120 mg/L is considered hard; less than 60 mg/L is soft.

Interim maximum acceptable concentration:	Where there is insufficient toxicological data to derive a maximum acceptable concentration with reasonable certainty, the recommended maximum level based on the available health data and employing an uncertainty factor.
Maximum acceptable concentration:	The concentration established for certain substances that are known or suspected to cause adverse effects on health. These concentrations are derived to safeguard health assuming lifelong consumption of drinking water containing the substance at that concentration.
Method detection Limit (MDL):	The minimum amount of a substance that can be routinely detected by the analytical instrument or technique with a high degree of confidence.
Microbiological indicator:	Bacteria indicating a risk of disease from pathogenic bacteria; If it can be shown that fecal contamination of the water has occurred, then pathogenic organisms may also be present. Common indicator bacteria include fecal coliforms, *Escherichia* coli (*E. coli*) and enterococci.
Micrograms per litre (µg/L):	One one-thousandth of one milligram per litre.
Milligrams per litre (mg/L):	A concentration unit of chemical constituents in solution; the weight of solute (substance) per unit volume of solvent (water).
Nutrient:	A substance (element or compound) necessary for the growth and development of plants and animals. Lake studies commonly focus on nutrients critical to plant growth: nitrogen and phosphorus.
Oligotrophic:	Describes a lake of low plant productivity.
pH:	A measure of the hydrogen-ion concentration in water. A quantitative expression for acidity or alkalinity of solution. The scale ranges from 0 to 14, pH 7 is neutral; less than 7 is acid; more than 7 is alkaline.
QA/QC (Quality assurance /Quality control):	QA is the overall verification program which provides producers and users of data the assurance that predefined standards of quality were met. QC is the system of guidelines, procedures and practices intended to regulate and control the quality of the data from collection through to analysis.
Specific conductance:	A measure of the ability of water to conduct an electric current; the greater the content of ions (dissolved metals and other materials) in the water, the more current the water can carry. Reported in microsiemens per centimetre (µS/cm).
Total metal:	A measure of metals in the dissolved state and those sorbed to particulate matter in suspension.

Turbidity:	A measure of the suspended particulate matter in a water body, which interferes with the passage of a beam of light through the water. Materials that contribute to turbidity include clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms. Higher turbidity levels are often associated with higher levels of disease-causing microorganisms. Reported in nephelometric turbidity units (NTU).
Water quality guideline (Criteria):	A numerical value(s) for a physical, chemical, or biological characteristic of water, biota, or sediment which must not be exceeded to prevent specified detrimental effects from occurring to water use; the safe level of a substance for the protection of a given water use.
Water quality objective:	A water quality criterion or guideline adapted to protect the most sensitive designated water use at a specific location with an adequate degree of safety, taking local circumstances into account.
Watershed:	A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Drinking Water Source Quality Monitoring 2002-03

Lakelse Lake and Mountain Creek Surface Water, and Jackpine Flats Groundwater

DATA APPENDIX

TABLE OF CONTENTS

WEEKLY MICROBIOLOGICAL INDICATOR & COLOUR AND TURBIDITY RESULTS (TABLE A) AND STATISTICAL ANALYSIS (TABLE B)

Table 1A – Site LL1 (EMS # E207580)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Aug-02	<1	<1	<1	<5	0.98
14-Aug-02	<1	<1	<1	<5	2.51
20-Aug-02	<1	<1	<1	<5	1.11
28-Aug-02	<1	<1	<1	<5	1.21
03-Sep-02	<1	<1	<1	5	1.59
08-Oct-02	5	<1	2	10	5.04
16-Oct-02	5	5	1	10	1.77
23-Oct-02	1	<1	<1	10	2.36
29-Oct-02	4	1	<1	10	1.82
06-Nov-02	2	<1	<1	10	1.65
08-Apr-03	<2	<2	<2	20	1.76
15-Apr-03	<2	<2	<2	20	1.08
23-Apr-03	<2	<2	<2	20	1.08
29-Apr-03	<2	<2	<2	20	0.97
05-May-03	<2	<2	<2	15	0.85
06-Aug-03	1	<1	<1	5	0.74
12-Aug-03	<1	<1	<1	5	0.89
18-Aug-03	<1	<1	<1	5	1.10
26-Aug-03	<1	<1	<1	5	1.46
03-Sep-03	2	2	13	5	1.38

Table 1B – Site LL1 (EMS # E207580)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**≤ 10 (90%)**	**≤ 10 (90%)**	**≤ 3 (90%)**	**≤ 15**	**≤ 5**
August, 2002					
Maximum	<1	<1	<1	5	2.51
Average	<1	<1	<1	5	1.48
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0
October, 2002					
Maximum	5	5	2	10	5.04
Average	3.4	1.2	0.6	10	2.53
90th percentile	5.0	3.4	1.6	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Not Met**
Exceedences	-	-	-	0	1
April, 2003					
Maximum	<1	<1	<1	20	1.76
Average	<1	<1	<1	19	1.15
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Not Met**	**Met**
Exceedences	-	-	-	4	0
August, 2003					
Maximum	2	2	13	5	1.46
Average	0.6	0.4	2.6	5	1.11
90th percentile	1.6	1.2	7.8	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Met**
Exceedences	-	-	-	0	0

Table 2A – Site LL2 (EMS # E246120)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Aug-02	14	<1	<1	<5	0.60
14-Aug-02	1	<1	4	<5	0.91
20-Aug-02	<1	<1	<1	<5	0.67
28-Aug-02	<1	<1	<1	<5	0.72
03-Sep-02	<1	<1	<1	<5	0.54
08-Oct-02	4	4	<1	10	5.44
16-Oct-02	3	3	<1	10	2.95
23-Oct-02	4	3	<1	10	2.53
29-Oct-02	8	3	3	10	1.94
06-Nov-02	11	6	4	10	1.47
08-Apr-03	<2	1	2	20	7.84
15-Apr-03	2	<2	<2	20	1.62
23-Apr-03	<2	<2	<2	15	1.58
29-Apr-03	<2	<2	<2	20	1.30
05-May-03	<2	<2	8	15	1.19
06-Aug-03	1	<1	<1	5	0.76
12-Aug-03	3	1	1	5	1.24
18-Aug-03	1	<1	<1	5	0.56
26-Aug-03	1	2	<1	5	0.55
03-Sep-03	<1	1	<1	5	0.64

Table 2B – Site LL2 (EMS # E246120)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**≤ 10 (90%)**	**≤ 10 (90%)**	**≤ 3 (90%)**	**≤ 15**	**≤ 5**
August, 2002					
Maximum	14	<1	4	5	0.91
Average	3.0	<1	0.8	5	0.69
90th percentile	8.8	<1	2.4	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0
October, 2002					
Maximum	11	6	4	10	5.44
Average	6.0	3.8	1.4	10	2.87
90th percentile	9.8	5.2	3.6	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Not Met**
Exceedences	-	-	-	0	1
April, 2003					
Maximum	2	1	8	20	7.84
Average	0.4	0.2	2.0	18	2.71
90th percentile	1.2	0.6	5.6	-	-
Guideline	**Met**	**Met**	**Not Met**	**Not Met**	**Not Met**
Exceedences	-	-	-	3	1
August, 2003					
Maximum	3	2	1	5	1.24
Average	1.2	0.8	0.2	5	0.75
90th percentile	2.2	1.6	0.6	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0

Table 3A – Site LL5 (EMS # E251910)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Aug-02	<1	<1	<1	<5	0.60
14-Aug-02	<1	<1	<1	<5	0.94
20-Aug-02	<1	<1	<1	<5	1.88
28-Aug-02	<1	<1	<1	<5	0.66
03-Sep-02	<1	<1	<1	<5	0.50
08-Oct-02	1	1	<1	5	2.75
16-Oct-02	<1	<1	<1	5	1.79
23-Oct-02	<1	<1	<1	5	3.14
29-Oct-02	<1	<1	<1	5	2.64
06-Nov-02	<1	<1	<1	10	1.62
15-Apr-03	<2	<2	<2	20	1.59
23-Apr-03	<2	<2	<2	10	1.03
29-Apr-03	<2	<2	<2	15	0.90
05-May-03	<2	<2	<2	10	0.77
13-May-03	<1	<1	<1	20	0.56
06-Aug-03	3	1	<1	5	0.87
12-Aug-03	<1	<1	<1	5	0.39
18-Aug-03	<1	<1	<1	5	0.54
26-Aug-03	<1	<1	<1	10	0.57
03-Sep-03	<1	<1	1	5	0.40

Table 3B – Site LL5 (EMS # E251910)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**≤ 10 (90%)**	**≤ 10 (90%)**	**≤ 3 (90%)**	**≤ 15**	**≤ 5**
August, 2002					
Maximum	<1	<1	<1	5	1.88
Average	<1	<1	<1	5	0.92
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0
October, 2002					
Maximum	1	1	<1	10	3.14
Average	0.2	0.2	<1	6	2.39
90th percentile	0.6	0.6	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0
April, 2003					
Maximum	<1	<1	<1	20	1.59
Average	<1	<1	<1	15	0.97
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Not Met**	**Met**
Exceedences	-	-	-	2	0
August, 2003					
Maximum	3	1	1	10	0.87
Average	0.6	0.2	0.2	6	0.55
90th percentile	1.8	0.6	0.6	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0

Table 4A – Site MC (EMS # E249501)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Oct-02	1	<1	<1	5	0.19
16-Oct-02	<1	<1	<1	5	0.19
23-Oct-02	<1	<1	1	5	0.25
29-Oct-02	<1	<1	<1	5	0.14
06-Nov-02	<1	<1	<1	5	0.12
08-Apr-03	2	<2	<2	10	0.24
15-Apr-03	<2	<2	<2	10	0.12
23-Apr-03	<2	<2	<2	15	0.18
29-Apr-03	<2	<2	<2	5	0.14
05-May-03	<2	<2	<2	10	0.19

Table 4B – Site MC (EMS # E249501)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**≤ 10 (90%)**	**≤ 10 (90%)**	**≤ 3 (90%)**	**≤ 15**	**≤ 5**
October, 2002					
Maximum	1	<1	1	5	0.25
Average	0.2	<1	0.2	5	0.18
90th percentile	0.6	<1	0.6	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0
April, 2003					
Maximum	2	<1	<1	15	0.24
Average	0.4	<1	<1	10	0.17
90th percentile	1.2	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	-	-	-	0	0

Table 5A – Site JF1 (EMS # E248954)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Aug-02	<1	<1	<1	<5	<0.10
14-Aug-02	<1	<1	<1	<5	0.15
20-Aug-02	<1	<1	<1	<5	0.24
28-Aug-02	<1	<1	2	<5	0.13
03-Sep-02	<1	<1	<1	<5	0.16
08-Oct-02	<1	<1	<1	<5	0.16
16-Oct-02	<1	<1	<1	<5	0.20
23-Oct-02	<1	<1	<1	<5	0.34
29-Oct-02	<1	<1	<1	<5	0.10
06-Nov-02	n/a	n/a	n/a	n/a	n/a
08-Apr-03	<2	<2	<2	<5	0.18
15-Apr-03	<2	<2	<2	5	0.24
23-Apr-03	46	<2	<2	<5	0.14
29-Apr-03	<2	<2	<2	5	0.27
05-May-03	<2	<2	<2	<5	0.15
06-Aug-03	<1	<1	<1	<5	0.14
12-Aug-03	<1	<1	<1	<5	<0.10
18-Aug-03	<1	<1	<1	<5	<0.10
26-Aug-03	<1	<1	<1	<5	<0.10
03-Sep-03	<1	<1	<1	<5	<0.10

Table 5B – Site JF1 (EMS # E248954)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
August, 2002					
Maximum	<1	<1	2	5	0.24
Average	<1	<1	0.4	5	0.16
90th percentile	<1	<1	1.2	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Met**
Exceedences	0	0	1	0	0
October, 2002					
Maximum	<1	<1	<1	5	0.34
Average	<1	<1	<1	5	0.20
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0
April, 2003					
Maximum	46	<1	<1	5	0.27
Average	9.2	<1	<1	5	0.20
90th percentile	27.6	<1	<1	-	-
Guideline	**Not Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	1	0	0	0	0
August, 2003					
Maximum	<1	<1	<1	5	0.14
Average	<1	<1	<1	5	0.11
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 6A – Site JF2 (EMS # E248955)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Aug-02	<1	<1	<1	<5	0.41
14-Aug-02	<1	<1	<1	<5	0.77
20-Aug-02	<1	<1	<1	<5	0.38
28-Aug-02	<1	<1	<1	<5	0.43
03-Sep-02	<1	<1	<1	<5	0.20
08-Oct-02	<1	<1	<1	<5	0.22
16-Oct-02	<1	<1	<1	<5	0.42
23-Oct-02	<1	<1	2	<5	0.49
29-Oct-02	<1	<1	<1	<5	0.38
06-Nov-02	<1	<1	<1	<5	0.15
08-Apr-03	<2	<2	<2	5	0.51
15-Apr-03	<2	<2	<2	<5	0.29
23-Apr-03	<2	<2	<2	<5	0.33
29-Apr-03	<2	<2	<2	<5	0.38
05-May-03	<2	<2	2	<5	0.23
06-Aug-03	<1	<1	<1	<5	0.27
12-Aug-03	<1	<1	<1	<5	0.17
18-Aug-03	<1	<1	<1	<5	0.38
26-Aug-03	<1	<1	<1	5	0.42
03-Sep-03	<1	<1	<1	<5	0.21

Table 6B – Site JF2 (EMS # E248955)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
August, 2002					
Maximum	<1	<1	<1	5	0.77
Average	<1	<1	<1	5	0.44
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0
October, 2002					
Maximum	<1	<1	2	5	0.49
Average	<1	<1	0.4	5	0.33
90th percentile	<1	<1	1.2	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Met**
Exceedences	0	0	1	0	0
April, 2003					
Maximum	<1	<1	2	5	0.51
Average	<1	<1	0.4	5	0.35
90th percentile	<1	<1	1.2	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Met**
Exceedences	0	0	1	0	0
August, 2003					
Maximum	<1	<1	<1	5	0.42
Average	<1	<1	<1	5	0.29
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 7A – Site JF3 (EMS # E248956)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Aug-02	<1	<1	<1	<5	21.90
14-Aug-02	<1	<1	<1	<5	13.40
20-Aug-02	<1	<1	<1	<5	7.83
28-Aug-02	<1	<1	<1	<5	4.61
03-Sep-02	<1	<1	<1	<5	21.50
08-Oct-02	<1	<1	<1	300	298.00
16-Oct-02	<1	<1	<1	5	189.00
23-Oct-02	<1	<1	<1	5	90.30
29-Oct-02	<1	<1	<1	5	85.20
06-Nov-02	n/a	n/a	n/a	n/a	n/a
08-Apr-03	<2	<2	<2	15	24.20
15-Apr-03	n/a	n/a	n/a	n/a	n/a
23-Apr-03	n/a	n/a	n/a	n/a	n/a
29-Apr-03	n/a	n/a	n/a	n/a	n/a
05-May-03	n/a	n/a	n/a	n/a	n/a

Table 7B – Site JF3 (EMS # E248956)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
August, 2002					
Maximum	<1	<1	<1	5	21.90
Average	<1	<1	<1	5	13.85
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Not Met**
Exceedences	0	0	0	0	4
October, 2002					
Maximum	<1	<1	<1	300	298.00
Average	<1	<1	<1	79	165.63
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Not Met**	**Not Met**
Exceedences	0	0	0	1	4
April, 2003					
Maximum	<1	<1	<1	15	24.20
Average	n/a	n/a	n/a	n/a	n/a
90th percentile	n/a	n/a	n/a	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Not Met**
Exceedences	0	0	0	0	1

Table 8A – Site JF4 (EMS # E249502)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Oct-02	0	0	0	n/a	n/a
16-Oct-02	0	0	0	<5	0.23
23-Oct-02	0	0	0	<5	0.51
29-Oct-02	0	0	0	<5	0.35
06-Nov-02	0	0	0	<5	0.45
08-Apr-03	0	0	0	5	4.07
15-Apr-03	0	0	0	5	0.22
23-Apr-03	0	0	0	<5	0.25
29-Apr-03	0	0	0	5	0.22
05-May-03	0	0	0	5	0.51
06-Aug-03	<1	<1	<1	<5	0.15
12-Aug-03	<1	<1	<1	<5	<0.10
18-Aug-03	<1	<1	<1	<5	<0.10
26-Aug-03	<1	<1	<1	5	0.13
03-Sep-03	<1	<1	<1	5	<0.10

Table 8B – Site JF4 (EMS # E249502)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
October, 2002					
Maximum	<1	<1	<1	5	0.51
Average	<1	<1	<1	5	0.39
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0
April, 2003					
Maximum	<1	<1	<1	5	4.07
Average	<1	<1	<1	5	1.05
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0
August, 2003					
Maximum	<1	<1	<1	5	0.15
Average	<1	<1	<1	5	0.12
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 9A – Site JF5 (EMS # E251789)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
06-Aug-03	<1	<1	<1	5	0.62
12-Aug-03	<1	<1	<1	10	1.43
18-Aug-03	<1	<1	<1	5	0.60
26-Aug-03	<1	<1	<1	5	0.81
03-Sep-03	<1	<1	<1	5	1.00

Table 9B – Site JF5 (EMS # E251789)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
August, 2003					
Maximum	<1	<1	<1	10	1.43
Average	<1	<1	<1	6	0.89
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 10A – Site JF6 (EMS # E251790)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Apr-03	<2	<2	<2	5	1.97
15-Apr-03	<2	<2	<2	<5	0.42
23-Apr-03	<2	<2	<2	<5	0.45
29-Apr-03	<2	<2	<2	<5	0.73
05-May-03	<2	<2	2	<5	0.33
06-Aug-03	<1	<1	<1	<5	0.71
12-Aug-03	<1	<1	<1	<5	0.24
18-Aug-03	<1	<1	<1	<5	0.33
26-Aug-03	<1	<1	<1	5	0.38
03-Sep-03	<1	<1	<1	<5	0.56

Table 10B – Site JF6 (EMS # E251790)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
April, 2003					
Maximum	<1	<1	2	5	1.97
Average	<1	<1	0.4	5	0.78
90th percentile	<1	<1	1.2	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Met**
Exceedences	0	0	1	0	0
August, 2003					
Maximum	<1	<1	<1	5	0.71
Average	<1	<1	<1	5	0.44
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 11A – Site JF7 (EMS # E251791)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
06-Aug-03	<1	<1	<1	<5	0.41

Table 11B – Site JF7 (EMS # E251791)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
August, 2003					
Maximum	<1	<1	<1	5	0.41
Average	n/a	n/a	n/a	n/a	n/a
90th percentile	n/a	n/a	n/a	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 12A – Site JF8 (EMS # E251792)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Apr-03	<2	<2	<2	<5	0.37
15-Apr-03	<2	<2	<2	<5	0.58
23-Apr-03	<2	<2	<2	5	0.44
29-Apr-03	<2	<2	<2	5	0.26
05-May-03	<2	<2	16	<5	0.34
06-Aug-03	<1	<1	<1	<5	0.74
12-Aug-03	<1	<1	<1	<5	0.42
18-Aug-03	<1	<1	<1	5	0.56
26-Aug-03	<1	<1	<1	5	0.79
03-Sep-03	<1	<1	<1	<5	0.74

Table 12B – Site JF8 (EMS # E251792)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
April, 2003					
Maximum	<1	<1	16	5	0.58
Average	<1	<1	3.2	5	0.40
90th percentile	<1	<1	9.6	-	-
Guideline	**Met**	**Met**	**Not Met**	**Met**	**Met**
Exceedences	0	0	1	0	0
August, 2003					
Maximum	<1	<1	<1	5	0.79
Average	<1	<1	<1	5	0.65
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Met**
Exceedences	0	0	0	0	0

Table 13A – Site JF9 (EMS # E253070)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
06-Aug-03	n/a	n/a	n/a	n/a	n/a
12-Aug-03	<1	<1	<1	<5	0.27
18-Aug-03	<1	<1	<1	<5	3.77
26-Aug-03	<1	<1	<1	5	7.80
03-Sep-03	<1	<1	<1	<5	2.41

Table 13B – Site JF9 (EMS # E253070)

	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
Guideline:	**0**	**0**	**0**	**≤ 15**	**≤ 5**
August, 2003					
Maximum	<1	<1	<1	5	7.80
Average	<1	<1	<1	5	3.56
90th percentile	<1	<1	<1	-	-
Guideline	**Met**	**Met**	**Met**	**Met**	**Not Met**
Exceedences	0	0	0	0	1

ADDITIONAL WATER QUALITY RESULTS (TABLE A) AND STATISTICAL ANALYSIS & SUMMARY (TABLE B)

Table 14A – Lakelse Lake Sites (LL1, LL2 and LL5)

(Values in mg/L unless otherwise noted)

	DS @ 6m 13-Aug-02	DS @ 6m 10-Sep-02	LL1 8-Oct-02	LL2 8-Oct-02	LL3 8-Oct-02
PYHSICAL					
pH (pH units)	7.6	7.3	7.3	7.3	7.3
Specific Conductance (uS/cm)	49	50	47	48	48
Residue Filterable - TDS	n/a	n/a	n/a	n/a	n/a
Hardness Total - T	19.8	20.8	19.8	20.2	19.1
Alkalinity Total (mg/L CaCO3)	n/a	n/a	n/a	n/a	n/a
ANIONS					
Chloride Dissolved	n/a	n/a	n/a	n/a	n/a
Fluoride Dissolved	n/a	n/a	n/a	n/a	n/a
CARBON					
Organic Carbon - Total	n/a	n/a	n/a	n/a	n/a
NITROGEN					
Total Kjeldahl N	0.06	0.07	0.07	0.07	0.05
Total N	0.05	0.07	0.09	0.09	0.05
Total Organic N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ammonia N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate Nitrogen Dissolved	< 0.02	< 0.02	< 0.02	0.02	< 0.02
Nitrate+Nitrite	< 0.002	< 0.002	0.018	0.024	0.002
Nitrite Nitrogen	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
PHOSPHORUS					
Ortho-Phosphorus	n/a	0.001	n/a	n/a	n/a
Phosphorus Total Dissolved	0.004	0.003	< 0.002	< 0.002	< 0.002
Phosphorus Total	0.005	0.004	0.009	0.004	< 0.002
SULFATE					
Sulfate	n/a	n/a	n/a	n/a	n/a
METALS TOTAL					
Aluminum	0.0187	0.0226	0.0854	0.105	0.0635
Antimony	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Arsenic	< 0.0001	0.0001	< 0.0001	< 0.0001	< 0.0001
Barium	0.0101	0.00985	0.0106	0.0115	0.0148
Beryllium	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Cadmium	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	6.93	7.27	6.87	6.98	6.61
Chromium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Cobalt	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Copper	0.00016	0.00063	0.0371	0.00923	0.0141
Iron	0.123	0.132	0.291	0.279	0.239
Lead	< 0.00001	0.00001	0.0008	0.00014	0.0002
Lithium	0.00053	< 0.00005	< 0.00005	0.00054	0.00016
Magnesium	0.6	0.64	0.65	0.67	0.62
Manganese	0.00618	0.00943	0.0201	0.0239	0.0219
Molybdenum	0.00062	0.00071	0.00061	0.00062	0.00062
Nickel	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Selenium	< 0.0002	0.0002	< 0.0002	< 0.0002	< 0.0002
Silver	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Strontium	0.0317	0.0395	0.0386	0.0394	0.0401
Thallium	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Uranium	0.000087	0.000071	0.000101	0.0001	0.000083
Vanadium	0.00015	0.00038	0.00053	0.00057	0.00051
Zinc	0.0002	0.0002	0.0051	0.0071	0.0135

Table 14A – Lakelse Lake Sites (LL1, LL2 and LL5) Continued
(Values in mg/L unless otherwise noted)

	LL1 8-Apr-03	LL2-1 8-Apr-03	LL2-2 8-Apr-03	LL5 15-Apr-03
PYHSICAL				
pH (pH units)	7.5	7.5	7.5	7.4
Specific Conductance (uS/cm)	65	64	65	68
Residue Filterable - TDS	n/a	n/a	n/a	n/a
Hardness Total - T	26.6	26.8	26.5	27.5
Alkalinity Total (mg/L CaCO3)	n/a	n/a	n/a	n/a
ANIONS				
Chloride Dissolved	n/a	n/a	n/a	n/a
Fluoride Dissolved	n/a	n/a	n/a	n/a
CARBON				
Organic Carbon - Total	n/a	n/a	n/a	n/a
NITROGEN				
Total Kjeldahl N	0.09	0.12	0.07	n/a
Total N	0.15	0.18	0.14	0.14
Total Organic N	< 0.1	0.12	< 0.1	n/a
Ammonia N	< 0.005	< 0.005	< 0.005	0.008
Nitrate Nitrogen Dissolved	0.06	0.06	0.07	n/a
Nitrate+Nitrite	0.064	0.06	0.069	n/a
Nitrite Nitrogen	0.003	< 0.002	0.002	0.002
PHOSPHORUS				
Ortho-Phosphorus	n/a	n/a	n/a	n/a
Phosphorus Total Dissolved	0.005	0.007	0.007	0.006
Phosphorus Total	0.007	**0.016**	0.01	0.007
SULFATE				
Sulfate	n/a	n/a	n/a	n/a
METALS TOTAL				
Aluminum	0.0823	0.165	0.118	0.0713
Antimony	0.00002	0.000016	0.000033	0.000013
Arsenic	0.0001	0.0002	0.0002	0.0002
Barium	0.0114	0.0139	0.0127	0.011
Beryllium	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth	< 0.00002	< 0.00002	< 0.00002	0.00008
Cadmium	< 0.00001	< 0.00001	0.00001	0.00001
Calcium	9.14	9.12	9.06	9.44
Chromium	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Cobalt	0.000019	0.000058	0.000048	0.000014
Copper	0.0304	0.0131	0.0149	0.0655
Iron	**0.343**	**1.13**	**0.631**	**0.426**
Lead	0.00045	0.00005	0.0001	0.00395
Lithium	0.00025	0.00023	0.00023	0.0004
Magnesium	0.92	0.99	0.94	0.95
Manganese	0.0151	0.0357	0.0241	0.0162
Molybdenum	0.00056	0.00058	0.00051	0.00077
Nickel	< 0.00005	0.00016	0.00018	< 0.00005
Selenium	< 0.0002	< 0.0002	< 0.0002	0.0002
Silver	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Strontium	0.049	0.049	0.0491	0.0522
Thallium	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin	< 0.00001	< 0.00001	< 0.00001	0.00006
Uranium	0.000123	0.000164	0.000136	0.000148
Vanadium	0.00071	0.001	0.00078	0.00061
Zinc	0.0045	0.0075	0.0145	0.013

Table 14A – Lakelse Lake Sites (LL1, LL2 and LL5) Continued

(Values in mg/L unless otherwise noted)

	LL1 6-Aug-03	LL2 6-Aug-03	LL5 6-Aug-03	Drinking Water Guideline		
PYHSICAL						
pH (pH units)	7.6	7.6	7.6	≤ 8.5	ao (>6.5)	Met
Specific Conductance (uS/cm)	60	62	61	≤ 700	mac	Met
Residue Filterable - TDS	40	44	52	≤ 500	ao	Met
Hardness Total - T	24.6	25.1	25.1	≤ 500	mac	Met
Alkalinity Total (mg/L CaCO3)	24.3	24.9	24.6			
ANIONS						
Chloride Dissolved	1.6	2	1.7	≤ 250	ao	Met
Fluoride Dissolved	0.03	0.03	0.03	≤ 1.5	mac	Met
CARBON						
Organic Carbon - Total	1.4	1.7	1.6	≤ 4	mac (THM)	Met
NITROGEN						
Total Kjeldahl N	n/a	n/a	n/a			
Total N	n/a	n/a	n/a			
Total Organic N	n/a	n/a	n/a			
Ammonia N	< 0.005	< 0.005	< 0.005			
Nitrate Nitrogen Dissolved	< 0.02	< 0.02	< 0.02	≤ 10	mac	Met
Nitrate+Nitrite	0.005	0.006	0.006			
Nitrite Nitrogen	< 0.002	< 0.002	< 0.002	≤ 1	mac	Met
						Met
PHOSPHORUS						Met
Ortho-Phosphorus	n/a	n/a	n/a			
Phosphorus Total Dissolved	n/a	n/a	n/a			
Phosphorus Total	0.007	0.01	0.008	≤ 0.01	mac (lakes)	**Not Met**
SULFATE						
Sulfate	1.9	2.3	2.3	≤ 500	ao	Met
METALS TOTAL						
Aluminum	0.0267	0.0242	0.0275	≤ 0.2	mac	Met
Antimony	0.000024	0.000009	0.000014	≤ 0.006	imac	Met
Arsenic	0.0002	0.0003	0.0003	≤ 0.025	imac	Met
Barium	0.0106	0.0112	0.0109	≤ 1	mac	Met
Beryllium	< 0.00002	< 0.00002	< 0.00002			
Bismuth	< 0.00002	< 0.00002	< 0.00002			
Cadmium	< 0.00001	< 0.00001	< 0.00001	≤ 0.005	mac	Met
Calcium	8.59	8.72	8.72			
Chromium	< 0.0002	< 0.0002	< 0.0002	≤ 0.05	mac	Met
Cobalt	0.000007	0.000007	0.00001			
Copper	0.0168	0.00355	0.0124	≤ 1	ao	Met
Iron	0.117	0.143	0.151	≤ 0.3	ao	**Not Met**
Lead	0.00025	0.00004	0.001	≤ 0.01	mac	Met
Lithium	0.00032	0.00028	0.00019			
Magnesium	0.77	0.8	0.8	≤ 100	ao	Met
Manganese	0.00688	0.0102	0.0113	≤ 0.05	ao	Met
Molybdenum	0.00085	0.00085	0.00083	≤ 0.25	mac	Met
Nickel	< 0.00005	< 0.00005	< 0.00005			
Selenium	< 0.0002	0.0002	< 0.0002	≤ 0.01	mac	Met
Silver	< 0.00002	< 0.00002	< 0.00002			
Strontium	0.0407	0.0415	0.0429			
Thallium	< 0.000002	< 0.000002	< 0.000002			
Tin	< 0.00001	< 0.00001	< 0.00001			
Uranium	0.00008	0.000088	0.000088	≤ 0.02	imac*	Met
Vanadium	0.00019	0.00021	0.00024	≤ 0.1	mac	Met
Zinc	0.001	0.0013	0.0025	≤ 5	ao	Met

Table 14B – Lakelse Lake Sites (LL1, LL2 and LL5)
(Values in mg/L unless otherwise noted)

	# Values	Minimum	Maximum	Mean	Drinking Water Guideline		
PYHSICAL							
pH (pH units)	12	7.3	7.6	7.5	≤	8.5	ao (>6.5)
Specific Conductance (uS/cm)	12	47	68	57	≤	700	mac
Residue Filterable - TDS	3	40	52	45	≤	500	ao
Hardness Total - T	12	19.1	27.5	23.5	≤	500	mac
Alkalinity Total (mg/L CaCO3)	3	24.3	24.9	24.6			
ANIONS							
Chloride Dissolved	3	1.6	2.0	1.8	≤	250	ao
Fluoride Dissolved	3	0.03	0.03	0.03	≤	1.5	mac
CARBON							
Organic Carbon - Total	3	1.4	1.7	1.6	≤	4	mac (THM)
NITROGEN							
Total Kjeldahl N	8	0.05	0.12	0.08			
Total N	9	0.05	0.18	0.11			
Total Organic N	8	0.1	0.1	0.1			
Ammonia N	12	0.005	0.008	0.005			
Nitrate Nitrogen Dissolved	11	0.02	0.07	0.03	≤	10	mac
Nitrate+Nitrite	11	0.002	0.069	0.023			
Nitrite Nitrogen	12	0.002	0.003	0.002	≤	1	mac
PHOSPHORUS							
Ortho-Phosphorus	1	0.001	0.001	0.001			
Phosphorus Total Dissolved	9	0.002	0.007	0.004			
Phosphorus Total	12	0.002	0.016	0.007	≤	0.01	mac (lakes)
SULFATE							
Sulfate	3	1.9	2.3	2.2	≤	500	ao
METALS TOTAL							
Aluminum	12	0.0187	0.1650	0.0675	≤	0.2	mac
Antimony	12	0.00001	0.00003	0.00001	≤	0.006	imac
Arsenic	12	0.0001	0.0003	0.0002	≤	0.025	imac
Barium	12	0.00985	0.01480	0.01155	≤	1	mac
Beryllium	12	0.00002	0.00002	0.00002			
Bismuth	12	0.00002	0.00008	0.00003			
Cadmium	12	0.00001	0.00001	0.00001	≤	0.005	mac
Calcium	12	6.61	9.44	8.12			
Chromium	12	0.0002	0.0002	0.0002	≤	0.05	mac
Cobalt	12	0.000005	0.000058	0.000016			
Copper	12	0.00016	0.06550	0.01816	≤	1	ao
Iron	12	0.117	1.130	0.334	≤	0.3	ao
Lead	12	0.00001	0.00395	0.00058	≤	0.01	mac
Lithium	12	0.00005	0.00054	0.00027			
Magnesium	12	0.60	0.99	0.78	≤	100	ao
Manganese	12	0.006180	0.035700	0.016749	≤	0.05	ao
Molybdenum	12	0.00051	0.00085	0.00068	≤	0.25	mac
Nickel	12	0.00005	0.00018	0.00007			
Selenium	12	0.0002	0.0002	0.0002	≤	0.01	mac
Silver	12	0.00002	0.00002	0.00002			
Strontium	12	0.031700	0.052200	0.042808			
Thallium	12	0.000002	0.000002	0.000002			
Tin	12	0.00001	0.00006	0.00001			
Uranium	12	0.000071	0.000164	0.000106	≤	0.02	imac*
Vanadium	12	0.00015	0.00100	0.00049	≤	0.1	mac
Zinc	12	0.0002	0.0145	0.0059	≤	5	ao

Table 15A – Mountain Creek (MC)
(Values in mg/L unless otherwise noted)

	MC 8-Oct-02	MC 8-Apr-03	Drinking Water Guideline		
PYHSICAL					
pH (pH units)	7.3	7.2	≤ 8.5	ao (>6.5)	Met
Specific Conductance (uS/cm)	36	24	≤ 700	mac	Met
Residue Filterable - TDS	n/a	n/a	≤ 500	ao	
Hardness Total - T	14.4	9.4	≤ 500	mac	Met
Alkalinity Total (mg/L CaCO3)	n/a	n/a			
ANIONS					
Chloride Dissolved	n/a	n/a	≤ 250	ao	
Fluoride Dissolved	n/a	n/a	≤ 1.5	mac	
CARBON					
Organic Carbon - Total	n/a	n/a	≤ 4	mac (THM)	
NITROGEN					
Total Kjeldahl N	0.05	0.04			
Total N	0.05	0.05			
Total Organic N	< 0.1	< 0.1			
Ammonia N	0.006	< 0.005			
Nitrate Nitrogen Dissolved	< 0.02	< 0.02	≤ 10	mac	Met
Nitrate+Nitrite	< 0.002	0.011			
Nitrite Nitrogen	< 0.002	0.002	≤ 1	mac	Met
PHOSPHORUS					
Ortho-Phosphorus	0.003	< 0.001			
Phosphorus Total Dissolved	n/a	n/a			
Phosphorus Total	0.004	0.005	≤ 0.01	mac (lakes)	
SULFATE					
Sulfate	n/a	n/a	≤ 500	ao	
METALS TOTAL					
Aluminum	0.0388	0.0531	≤ 0.2	mac	Met
Antimony	< 0.000005	0.000009	≤ 0.006	imac	Met
Arsenic	< 0.0001	< 0.0001	≤ 0.025	imac	Met
Barium	0.0116	0.00777	≤ 1	mac	Met
Beryllium	< 0.00002	< 0.00002			
Bismuth	< 0.00002	< 0.00002			
Cadmium	< 0.00001	< 0.00001	≤ 0.005	mac	Met
Calcium	5.1	3.31			
Chromium	< 0.0002	< 0.0002	≤ 0.05	mac	Met
Cobalt	< 0.000005	< 0.000005			
Copper	0.00006	0.00017	≤ 1	ao	Met
Iron	0.022	0.016	≤ 0.3	ao	Met
Lead	< 0.00001	< 0.00001	≤ 0.01	mac	Met
Lithium	0.0004	< 0.00005			
Magnesium	0.41	0.28	≤ 100	ao	Met
Manganese	0.00103	0.000779	≤ 0.05	ao	Met
Molybdenum	0.00119	0.00119	≤ 0.25	mac	Met
Nickel	< 0.00005	< 0.00005			
Selenium	< 0.0002	< 0.0002	≤ 0.01	mac	Met
Silver	< 0.00002	< 0.00002			
Strontium	0.0546	0.0358			
Thallium	< 0.000002	< 0.000002			
Tin	< 0.00001	< 0.00001			
Uranium	0.000111	0.000126	≤ 0.02	imac*	Met
Vanadium	0.0003	0.00028	≤ 0.1	mac	Met
Zinc	< 0.0001	< 0.0001	≤ 5	ao	Met

Table 15B – Mountain Creek (MC)
(Values in mg/L unless otherwise noted)

	# Values	Minimum	Maximum	Mean	Drinking Water Guideline		
PYHSICAL							
pH (pH units)	2	7.2	7.3	7.3	≤	8.5	ao (>6.5)
Specific Conductance (uS/cm)	2	24	36	30	≤	700	mac
Residue Filterable - TDS	0				≤	500	ao
Hardness Total - T	2	9.4	14.4	11.9	≤	500	mac
Alkalinity Total (mg/L CaCO3)	0						
ANIONS							
Chloride Dissolved	0				≤	250	ao
Fluoride Dissolved	0				≤	1.5	mac
CARBON							
Organic Carbon - Total	0				≤	4	mac (THM)
NITROGEN							
Total Kjeldahl N	2	0.04	0.05	0.05			
Total N	2	0.05	0.05	0.05			
Total Organic N	2	0.1	0.1	0.1			
Ammonia N	2	0.005	0.006	0.006			
Nitrate Nitrogen Dissolved	2	0.02	0.02	0.02	≤	10	mac
Nitrate+Nitrite	2	0.002	0.011	0.007			
Nitrite Nitrogen	2	0.002	0.002	0.002	≤	1	mac
PHOSPHORUS							
Ortho-Phosphorus	2	0.001	0.003	0.002			
Phosphorus Total Dissolved	0						
Phosphorus Total	2	0.004	0.005	0.005	≤	0.01	mac (lakes)
SULFATE							
Sulfate	0				≤	500	ao
METALS TOTAL							
Aluminum	2	0.0388	0.0531	0.0460	≤	0.2	mac
Antimony	2	0.00001	0.00001	0.00001	≤	0.006	imac
Arsenic	2	0.0001	0.0001	0.0001	≤	0.025	imac
Barium	2	0.00777	0.01160	0.00969	≤	1	mac
Beryllium	2	0.00002	0.00002	0.00002			
Bismuth	2	0.00002	0.00002	0.00002			
Cadmium	2	0.00001	0.00001	0.00001	≤	0.005	mac
Calcium	2	3.31	5.10	4.21			
Chromium	2	0.0002	0.0002	0.0002	≤	0.05	mac
Cobalt	2	0.000005	0.000005	0.000005			
Copper	2	0.00006	0.00017	0.00012	≤	1	ao
Iron	2	0.016	0.022	0.019	≤	0.3	ao
Lead	2	0.00001	0.00001	0.00001	≤	0.01	mac
Lithium	2	0.00005	0.00040	0.00023			
Magnesium	2	0.28	0.41	0.35	≤	100	ao
Manganese	2	0.000779	0.001030	0.000905	≤	0.05	ao
Molybdenum	2	0.00119	0.00119	0.00119	≤	0.25	mac
Nickel	2	0.00005	0.00005	0.00005			
Selenium	2	0.0002	0.0002	0.0002	≤	0.01	mac
Silver	2	0.00002	0.00002	0.00002			
Strontium	2	0.035800	0.054600	0.045200			
Thallium	2	0.000002	0.000002	0.000002			
Tin	2	0.00001	0.00001	0.00001			
Uranium	2	0.000111	0.000126	0.000119	≤	0.02	imac*
Vanadium	2	0.00028	0.00030	0.00029	≤	0.1	mac
Zinc	2	0.0001	0.0001	0.0001	≤	5	ao

Table 16A – Jackpine Flats Sites (JF1 – JF9)

(Values in mg/L unless otherwise noted)

	JF1 8-Aug-02	JF2 8-Aug-02	JF3 8-Aug-02	JF1 8-Oct-02	JF2 8-Oct-02	JF3 8-Oct-02
PYHSICAL						
pH (pH units)	n/a	n/a	n/a	7	8.2	7.3
Specific Conductance (uS/cm)	44	73	64	45	81	61
Residue Filterable - TDS	n/a	n/a	n/a	n/a	n/a	n/a
Hardness Total - T	15.9	32.8	30.1	16.3	33	29.1
Alkalinity Total (mg/L CaCO3)	n/a	n/a	n/a	n/a	n/a	n/a
ANIONS						
Chloride Dissolved	2.7	2.9	1.4	1.7	2.1	0.9
Fluoride Dissolved	n/a	n/a	n/a	n/a	n/a	n/a
CARBON						
Organic Carbon - Total	n/a	n/a	n/a	n/a	n/a	n/a
NITROGEN						
Total Kjeldahl N	< 0.02	< 0.02	< 0.02	< 0.02	0.05	0.04
Total N	< 0.02	0.41	0.09	< 0.02	1.26	0.05
Total Organic N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ammonia N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.029
Nitrate Nitrogen Dissolved	< 0.02	0.39	0.07	< 0.02	1.21	< 0.02
Nitrate+Nitrite	0.005	0.396	0.073	< 0.002	1.21	0.012
Nitrite Nitrogen	0.002	0.002	0.005	< 0.002	< 0.002	< 0.002
PHOSPHORUS						
Ortho-Phosphorus	n/a	n/a	n/a	n/a	n/a	n/a
Phosphorus Total Dissolved	n/a	n/a	n/a	n/a	n/a	n/a
Phosphorus Total	n/a	n/a	n/a	n/a	n/a	n/a
SULFATE						
Sulfate	n/a	n/a	n/a	n/a	n/a	n/a
METALS TOTAL						
Aluminum	0.0025	0.0007	0.0008	0.0024	0.0004	0.0042
Antimony	0.00002	0.000041	0.000016	< 0.000005	0.000021	< 0.000005
Arsenic	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Barium	0.00987	0.00851	0.0149	0.0099	0.00836	0.0114
Beryllium	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Cadmium	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	5.54	11.2	10.7	5.74	11.3	10.3
Chromium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	0.0012
Cobalt	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005	< 0.000005
Copper	0.0278	0.0639	0.00567	0.031	0.0201	0.00922
Iron	n/a	n/a	n/a	0.016	0.034	**26.2**
Lead	0.00068	0.00246	0.00023	0.00045	0.00031	0.00014
Lithium	< 0.00005	< 0.00005	< 0.00005	0.0007	0.00044	< 0.00005
Magnesium	0.49	1.18	0.82	0.48	1.15	0.81
Manganese	0.000735	0.00266	0.0389	0.000999	0.000563	**0.27**
Molybdenum	0.00011	0.00009	0.00013	0.00008	0.00005	0.00008
Nickel	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00122
Selenium	< 0.0002	0.0002	0.0004	< 0.0002	< 0.0002	< 0.0002
Silver	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Strontium	0.0381	0.0519	0.0391	0.0402	0.0568	0.0385
Thallium	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin	0.00052	0.00251	0.00008	< 0.00001	0.00023	0.00001
Uranium	< 0.000002	< 0.000002	< 0.000002	0.000009	0.000013	0.000036
Vanadium	0.00022	0.0001	0.00012	0.0005	0.00038	0.00059
Zinc	0.001	0.0293	0.0084	0.0023	0.0136	0.0095

Table 16A – Jackpine Flats Sites (JF1 – JF9) Continued

(Values in mg/L unless otherwise noted)

	JF4 23-Oct-02	JF1 8-Apr-03	JF2 8-Apr-03	JF3 8-Apr-03	JF4 8-Apr-03	JF6 8-Apr-03
PYHSICAL						
pH (pH units)	7.2	6.9	7.1	7.3	7.2	7.4
Specific Conductance (uS/cm)	41	45	77	64	51	91
Residue Filterable - TDS	n/a	n/a	n/a	n/a	n/a	n/a
Hardness Total - T	17.2	16.3	35.1	29.7	20.7	42.1
Alkalinity Total (mg/L CaCO3)	n/a	n/a	n/a	n/a	n/a	n/a
ANIONS						
Chloride Dissolved	< 0.5	3	1.3	0.8	2.7	1.3
Fluoride Dissolved	n/a	n/a	n/a	n/a	n/a	n/a
CARBON						
Organic Carbon - Total	n/a	n/a	n/a	n/a	n/a	n/a
NITROGEN						
Total Kjeldahl N	< 0.02	< 0.02	< 0.02	< 0.02	0.03	0.02
Total N	0.04	0.02	0.42	0.09	0.11	0.22
Total Organic N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Ammonia N	< 0.005	< 0.005	< 0.005	< 0.005	0.006	< 0.005
Nitrate Nitrogen Dissolved	0.05	< 0.02	0.42	0.08	0.08	0.19
Nitrate+Nitrite	0.052	0.013	0.423	0.081	0.08	0.193
Nitrite Nitrogen	0.004	< 0.002	< 0.002	0.003	0.002	0.003
PHOSPHORUS						
Ortho-Phosphorus	n/a	n/a	n/a	n/a	n/a	n/a
Phosphorus Total Dissolved	n/a	n/a	n/a	n/a	n/a	n/a
Phosphorus Total	n/a	n/a	n/a	n/a	n/a	n/a
SULFATE						
Sulfate	n/a	n/a	n/a	n/a	n/a	n/a
METALS TOTAL						
Aluminum	0.0269	0.0024	0.0005	< 0.0003	0.0254	< 0.0003
Antimony	< 0.000036	0.000005	0.000005	0.000005	0.000014	0.000016
Arsenic	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Barium	0.0118	0.00897	0.00884	0.0137	0.012	0.00289
Beryllium	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Cadmium	< 0.00001	< 0.00001	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	6.11	5.77	12	10.6	7.34	15
Chromium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Cobalt	< 0.000005	< 0.000005	< 0.000005	0.000012	< 0.000005	0.000005
Copper	0.00213	0.0249	0.0276	0.00692	0.00187	0.0295
Iron	0.06	0.01	0.029	**1.73**	**0.477**	**0.418**
Lead	0.00017	0.0007	0.00013	0.00007	0.00014	0.00013
Lithium	< 0.00005	< 0.00005	0.00005	< 0.00005	< 0.00005	< 0.00005
Magnesium	0.48	0.47	1.25	0.79	0.57	1.13
Manganese	0.000823	0.000684	**1.38**	0.0383	0.00157	0.0474
Molybdenum	0.00062	0.00008	0.00007	0.00009	0.0006	0.00044
Nickel	< 0.00005	< 0.00005	0.00007	0.0001	< 0.00005	0.00005
Selenium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Silver	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Strontium	0.029	0.0389	0.059	0.0398	0.032	0.055
Thallium	0.000003	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin	< 0.00001	< 0.00001	0.00002	< 0.00001	< 0.00001	0.00045
Uranium	0.000144	0.000008	0.000015	0.000013	0.000144	0.000046
Vanadium	0.0003	0.00084	0.0144	0.00072	0.00056	0.00083
Zinc	0.0079	0.0037	0.0421	0.012	0.0074	0.0083

Table 16A – Jackpine Flats Sites (JF1 – JF9) Continued

(Values in mg/L unless otherwise noted)

	JF8 8-Apr-03	JF1 6-Aug-03	JF2 6-Aug-03	JF4 6-Aug-03	JF5 6-Aug-03	JF6-1 6-Aug-03
PYHSICAL						
pH (pH units)	7.4	6.9	7.3	7.3	7.3	7.5
Specific Conductance (uS/cm)	84	47	80	49	91	92
Residue Filterable - TDS	n/a	34	66	36	62	60
Hardness Total - T	41.3	17.5	34.7	21.4	42.7	43
Alkalinity Total (mg/L CaCO3)	n/a	21.5	31	22.9	41	41.3
ANIONS						
Chloride Dissolved	< 0.5	0.9	2.8	< 0.5	< 0.5	0.6
Fluoride Dissolved	n/a	0.02	0.01	0.02	0.02	0.02
CARBON						
Organic Carbon - Total	n/a	< 0.5	< 0.5	0.7	< 0.5	< 0.5
NITROGEN						
Total Kjeldahl N	< 0.02	n/a	n/a	n/a	n/a	n/a
Total N	0.11	n/a	n/a	n/a	n/a	n/a
Total Organic N	< 0.1	n/a	n/a	n/a	n/a	n/a
Ammonia N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nitrate Nitrogen Dissolved	0.1	< 0.02	0.54	0.06	0.14	0.16
Nitrate+Nitrite	0.1	0.002	0.538	0.064	0.138	0.163
Nitrite Nitrogen	0.003	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
PHOSPHORUS						
Ortho-Phosphorus	n/a	n/a	n/a	n/a	n/a	n/a
Phosphorus Total Dissolved	n/a	n/a	n/a	n/a	n/a	n/a
Phosphorus Total	n/a	n/a	n/a	n/a	n/a	n/a
SULFATE						
Sulfate	n/a	1.6	1.3	1.5	3.8	3.5
METALS TOTAL						
Aluminum	0.0031	0.0032	0.001	0.0243	0.0032	0.0005
Antimony	0.00026	0.000008	0.000006	< 0.000005	0.00015	0.000016
Arsenic	< 0.0001	0.0001	0.0001	0.0002	< 0.0001	0.0001
Barium	0.00902	0.0102	0.00875	0.0132	0.00351	0.0031
Beryllium	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Bismuth	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Cadmium	< 0.00001	< 0.00001	0.00001	< 0.00001	< 0.00001	< 0.00001
Calcium	15.2	6.16	11.9	7.58	15.3	15.3
Chromium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Cobalt	< 0.000005	< 0.000005	< 0.000005	< 0.000005	0.000015	0.000007
Copper	0.00844	0.0283	0.0111	0.00129	0.173	0.0232
Iron	0.032	0.007	0.035	0.01	0.172	0.083
Lead	0.0016	0.00039	0.00023	0.00008	0.00025	0.00022
Lithium	< 0.00005	< 0.00005	0.00007	< 0.00005	< 0.00006	< 0.00005
Magnesium	0.82	0.51	1.2	0.59	1.08	1.17
Manganese	0.000334	0.000632	0.000808	0.000258	0.0049	0.0076
Molybdenum	0.00056	0.00014	0.0001	0.00081	0.00105	0.00074
Nickel	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Selenium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Silver	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002	< 0.00002
Strontium	0.0555	0.0379	0.0543	0.0311	0.0506	0.0493
Thallium	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002	< 0.000002
Tin	0.00001	0.00001	0.00002	< 0.00001	0.00002	0.00001
Uranium	0.000034	0.000011	0.000018	0.000145	0.000106	0.000067
Vanadium	0.00081	0.00032	0.00026	0.00028	0.00025	0.00032
Zinc	0.0021	0.0054	0.0063	0.003	0.0041	0.0055

Table 16A – Jackpine Flats Sites (JF1 – JF9) Continued

(Values in mg/L unless otherwise noted)

	JF6-2 6-Aug-03	JF7 6-Aug-03	JF8 6-Aug-03	JF9 3-Sep-03	Drinking Water Guideline		
PYHSICAL							
pH (pH units)	7.5	7.6	7.3	7.3	≤ 8.5	ao (>6.5)	Met
Specific Conductance (uS/cm)	92	109	89	54	≤ 700	mac	Met
Residue Filterable - TDS	56	68	62	34	≤ 500	ao	Met
Hardness Total - T	41.9	49	42	24.9	≤ 500	mac	Met
Alkalinity Total (mg/L CaCO3)	41	46.5	39.4	25.2			
ANIONS							
Chloride Dissolved	0.7	2.2	0.7	< 0.5	≤ 250	ao	Met
Fluoride Dissolved	0.02	0.02	0.01	0.03	≤ 1.5	mac	Met
CARBON							
Organic Carbon - Total	< 0.5	< 0.5	< 0.5	n/a	≤ 4	mac (THM)	Met
NITROGEN							
Total Kjeldahl N	n/a	n/a	n/a	n/a			
Total N	n/a	n/a	n/a	n/a			
Total Organic N	n/a	n/a	n/a	n/a			
Ammonia N	< 0.005	< 0.005	< 0.005	< 0.005			
Nitrate Nitrogen Dissolved	0.17	0.39	0.13	0.08	≤ 10	mac	Met
Nitrate+Nitrite	0.169	0.386	0.125	0.08			
Nitrite Nitrogen	< 0.002	< 0.002	< 0.002	< 0.002	≤ 1	mac	Met
PHOSPHORUS							
Ortho-Phosphorus	n/a	n/a	n/a	n/a			
Phosphorus Total Dissolved	n/a	n/a	n/a	n/a			
Phosphorus Total	n/a	n/a	n/a	n/a	≤ 0.01	mac (lakes)	n/a
SULFATE							
Sulfate	3	1.8	2.9	1.6	≤ 500	ao	Met
METALS TOTAL							
Aluminum	0.0006	0.0005	0.002	0.0005	≤ 0.2	mac	Met
Antimony	0.000016	0.00001	0.000025	0.000008	≤ 0.006	imac	Met
Arsenic	0.0002	0.0001	0.0001	< 0.0001	≤ 0.025	imac	Met
Barium	0.00309	0.00632	0.00957	0.0112	≤ 1	mac	Met
Beryllium	< 0.00002	< 0.00002	< 0.00002	< 0.00002			
Bismuth	< 0.00002	< 0.00002	< 0.00002	< 0.00002			
Cadmium	< 0.00001	< 0.00001	< 0.00001	< 0.00001	≤ 0.005	mac	Met
Calcium	14.9	16.7	15.4	8.89			
Chromium	< 0.0002	0.0002	< 0.0002	0.0004	≤ 0.05	mac	Met
Cobalt	0.000011	< 0.000005	0.000013	< 0.000005			
Copper	0.0243	0.0106	0.0236	0.00553	≤ 1	ao	Met
Iron	0.081	0.04	0.112	0.185	≤ 0.3	ao	**Not Met**
Lead	0.00026	0.00025	0.00133	0.00014	≤ 0.01	mac	Met
Lithium	0.0001	0.00014	< 0.00005	0.0001			
Magnesium	1.15	1.77	0.85	0.65	≤ 100	ao	Met
Manganese	0.006563	0.00156	0.00247	0.0232	≤ 0.05	ao	**Not Met**
Molybdenum	0.0007	0.00042	0.00072	0.00035	≤ 0.25	mac	Met
Nickel	< 0.00005	< 0.00005	0.0003	< 0.00005			
Selenium	< 0.0002	< 0.0002	< 0.0002	< 0.0002	≤ 0.01	mac	Met
Silver	< 0.00002	< 0.00002	< 0.00002	< 0.00002			
Strontium	0.0495	0.0568	0.0513	0.03			
Thallium	< 0.000002	0.000002	0.000004	< 0.000002			
Tin	0.00002	< 0.00001	< 0.00001	< 0.00001			
Uranium	0.000067	0.000051	0.000036	0.000033	≤ 0.02	imac*	Met
Vanadium	0.00038	0.00057	0.00027	0.00022	≤ 0.1	mac	Met
Zinc	0.0057	0.0059	0.0127	0.0102	≤ 5	ao	Met

Table 16B – Jackpine Flats Sites (JF1 – JF9)
(Values in mg/L unless otherwise noted)

	# Values	Minimum	Maximum	Mean	Drinking Water Guideline		
PYHSICAL							
pH (pH units)	19	6.9	8.2	7.3	≤	8.5	ao (>6.5)
Specific Conductance (uS/cm)	22	41	109	69	≤	700	mac
Residue Filterable - TDS	9	34	68	53	≤	500	ao
Hardness Total - T	22	15.9	49.0	30.8	≤	500	mac
Alkalinity Total (mg/L CaCO3)	9	21.5	46.5	34.4			
ANIONS							
Chloride Dissolved	22	0.5	3.0	1.4	≤	250	ao
Fluoride Dissolved	9	0.01	0.03	0.02	≤	1.5	mac
CARBON							
Organic Carbon - Total	8	0.5	0.7	0.5	≤	4	mac (THM)
NITROGEN							
Total Kjeldahl N	13	0.02	0.05	0.02			
Total N	13	0.02	1.26	0.22			
Total Organic N	13	0.1	0.1	0.1			
Ammonia N	22	0.005	0.029	0.006			
Nitrate Nitrogen Dissolved	22	0.02	1.21	0.20	≤	10	mac
Nitrate+Nitrite	22	0.002	1.210	0.196			
Nitrite Nitrogen	22	0.002	0.005	0.002	≤	1	mac
PHOSPHORUS							
Ortho-Phosphorus	0						
Phosphorus Total Dissolved	0						
Phosphorus Total	0				≤	0.01	mac (lakes)
SULFATE							
Sulfate	9	1.3	3.8	2.3	≤	500	ao
METALS TOTAL							
Aluminum	22	0.0003	0.0269	0.0048	≤	0.2	mac
Antimony	22	0.00001	0.00026	0.00003	≤	0.006	imac
Arsenic	22	0.0001	0.0002	0.0001	≤	0.025	imac
Barium	22	0.00289	0.01490	0.00905	≤	1	mac
Beryllium	22	0.00002	0.00002	0.00002			
Bismuth	22	0.00002	0.00002	0.00002			
Cadmium	22	0.00001	0.00001	0.00001	≤	0.005	mac
Calcium	22	5.54	16.70	10.86			
Chromium	22	0.0002	0.0012	0.0003	≤	0.05	mac
Cobalt	22	0.000005	0.000015	0.0000065			
Copper	22	0.00129	0.17300	0.02545	≤	1	ao
Iron	19	0.007	26.200	1.565	≤	0.3	ao
Lead	22	0.00007	0.00246	0.00047	≤	0.01	mac
Lithium	22	0.00005	0.00070	0.00011			
Magnesium	22	0.47	1.77	0.88	≤	100	ao
Manganese	22	0.000258	1.380000	0.083225	≤	0.05	ao
Molybdenum	22	0.00005	0.00105	0.00037	≤	0.25	mac
Nickel	22	0.00005	0.00122	0.00012			
Selenium	22	0.0002	0.0004	0.0002	≤	0.01	mac
Silver	22	0.00002	0.00002	0.00002			
Strontium	22	0.029000	0.059000	0.044755			
Thallium	22	0.000002	0.000004	0.000002			
Tin	22	0.00001	0.00251	0.00018			
Uranium	22	0.000002	0.000145	0.000046	≤	0.02	imac*
Vanadium	22	0.00010	0.01440	0.00106	≤	0.1	mac
Zinc	22	0.0010	0.0421	0.0094	≤	5	ao

QA/QC ANALYSIS OF WEEKLY RESULTS (TABLE A) AND ADDITIONAL WATER QUALITY RESULTS (TABLE B)

Table 17A – QA/QC Analysis of Microbiological Indicators & Colour and Turbidity (Weekly Results)

(Values in mg/L unless otherwise noted)

Blanks:

Date	Fecal coliform (CFU/100mL)	*E. coli* (CFU/100mL)	Enterococci (CFU/100mL)	Colour True (Col.unit)	Turbidity (NTU)
08-Apr-03	< 2	< 2	< 2	< 5	< 0.1
15-Apr-03	< 2	< 2	< 2	< 5	< 0.1
23-Apr-03	< 2	< 2	< 2	< 5	0.32
29-Apr-03	< 2	< 2	< 2	< 5	0.15
05-May-03	< 2	< 2	< 2	< 5	< 0.1

Duplicates:

Date	Site	Colour True Result 1	Colour True Result 2	RPD	Turbidity Result 1	Turbidity Result 2	RPD
29-Apr-03	JF2	< 5	< 5		0.38	0.35	
23-Apr-03	JF4	< 5	5		0.25	0.24	
12-Aug-03	JF4	< 5	< 5		< 0.1	< 0.1	
06-Aug-03	JF6	< 5	< 5		0.71	1.04	**-37.7**
05-May-03	LL5	10	15		0.77	0.68	12.4
26-Aug-03	LL5	10	5		0.57	0.59	-3.4

Table 17B – QA/QC Analysis of Additional Water Quality Results

(Values in mg/L unless otherwise noted)

	MDL	Blanks	Duplicates		
		LT1 8-Apr-03	LL2-1 8-Apr-03	LL2-2 8-Apr-03	RPD
PYHSICAL					
pH (pH units)	0.1	6.1	7.5	7.5	0.0
Specific Conductance (uS/cm)	1	1	64	65	-1.6
Residue Filterable - TDS	10	n/a	n/a	n/a	
Hardness Total - T	0.3	< 0.3	26.8	26.5	1.1
Alkalinity Total (mg/L CaCO3)	0.3	n/a	n/a	n/a	
ANIONS					
Chloride Dissolved	0.5	< 0.5	n/a	n/a	
Fluoride Dissolved	0.01	n/a	n/a	n/a	
CARBON					
Organic Carbon - Total	0.5	n/a	n/a	n/a	
NITROGEN					
Total Kjeldahl N	0.02	< 0.02	0.12	0.07	
Total N	0.02	< 0.02	0.18	0.14	25.0
Total Organic N	0.1	< 0.1	0.12	< 0.1	
Ammonia N	0.005	< 0.005	< 0.005	< 0.005	
Nitrate Nitrogen Dissolved	0.02	< 0.02	0.06	0.07	
Nitrate+Nitrite	0.002	0.011	0.06	0.069	-14.0
Nitrite Nitrogen	0.002	< 0.002	< 0.002	0.002	
PHOSPHORUS					
Ortho-Phosphorus	0.001	n/a	n/a	n/a	
Phosphorus Total Dissolved	0.002	0.004	0.007	0.007	
Phosphorus Total	0.002	< 0.002	**0.016**	0.01	
SULFATE					
Sulfate	0.5	n/a	n/a	n/a	
METALS TOTAL					
Aluminum	0.0003	< 0.0003	0.165	0.118	**33.2**
Antimony	0.000005	< 0.000005	0.000016	0.000033	
Arsenic	0.0001	< 0.0001	0.0002	0.0002	
Barium	0.00002	< 0.00002	0.0139	0.0127	9.0
Beryllium	0.00002	< 0.00002	< 0.00002	< 0.00002	
Bismuth	0.00002	< 0.00002	< 0.00002	< 0.00002	
Cadmium	0.00001	< 0.00001	< 0.00001	0.00001	
Calcium	0.05	< 0.05	9.12	9.06	0.7
Chromium	0.0002	< 0.0002	< 0.0002	< 0.0002	
Cobalt	0.000005	< 0.000005	0.000058	0.000048	18.9
Copper	0.00005	0.00032	0.0131	0.0149	-12.9
Iron	0.005	< 0.005	**1.13**	**0.631**	**56.7**
Lead	0.00001	< 0.00001	0.00005	0.0001	
Lithium	0.00005	< 0.00005	0.00023	0.00023	
Magnesium	0.05	< 0.05	0.99	0.94	5.2
Manganese	0.000008	< 0.00008	0.0357	0.0241	**38.8**
Molybdenum	0.00005	< 0.00005	0.00058	0.00051	12.8
Nickel	0.00005	< 0.00005	0.00016	0.00018	
Selenium	0.0002	< 0.0002	< 0.0002	< 0.0002	
Silver	0.00002	< 0.00002	< 0.00002	< 0.00002	
Strontium	0.000005	< 0.00005	0.049	0.0491	-0.2
Thallium	0.000002	< 0.000002	< 0.000002	< 0.000002	
Tin	0.00001	< 0.00001	< 0.00001	< 0.00001	
Uranium	0.000002	< 0.000002	0.000164	0.000136	18.7
Vanadium	0.00006	< 0.00006	0.001	0.00078	24.7
Zinc	0.0001	< 0.0001	0.0075	0.0145	**-63.6**

Table 17B – QA/QC Analysis of Additional Water Quality Results (Continued)
(Values in mg/L unless otherwise noted)

	MDL	Duplicates		
		JF6-1 6-Aug-03	JF6-2 6-Aug-03	RPD
PYHSICAL				
pH (pH units)	0.1	7.5	7.5	0.0
Specific Conductance (uS/cm)	1	92	92	0.0
Residue Filterable - TDS	10	60	56	6.9
Hardness Total - T	0.3	43	41.9	2.6
Alkalinity Total (mg/L CaCO3)	0.3	41.3	41	0.7
ANIONS				
Chloride Dissolved	0.5	0.6	0.7	
Fluoride Dissolved	0.01	0.02	0.02	
CARBON				
Organic Carbon - Total	0.5	< 0.5	< 0.5	
NITROGEN				
Total Kjeldahl N	0.02	n/a	n/a	
Total N	0.02	n/a	n/a	
Total Organic N	0.1	n/a	n/a	
Ammonia N	0.005	< 0.005	< 0.005	
Nitrate Nitrogen Dissolved	0.02	0.16	0.17	-6.1
Nitrate+Nitrite	0.002	0.163	0.169	
Nitrite Nitrogen	0.002	< 0.002	< 0.002	
PHOSPHORUS				
Ortho-Phosphorus	0.001	n/a	n/a	
Phosphorus Total Dissolved	0.002	n/a	n/a	
Phosphorus Total	0.002	n/a	n/a	
SULFATE				
Sulfate	0.5	3.5	3	15.4
METALS TOTAL				
Aluminum	0.0003	0.0005	0.0006	
Antimony	0.000005	0.000016	0.000016	
Arsenic	0.0001	0.0001	0.0002	
Barium	0.00002	0.0031	0.00309	0.3
Beryllium	0.00002	< 0.00002	< 0.00002	
Bismuth	0.00002	< 0.00002	< 0.00002	
Cadmium	0.00001	< 0.00001	< 0.00001	
Calcium	0.05	15.3	14.9	2.6
Chromium	0.0002	< 0.0002	< 0.0002	
Cobalt	0.000005	0.000007	0.000011	
Copper	0.00005	0.0232	0.0243	-4.6
Iron	0.005	0.083	0.081	2.4
Lead	0.00001	0.00022	0.00026	-16.7
Lithium	0.00005	< 0.00005	0.0001	
Magnesium	0.05	1.17	1.15	1.7
Manganese	0.000008	0.0076	0.006563	14.6
Molybdenum	0.00005	0.00074	0.0007	5.6
Nickel	0.00005	< 0.00005	< 0.00005	
Selenium	0.0002	< 0.0002	< 0.0002	
Silver	0.00002	< 0.00002	< 0.00002	
Strontium	0.000005	0.0493	0.0495	-0.4
Thallium	0.000002	< 0.000002	< 0.000002	
Tin	0.00001	0.00001	0.00002	
Uranium	0.000002	0.000067	0.000067	0.0
Vanadium	0.00006	0.00032	0.00038	-17.1
Zinc	0.0001	0.0055	0.0057	-3.6