Martinson Creek (Lucille Mountain Water Users):
Source Water Characteristics

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January, 2007

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Introduction

In British Columbia, drinking water quality is becoming a significant public issue. We all want to have confidence in the quality of the water we consume. Its protection is also important to local purveyors, who act as our water suppliers, and to provincial government ministries responsible for water management. Within the Omineca-Peace region of B.C., our most common potable source per capita is ground water, although many communities do make use of rivers, streams or lakes. Our basic drinking water quality is determined by a number of factors including local geology, climate and hydrology. In addition to these, human land use activities such as urbanization, agriculture and forestry, and the pollution they may cause, are becoming increasingly important influences. Environmental managers have a responsibility to control land use development so as to minimise the effects of these activities on source water quality.

The province's Drinking Water Protection Act, enacted in October, 2002, places the responsibility for drinking water quality protection with the B.C. Ministry of Health and local water purveyors. However, through the B.C. Environmental Management Act, the British Columbia Ministry of Environment (MOE) is responsible for managing and regulating activities in watersheds that have a potential to affect water quality. Accordingly, the Ministry plans to take an active role in protecting drinking water quality at its source.

MOE implemented a raw water quality and stream sediment monitoring program at selected communities in the Omineca-Peace region in 2002. Community sites were selected using a risk assessment process that considered:

- whether the source supply was surface water or ground water,
- the level of water treatment used,
- the population size served,
- the potential for upstream diffuse and point-source pollution,
- the availability of current, high-quality and representative data on each raw water source,
- whether past outbreaks of waterborne illness had been reported,
- the ability/willingness of local purveyors to assist with sampling.

Through this process and with available funding, 18 community water supplies in the Omineca-Peace region were selected for monitoring during 2002/03, with four or more sites being selected each subsequent year.

This brief report will summarise water quality data collected from Martinson Creek. This stream is the source water for the Lucille Mountain water users. The data are compared to current Canadian drinking water quality guidelines meant to protect finished water. This comparison should identify parameters with concentrations that represent a risk to human health. It is intended that this process will lead to the identification of human activities responsible for unacceptable source water quality, and that it will assist water managers to develop measures to improve raw water quality, where needed.

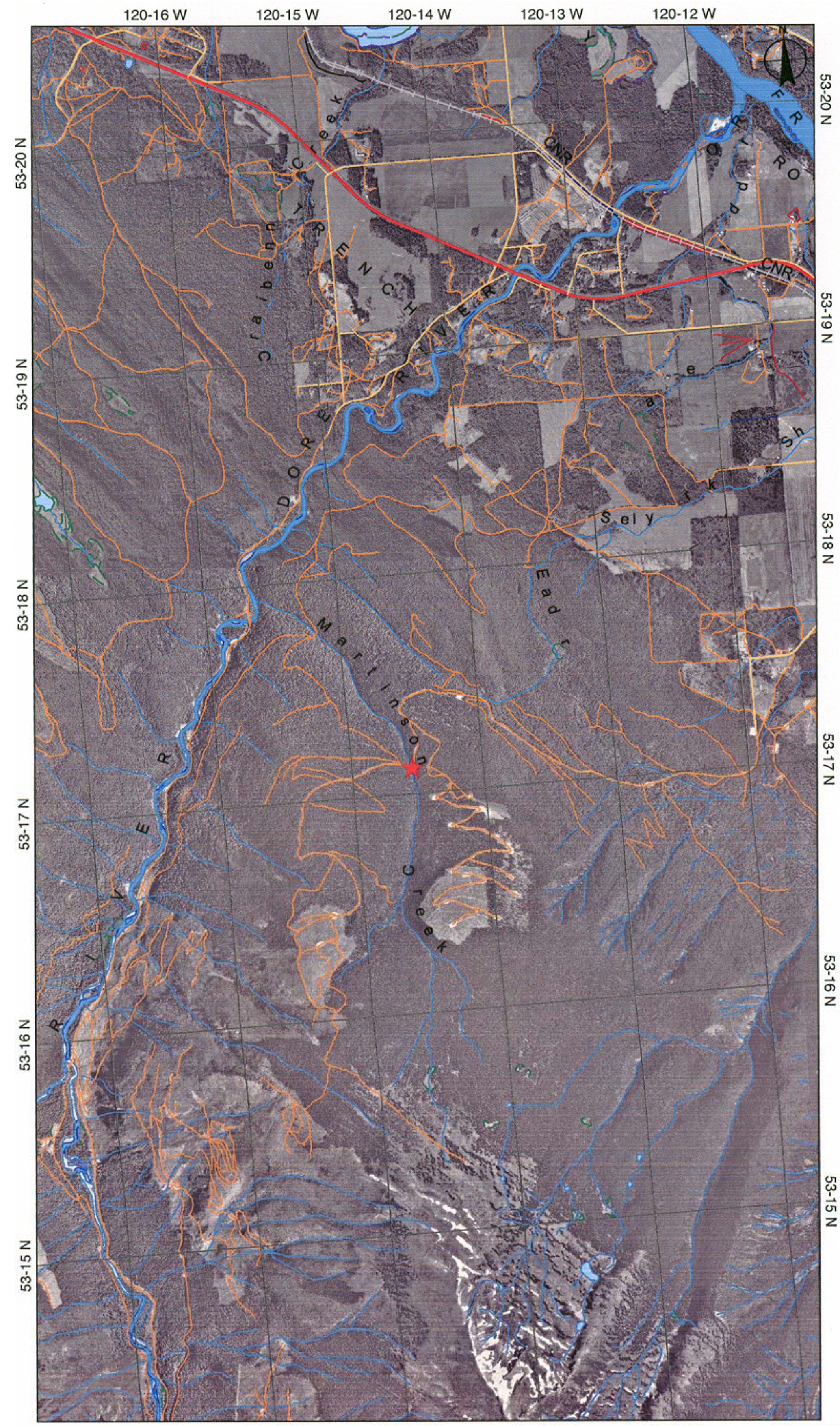

Figure 1. Martinson Creek watershed and surrounding area. The sample site is illustrated by the red star. The map scale is 1:50,000.

Site Description

Watershed Overview

Martinson Creek is located approximately 5km southwest of McBride. It is a 2nd order stream approximately 4.5km in length that drains northwest to the Dore River. This watershed lies within two biogeoclimatic zones, including the Engleman Spruce-Subalpine Fir and the Interior Cedar Hemlock. The Engleman Spruce-Subalpine Fir zone has hilly, mountainous terrain, cold and snowy conditions (a snowpack of 2-3 m is common) for 5-7 months of the year, and short cool summers. The Interior Cedar Hemlock zone generally has long warm summers, cool wet winters and productive coniferous forests (B.C. Ministry of Forests, 1998).

The Martinson Creek watershed is very small (approximately $5.5km^2$); however, it does contain some land use activity. More specifically, there are two cutblocks upstream of the water diversion. Available GIS information indicate these blocks were harvested in 1990 and 1991, suggesting the blocks are approximately 16-17 year old. Forest activities are generally associated with sediment and nutrient loading to streams; however, this may be greatly reduced due to the age of the cutblocks and the associated vegetation re-growth.

There is a diversion system on Martinson Creek (Figures 2 and 3) that redirects stream water to Edand Creek, which gravity feeds water through a distribution system to approximately 38 homes.

According to Ministry water licensing information, there are 33 active domestic, 6 stock watering and 3 irrigation water licenses for Martinson Creek. The total domestic and stock watering withdrawal is approximately 21,400 gallons/day and the total allowable irrigation withdrawal is approximately 92,450 gallons/day.

Materials & Methods

Sample Collection & Analyses for the 2005/06 Water Monitoring Program

An experienced MOE staff member collected water samples in laboratory certified polyethylene bottles for a variety of chemical and bacterial analyses. Representative grab samples were collected directly from Martinson Creek (Figures 2 and 3), upstream of the Lucille Mountain FSR crossing. Samples were collected on four dates during various flow conditions. This included a winter low, spring runoff, a summer rain and a fall low. It was planned that an additional sample was to be collected in March of 2006 to collect samples after an early spring melt; however, due to accessibility issues, the site was not visited.

Bottles used for general ion analyses were rinsed three times with source water prior to sample collection. Metal and bacterial bottles were not rinsed and metal samples were lab preserved. Water samples were shipped by overnight courier in coolers with ice packs to Cantest Laboratories Inc. for bacteria and Maxxam Analytical Services for chemistry analysis. Bacterial samples were analysed using membrane filtration. Metals analysis made use of ICPMS technology.

Figure 2. An upstream view of Martinson Creek taken downstream of the small dam/diversion.

Figure 3. A view of the Martinson Creek dam overflow.

Quality Assessment (QA)

To ensure accuracy and precision of data, quality assurance and control (QA/QC) procedures were incorporated into the monitoring program. This included use of rigorous sampling protocols, proper training of field staff, setting of data quality objectives (DQO) and the submission of QA samples to the lab. Field QA included duplicate and blind blank samples.

Blank samples detect contamination introduced in the field and/or in the lab. A comparison of duplicate results measures the effect of combined field error, laboratory error and real between-sample variability. The blind blank and duplicate program accounted for roughly 10% of the overall chemistry and bacterial sample numbers.

Results

Water Monitoring Program (2005/06)

Quality Assessment (QA)

The field blank and duplicate results indicate that minimal field or lab contamination of samples with bacteria occurred and that acceptable precision in bacterial sampling and analysis was observed. Bacterial samples collected on October 7th, 2005, were not included in this report because they exceeded our required holding time of 48hrs.

The water chemistry field blank and replicate samples were considered to be of good quality, except for one replicate DQO exceedance. The total manganese replicate sample collected on January 10th, 2006 had a relative percent difference of 29%, exceeding our DQO of 25%. However, the values detected were still an order of magnitude below the recommended guideline, suggesting the DQO exceedance will not have a large impact on the results in this study. Because of the exceedance, the values were removed from the summary statistics. There were no blanks that exceeded the lab acceptance criteria of 5 times the method detection limit (MDL).

All data, with the above exceptions, are considered to be of good quality and are considered suitable for review.

Bacteriology

The 2005/06 bacterial data are summarised in Table 1. As displayed both total coliforms and Enterococci were detected during sample collection. Although total coliforms can originate naturally in the environment, Enterococci generally suggests contamination by human or warm-blooded animals. The presence of these indicator bacteria tend to suggest that human illness may result if users are not currently treating their water supply.

Table 1. Results of bacterial analysis for Martinson Creek. Results are in CFU/100mL.

Date	Total Coliforms	*E.coli*	Enterococci	Fecal Coliforms
Provincial Guideline	0 CFU/100mL	0 CFU/100mL	0 CFU/100mL	0 CFU/100mL
10/07/05	N/A	N/A	N/A	N/A
01/10/06	<1; <1	<1; <1	<1; <1	<1; <1
05/15/06	**1**	<1	<1	<1
08/01/06	**23**	**1**	**12**	**1**

Water Chemistry

In 2005/06, stream water samples were collected on four dates. The water samples were analysed for general parameters as well as for the ICPMS low level metals package that includes metals in the total and dissolved form (Table 2).

Of the chemical and physical parameters tested through the duration of this study, only one slightly exceeded recommended drinking water guidelines.

Turbidity (NTU) - The maximum detected turbidity was 0.3 NTU, with a mean of 0.2 NTU, both exceeding the recommended Canadian DW guideline of <0.1 NTU (it is of note that these values are very close to the MDL and therefore uncertainty is high). Turbidity is a measure of the suspended particulate matter in the water, including silt, organic material and/or micro-organisms, that interfere with the passage of light. Turbidity can increase the available surface area of solids upon which bacteria grow, can interfere with disinfection and can be aesthetically unpleasant. Possible sources of elevated turbidity include riparian clearing, poorly constructed road crossings and unstable stream banks. Although these concentrations exceed the new drinking water guideline, the concentrations are still very low and are likely of natural origin.

Table 2. Results of chemical analysis for Martinson Creek. MDL = Method Detection Level.

	Unit	MDL	Sample Date 07-Oct-05	Sample Date 10-Jan-06	Sample Date 10-Jan-06	**Duplicate Average 11-Jan-06**	Sample Date 05/15/06	Sample Date 08-Jan-06	DW Guideline
Bacteria									
Total Coliforms	CFU/100mL	<1		<1	<1	**<1**	1	23	<10
Fecal Coliforms	CFU/100mL	<1		<1	<1	**<1**	<1	1	<1
E.Coli	CFU/100mL	<1		<1	<1	**<1**	<1	1	<1
Enterococci	CFU/100mL	<1		<1	<1	**<1**	<1	12	<1
Misc. Inorganics									
Bromide (Br)	mg/L	0.1	<0.1	<0.1	<0.1	**<0.1**	<0.1	<0.1	
Fluoride (F)	mg/L	0.01	0.05	0.06	0.06	**0.06**	0.04	0.05	1.5
Preparation									
Filter and HNO3 Preservation	N/A	N/A	YES					Yes	
Calculated Parameters									
Total Hardness (CaCO3)	mg/L	0.5	44	57	59	**58**	58	53	
Misc. Inorganics									
Dissolved Hardness (CaCO3)	mg/L	0.5	44	57	59	**58**	58	53	500
Alkalinity (Total as CaCO3)	mg/L	0.5	39.8	50.2	51.2	**50.7**	50.9	45.1	
Total Organic Carbon (C)	mg/L	0.5	0.6	<0.5	<0.5	**<0.5**	2.4	1.2	4
Anions									
Dissolved Sulphate (SO4)	mg/L	0.5	4.9	5.7	5.6	**5.65**	4.1	4.2	500
Dissolved Chloride (Cl)	mg/L	0.5	<0.5	<0.5	<0.5	**<0.5**	<0.5	<0.5	250
Dissolved Metals by ICPMS									
Dissolved Aluminum (Al)	ug/L	0.3	3.9	3.5	3.6	**3.55**	10.3	5.1	200
Dissolved Antimony (Sb)	ug/L	0.005	<0.005	<0.005	<0.005	**<0.005**	<0.005	0.006	
Dissolved Arsenic (As)	ug/L	0.1	0.5	0.4	0.3	**0.35**	0.2	0.4	
Dissolved Barium (Ba)	ug/L	0.02	0.87	0.93	0.91	**0.92**	0.83	0.96	
Dissolved Beryllium (Be)	ug/L	0.02	<0.02	<0.02	<0.02	**<0.02**	<0.02	<0.02	
Dissolved Bismuth (Bi)	ug/L	0.02	<0.02	<0.02	<0.02	**<0.02**	0.03	<0.02	
Dissolved Cadmium (Cd)	ug/L	0.01	<0.01	<0.01	<0.01	**<0.01**	<0.01	<0.01	
Dissolved Chromium (Cr)	ug/L	0.2	0.3	<0.2	<0.2	**<0.2**	<0.2	<0.2	
Dissolved Cobalt (Co)	ug/L	0.005	<0.005	0.005	0.007	**0.006**	0.075	<0.005	
Dissolved Copper (Cu)	ug/L	0.05	0.20	0.06	0.07	**0.065**	0.19	0.07	
Dissolved Lead (Pb)	ug/L	0.01	0.02	<0.01	<0.01	**<0.01**	<0.01	<0.01	
Dissolved Lithium (Li)	ug/L	0.05	0.80	1.06	0.95	**1.005**	0.91	1.21	
Dissolved Manganese (Mn)	ug/L	0.008	<0.008	0.972	1.12	**1.046**	1.6	0.193	
Dissolved Molybdenum (Mo)	ug/L	0.05	<0.05	0.05	<0.05	**0.05**	<0.05	<0.05	
Dissolved Nickel (Ni)	ug/L	0.05	0.13	<0.05	0.10	**0.1**	0.17	<0.05	
Dissolved Selenium (Se)	ug/L	0.2	<0.2	<0.2	<0.2	**<0.2**	<0.2	<0.2	
Dissolved Silver (Ag)	ug/L	0.02	<0.02	<0.02	<0.02	**<0.02**	<0.02	<0.02	
Dissolved Strontium (Sr)	ug/L	0.005	44.4	50.0	52.6	**51.3**	43.1	45	
Dissolved Thallium (Tl)	ug/L	0.002	<0.002	<0.002	<0.002	**<0.002**	<0.002	0.003	
Dissolved Tin (Sn)	ug/L	0.01	<0.01				0.01	<0.01	
Dissolved Uranium (U)	ug/L	0.002	0.140	0.356	0.385	**0.3705**	0.282	0.185	
Dissolved Vanadium (V)	ug/L	0.06	<0.06	<0.06	<0.06	**<0.06**	<0.06	<0.06	
Dissolved Zinc (Zn)	ug/L	0.1	0.2	0.5	<0.1	**0.5**	0.5	<0.1	
Leachable Metals									
Total Aluminum (Al)	ug/L	0.3	4.8	5.0	4.3	**4.65**	20.6	4.6	
Total Antimony (Sb)	ug/L	0.005	<0.005	<0.005	<0.005	**<0.005**	<0.005	0.009	6
Total Arsenic (As)	ug/L	0.1	0.5	0.4	0.3	**0.35**	0.3	0.5	10
Total Barium (Ba)	ug/L	0.02	0.93	0.98	0.97	**0.975**	1.06	0.86	1000
Total Beryllium (Be)	ug/L	0.02	<0.02	<0.02	<0.02	**<0.02**	<0.02	<0.02	4
Total Bismuth (Bi)	ug/L	0.02	<0.02	<0.02	<0.02	**<0.02**	0.08	<0.02	
Total Cadmium (Cd)	ug/L	0.01	<0.01	<0.01	<0.01	**<0.01**	<0.01	<0.01	5
Total Chromium (Cr)	ug/L	0.2	0.4	0.3	<0.2	**0.3**	<0.2	<0.2	50
Total Cobalt (Co)	ug/L	0.005	<0.005	0.007	0.010	**0.0085**	0.109	<0.005	
Total Copper (Cu)	ug/L	0.05	0.22	0.08	0.08	**0.08**	0.23	<0.05	1000
Total Lead (Pb)	ug/L	0.01	0.02	0.01	<0.01	**0.01**	0.02	<0.01	10
Total Lithium (Li)	ug/L	0.05	1.06	1.16	1.05	**1.105**	0.84	0.94	
Total Manganese (Mn)	ug/L	0.008	0.034	1.76	1.32	**1.54**	4.31	0.526	50
Total Molybdenum (Mo)	ug/L	0.05	<0.05	0.05	<0.05	**0.05**	<0.05	0.07	250
Total Nickel (Ni)	ug/L	0.05	0.18	0.05	0.11	**0.08**	0.25	<0.05	
Total Selenium (Se)	ug/L	0.2	<0.2	<0.2	<0.2	**<0.2**	<0.2	<0.2	10
Total Silver (Ag)	ug/L	0.02	<0.02	<0.02	<0.02	**<0.02**	<0.02	<0.02	
Total Strontium (Sr)	ug/L	0.005	44.7	51.9	52.7	**52.3**	50.6	40.5	
Total Thallium (Tl)	ug/L	0.002	<0.002	<0.002	<0.002	**<0.002**	<0.002	<0.002	2
Total Tin (Sn)	ug/L	0.01	0.01	0.02	0.01	**0.015**	0.02	<0.01	
Total Uranium (U)	ug/L	0.002	0.147	0.363	0.39	**0.3765**	0.389	0.202	100
Total Vanadium (V)	ug/L	0.06	<0.06	<0.06	<0.06	**<0.06**	<0.06	<0.06	
Total Zinc (Zn)	ug/L	0.1	0.5	0.5	0.2	**0.35**	0.7	<0.1	5000
MISCELLANEOUS									
True Colour	Col. Unit	5	5	<5	<5	**<5**	5	<5	15
Nutrients									
Total Kjeldahl Nitrogen (Calc)	mg/L	0.02	0.03	<0.02	<0.02	**<0.02**	0.11	0.04	
Total Organic Nitrogen (N)	mg/L	0.02	0.03	<0.02	<0.02	**<0.02**	0.11	0.04	
Dissolved Phosphorus (P)	mg/L	0.002	<0.002	0.003	0.002	**0.0025**	0.003	<0.002	
Ammonia (N)	mg/L	0.005	<0.005	<0.005	<0.005	**<0.005**	<0.005	0.006	Refer to tables
Total Inorganic Carbon (C)	mg/L	0.5	9.7	10.4	10.7	**10.55**	11.8	11.4	
Nitrate plus Nitrite (N)	mg/L	0.002	0.020	0.066	0.065	**0.0655**	0.129	0.01	10
Total Nitrogen (N)	mg/L	0.02	0.05	0.08	0.08	**0.08**	0.24	0.05	
Total Phosphorus (P)	mg/L	0.002	<0.002	<0.002	<0.002	**<0.002**	<0.002	<0.002	
Physical Properties									
Conductivity	uS/cm	1	87	110	112	**111**	103	98	700
pH	pH Units	0.1	7.7	7.5	7.5	**7.5**	7.1	7.9	6.5-8.5
Physical Properties									
Total Suspended Solids	mg/L	4	<4	<4	<4	**<4**	<4	<4	Refer to tables
Turbidity	NTU	0.1	0.3	0.2	0.2	**0.2**	0.2	0.2	0.1
Dissolved Metals by ICP									
Dissolved Boron (B)	mg/L	0.008		<0.008	<0.008	**<0.008**			
Dissolved Calcium (Ca)	mg/L	0.05	13.1	16.6	17.0	**16.8**	16.5	15.7	
Dissolved Iron (Fe)	mg/L	0.005	<0.005	<0.005	<0.005	**<0.005**	0.009	<0.005	0.3
Dissolved Magnesium (Mg)	mg/L	0.05	2.71	3.90	4.09	**3.995**	4	3.43	100
Dissolved Phosphorus (P)	mg/L	0.1		<0.1	<0.1	**<0.1**			
Dissolved Potassium (K)	mg/L	1		<1	<1	**<1**			
Dissolved Sodium (Na)	mg/L	0.05		1.24	1.22	**1.23**			
Dissolved Sulphur (S)	mg/L	0.1		2.0	2.0	**2**			
Dissolved Titanium (Ti)	mg/L	0.003		<0.003	<0.003	**<0.003**			
Dissolved Zirconium (Zr)	mg/L	0.005		<0.005	<0.005	**<0.005**			
Total Metals by ICP									
Total Boron (B)	mg/L	<0.008		<0.008	<0.008	**<0.008**			
Total Calium (Ca)	mg/L	0.05	12.8	16.5	17.0	**16.75**	16.5	13.6	
Total Iron (Fe)	mg/L	0.005	<0.005	0.010	0.028	**0.019**	0.045	<0.005	
Total Magnesium (Mg)	mg/L	0.05	2.71	3.88	4.06	**3.97**	4	3.04	
Total Phosphorus (P)	mg/L	1		<0.1	<0.1	**<0.1**			
Total Potassium (K)	mg/L	1		<1	<1	**<1**			
Total Sodium (Na)	mg/L	0.05	1.06	1.32	1.32	**1.32**	1.02	1.05	200 (20 for sensitive)
Total Sulphur (S)	mg/L	0.1		1.9	2.0	**1.95**			
Total Titanium (Ti)	mg/L	0.003		<0.003	<0.003	**<0.003**			
Total Zirconium (Zr)	mg/L	0.005		<0.005	<0.005	**<0.005**			
Extra									
Ultra Violet Transmittance	%	2	93			0.43 (in AU/cm)			
	Exceeding DQO								
	Exceeding WQ Guideline								

Conclusions & Recommendations

Review of Martinson Creek water quality data suggests excellent source water. All chemical water quality parameters were well under Canadian drinking water guidelines, except for slightly elevated turbidity. However, these turbidity values were less than five times their MDL, and therefore considered too unreliable to make strong conclusions. Furthermore, the low values detected, 0.1-0.3NTU, are well within naturally occurring surface water concentrations.

One concern regarding the water supply is the detected Enterococci and total coliform indicators. The levels detected were high enough to cause human illness should water treatment systems become ineffective. The elevated levels were found in August of 2006, following a precipitation event of approximately 15mm. This suggests that the feces of warm blooded animals may have been transported to the stream via overland flow. Regardless, surface waters such as streams and lakes are more likely to contain disease-causing organisms than groundwater (B.C. Healthfile #49b, 2000). Because of this, water treatment is recommended for any resident of British Columbia who receives their drinking water directly from a surface source (B.C. Healthfile #49a, 2000).

It is recommended that Martinson Creek users discuss water treatment options with Northern Health. More specifically, the water should be treated for pathogens, including bacteria and parasites. It is also recommended that any future development in the upper sectors of the watershed have adequate sediment control measures to prevent any degradation of the stream water quality for the downstream users. Given the steep slope of the terrain, increased activity in the riparian area will likely increase the amount of suspended solids and turbidity, which in turn will impair the quality of the resource.

It should be of note that sampling during this program occurred only at the diversion system on Martinson Creek. At this diversion, the water is re-directed to a ditch and subsequently into Edand Creek where it is delivered to the water users. Therefore, any degrading land use activity or potential contaminants entering the system downstream of the diversion system would not have been included in the water quality analysis.

This study is one part of a broader water quality management program being carried out by the Environmental Quality Section in MOE's Omineca-Peace Region. The overall objectives of this program are to monitor water quality to identify problems, to determine causes, and to work with local governments, landowners and other interested parties to improve or otherwise protect water quality and aquatic life. Information sharing between governments, specifically MOE, Northern Health and various Regional and Municipal governments, is an ongoing practice.

Acknowledgements

Northern Health is thanked for their help during the planning of the project. MOE biologist Gabi Matscha is thanked for report edits.

Contact Information

For more information regarding either this short report, watershed protection and/or drinking water, please contact:

- Ministry of Environment (Prince George) - James Jacklin, 250-565-4403
- Northern Health (Prince George) - Bruce Gaunt, 250-565-2150

References Cited

B.C. Health Files #49a. 2000. Water-borne Diseases in B.C.. Ministry of Health Services.

B.C. Health Files #49b. 2000. How to Disinfect Drinking Water. Ministry of Health Services.

Greenberg, A.E., L.S. Clesceri, and A.D. Eaton (EDS.). 1992. Standard methods for the examination of water and wastewater (18^{th} Edition). Published Jointly by American Public Health Association, American Water Works Association, and Water Environment Federation.

Health Canada. 1990. Guidelines for Canadian Drinking Water Quality.

Ministry of Environment. 2006. iMap.

Ministry of Environment. 2006. British Columbia Approved Water Quality Guidelines.

Provincial Health Officer. 2001. Drinking water quality in British Columbia: the public health perspective. A report of the health of British Columbians. Provincial Health Officer's Annual Report 2000, B.C. Ministry of Health Planning, Victoria, B.C.. 147 pp.

PSC. 2002. 2002-2006 analysis & pricing information. Prepared by PSC Environmental Services, 8577 Commerce Court, Burnaby, B.C., V5A 4N5, for B.C. Ministry of Water, Land and Air Protection. 47pp.

Resource Inventory Committee. 1998. Guidelines for interpreting water quality data. Province of British Columbia.

The Ecology of the Engleman Spruce-Sub Alpine Fir Zone. 1998. Ministry of Forests Research Branch, Victoria, B.C.

The Ecology of the Interior Cedar-Hemlock Zone. 1998. Ministry of Forests Research Branch, Victoria, B.C.

The Ecology of the Sub-Boreal Spruce Zone. 1998. Ministry of Forests Research Branch, Victoria, B.C.

World Health Organization. 2004. Guidelines for Drinking Water Quality.