Assessment of the Tumbler Ridge Drinking Water Supply: Source Water Characteristics

James Jacklin, March 2004[1]

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 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.

Plate 1. A view of the Tumbler Ridge water treatment plant. The raw water samples were collected from an inside tap.

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,
- 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, a total of 18 community water supplies in the Omineca-Peace region were selected for monitoring during 2002/03.

This brief report will summarise water quality data collected from the Tumbler Ridge raw potable water source (ground water) (Plate 1). The data are compared to current provincial drinking water quality guidelines meant to protect finished water if no treatment other than disinfection is present. This comparison should identify parameters with concentrations that represent a risk to human health. It is intended that this program 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.

[1]A template report was prepared for the author by Todd D. French of TDF Watershed Solutions, Research & Management and Bruce Carmichael, Ministry of Environment.

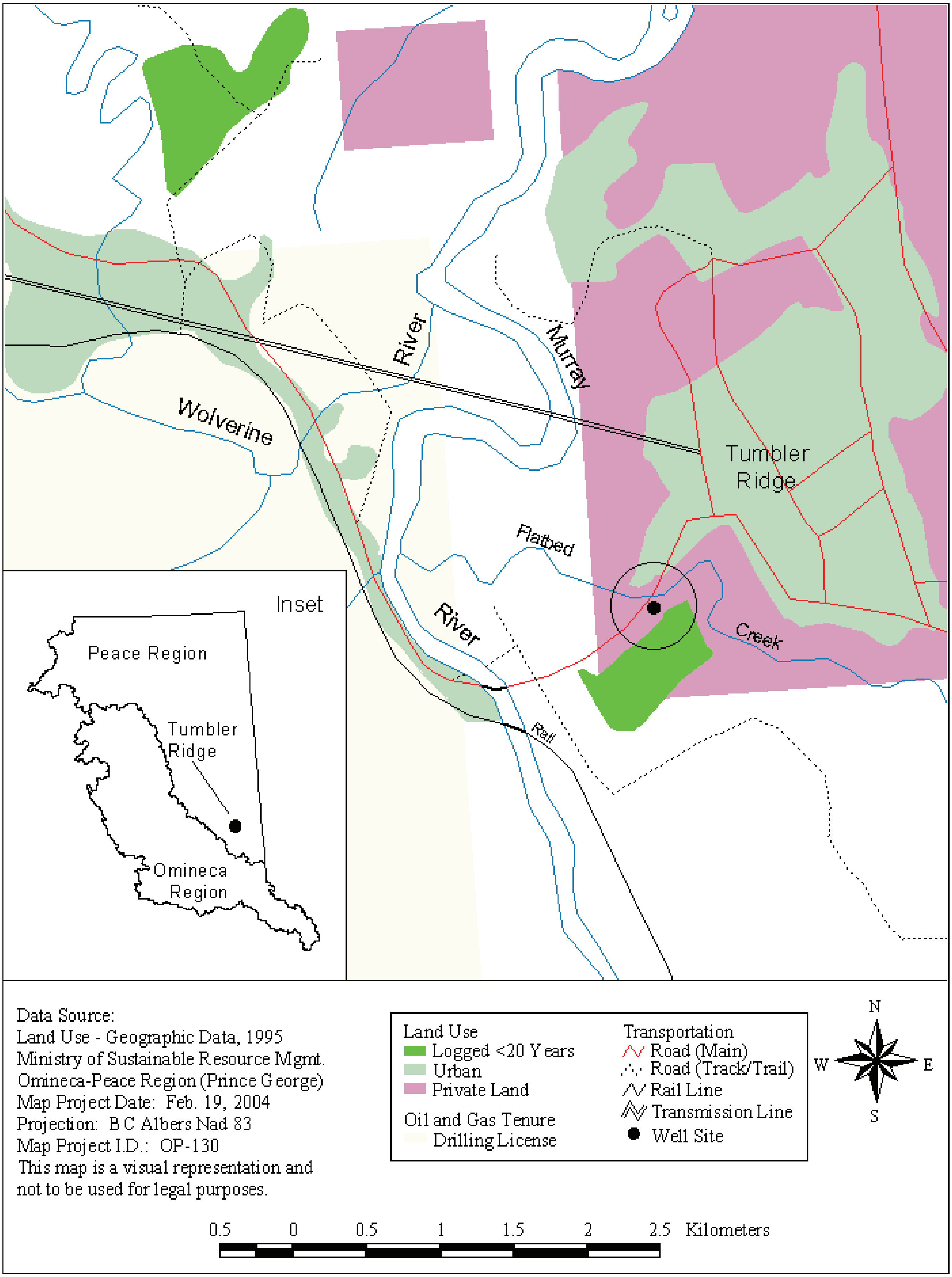

Figure 1. Tumbler Ridge water well and nearby land use practices. A 300 m radius surrounds the well indicating the zone where contamination is most probable to occur

Site Description

Watershed Overview

The Tumbler Ridge drinking water supply consists of two wells that lie within the Boreal White and Black Spruce biogeoclimatic zone. This zone is characterized by long, extremely cold winters, with a short and cold summer growing season. The terrain has rolling topography, and is dominated by both upland forests and muskeg. Common trees in this zone include white spruce, black spruce, lodgepole pine and trembling aspen (B.C. Ministry of Forests, 1998).

The predominant land-use activities (Figure 1) in the vicinity of the Tumbler Ridge wells are urban use and forestry activities. These activities may pose a risk to well water quality, especially due to their close proximity.

According to Andrew Crooks, a water purveyor for the community, the current withdrawal rate from each well is approximately 50-55 litres/second. However, according to Mr. Crooks only one pump is generally run at a time. The wells draw water from a bed composed dominantly of sands and gravels (Table 1). The sands and gravels throughout the lithology profile suggest an unconfined aquifer. This implies that the well is particularly sensitive to land-use activities where chemicals or contaminants could easily leach into the ground, compared to a well with an overlying clay or bedrock layer.

Table 1. Lithology profile from one of the Tumbler Ridge water wells (well tag number 52755-#WR-286-839). Data from the aquifer database of B.C..

Depth (Ft)	Grain Size
0-15	Gravel, loose with boulders
15-99	Sand, some gravel
99-107	Sand, coarse with some pea gravel
107-128	Sand and gravel, water bearing
128-130	till
130-140	Shale, black

There are three waste disposal permits within Tumbler Ridge, however none of these permits are located in the same area as the water wells. Because of this, it is expected the waste disposal sites will have no impact on the well water quality.

Drinking Water Supply & Treatment

Tumbler Ridge draws its domestic water from a ground water supply, consisting of two wells. The water is then piped into town where it is treated at the water plant. A large water reservoir also exists, which helps to keep a constant volume of water at all times. As measured with a GPS unit, the geographic co-ordinates of the water treatment plant (where the water samples were collected) are 55.1263N/120.9943W. The community currently treats the source water using filters, potassium permanganate and chlorination (Crooks, p.c.).

According to Andrew Crooks, the community has no concerns regarding the current water system.

Materials & Methods

Review of Previous Data

Historical data relevant to the Tumbler Ridge source water supply assessment have been included in this report. The data were copied from Northern Health Authority (NHA) computer and paper files and include data from October 1996 - August 2002.

Sample Collection & Analyses for the 2002/03 Water Monitoring Program

Water Quality

An experienced consultant and/or MOE staff member collected water samples in laboratory certified polyethylene bottles for a variety of chemical and bacterial analyses. Representative grab samples were collected from the raw water tap (Plate 2) inside the Tumbler Ridge water treatment plant (site E249367 - Water Source ID Tag 1347). The chemical results, analytical detection levels and drinking water quality guidelines are provided in Table 2, Appendix A.

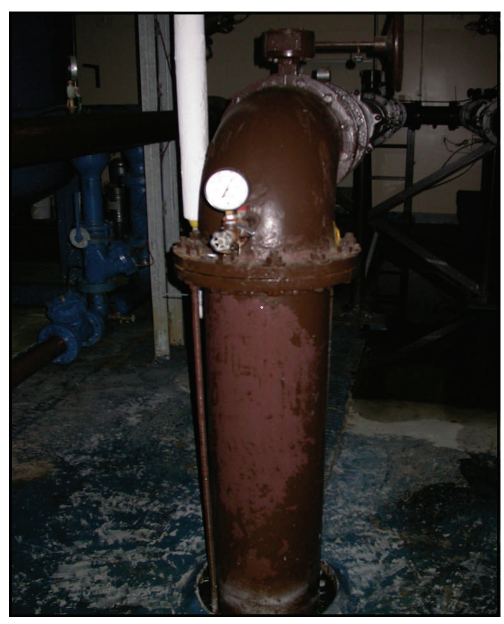

Plate 2. A picture of the raw water tap inside the Tumbler Ridge pump house.

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. Prior to sampling the raw water tap, the source was flushed for 5 minutes in order to minimize contamination by system piping. Water samples were shipped by overnight courier in coolers with ice packs to CanTest Ltd. (from September 2002-March 2003) and JR Laboratories Inc. (April 2003 to September 2003) for bacteria and PSC Environmental Services Ltd. for chemistry. Bacterial samples were analysed using membrane filtration. Metals analysis made use of ICPMS technology.

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 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 20% of the overall chemistry and bacterial sample numbers.

Results

Review of Previous Data

Bacteriology

The NHA sampled the Tumbler Ridge raw water supply from the water treatment plant 81 times between October 1996 and August 2002. All 81 samples were tested for both total and fecal coliforms. Bacterial concentrations were less than detectable during all sample collection's. This suggests that bacterial concentrations are generally low in the Tumbler Ridge water system.

Water Monitoring Program (2002/03)

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.

The five water chemistry field blank samples that were prepared either the same day or within one day of the Tumbler Ridge collections tested positive for some parameters. The concentration of most of these parameters was either very close to or less than 5-fold the minimum detectable concentration, an acceptable threshold as per the lab acceptance criteria. Eight parameters exceeded these acceptance criteria and are listed below in Table 3.

Table 3. Blind blank samples that tested strongly positive (≥ 5-fold MDL) for chemical contamination.

Date	Parameter	Measured Concentration	MDL
Oct. 8/02	Strontium-Total	0.079 µg/L	0.005 µg/L
Oct. 8/02	Uranium-Total	0.012 µg/L	0.002 µg/L
Mar. 20/03	Copper-Total	0.37 µg/L	0.05 µg/L
Mar. 20/03	Lead-Total	0.06 µg/L	0.01 µg/L
Mar. 20/03	Nitrate+Nitrite	0.013 mg/L	0.002 mg/L
Mar. 20/03	Strontium-Total	0.1 µg/L	0.005 µg/L
May 1/03	Nitrate+Nitrite	0.054 mg/L	0.002 mg/L
May 1/03	Sulphate	2.7 mg/L	0.5 mg/L

Although the levels of some of these results are greater than the concentrations observed in Tumbler Ridge, they are usually well below provincial raw drinking water guidelines by greater than two orders of magnitude. The contamination that did occur may have resulted during the deionization process in the lab or during the transfer of the deionized water between bottles in the field. Regardless, these levels of blank contamination should not limit the comparison of data to water quality guidelines.

The five water chemistry duplicate samples that were prepared either the same day or within one day of the Tumbler Ridge collections did have some values outside the lab acceptance criteria of 25% relative percent difference (Table 4, Appendix A). The differences that are present may be due to problems with collection and/or analytical precision. All of the parameters that did have differences greater than 25% between the duplicates occurred well below recommended drinking water guidelines except two. During the April and May collections, many of the rivers where samples were collected were at bank full capacity and turbid, experiencing the first part of spring runoff. During this period, the river water appeared very heterogeneous. This may have affected the imprecision of these parameters.

Bacteriology

The 2002/03 bacterial data are summarised in Table 5. Drinking water quality guidelines are ≤100CFU/100 mL (90th perc.) for *E. coli* and fecal coliforms and ≤25CFU/100 mL (90th perc.) for *Enterococci* in systems that receive partial water treatment.

Most samples collected from this water supply contained no detectable bacteria. The May 28th sample did have positive results for total coliforms, however, there are no water quality guidelines for these bacteria. Additionally, the detection of 1 CFU/100 mL may have been affected by the lab holding time or arrival temperature.

Table 5. Results of bacterial analyses for the Tumbler Ridge raw water supply. Units are CFU/100mL.

Date	Total Coliform	*E. coli*	*Enterococci*	Fecal Coliform
Provincial Guideline	No Provincial Guideline	≤100CFU/100 mL (90th perc.)	≤25CFU/100 mL (90th perc.)	≤100CFU/100 mL (90th perc.)
Oct. 8/02	<1	<1	<1	<1
Jan. 13/03	<1	<1	<1	-
Mar. 20/03	<1; <1	<1; <1	<1; <1	<1; <1
May 1/03	<2	<2	<2	<2
May 28/03	1	<1	<1	<1
Aug. 21/03	<1	<1	<1	<1

Water Chemistry

In 2002/03, ground water samples were collected on six different dates. The water samples were analysed for 15 general parameters as well as for the ICPMS low level metals package that includes 27 metals in the total form.

Of the chemical parameters tested through the duration of this study, five exceeded provincial guidelines for raw drinking water and one was of note (RIC, 1998).

Colour (TCU) - The maximum colour concentration for the year was 40 TCU, over the recommended water quality guideline of 15 TCU. The colour of water is a measure of its dissolved compounds (attributed to the presence of organic and inorganic materials). High colour levels are regarded as a pollution problem in terms of aesthetics, and can be produced by agricultural and industrial effluents. Colour can also originate naturally from organic soils and wetlands.

Specific Conductance (µS/cm) - The maximum specific conductance measurement was 784 µS/cm, over the recommended guideline of 700 µS/cm. High specific conductivity values indicate a high ion concentration, which can be related to the dissolved solids content of the water.

Turbidity (NTU) - The mean and maximum turbidity levels were 18 and 33 NTU, respectively, both exceeding the provincial guideline of 5 NTU. 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. Additionally, high turbidity can interfere with disinfection and can be aesthetically unpleasant.

Iron, Total (mg/L) - The mean iron concentration was 1.37 mg/L with a maximum value of 2.55 mg/L, both exceeding the aesthetic guideline of 0.3 mg/L. Insoluble iron is often found in waters as colloidal material which can be difficult to remove. Additionally, iron has the tendency to colour water.

Manganese, Total (µg/L) - The mean manganese concentration was 67 µg/L with a maximum of 124 µg/L, both exceeding the aesthetic objective of 50 µg/L. Similar to iron, manganese can colour water and form colloidal material that can be difficult to remove.

Water hardness, which can often be a problem in ground water supplies, had a maximum concentration of 455 mg/L $CaCO_3$. Waters that exceed 120 mg/L $CaCO_3$ are considered hard. Hard water can reduce the toxicity of some metals, but can also leave scale deposits on piping. Some anthropogenic sources that contribute to water hardness are mining and industrial effluents. Hard water also occurs naturally in many ground water systems due to the dissolution of calcium and magnesium bearing rocks and minerals.

A complete list of the results as well as their corresponding guideline is attached in Table 2, Appendix A. A complete list of the raw data from the 2002/03 program is attached in Table 6, Appendix A.

Conclusions & Recommendations

Review of the Tumbler Ridge ground water data indicates a raw drinking water quality that has some undesirable characteristics. Most water soluble contaminants were present at concentrations well below drinking water guidelines, however, there were exceedances by colour, specific conductance, turbidity, iron, manganese and hardness.

Most of these noted parameters occur naturally in ground water supplies, however, since the lithology profile of the well indicates dominantly sands and gravels, the aquifer is probably unconfined and therefore more susceptible to leaching materials compared to aquifers with an upper confining layer (clay or bedrock). Because of this, it is recommended that a site assessment be done on land use activities within this zone to indicate where there is potential for contamination. According to Mike Wei, a senior hydrogeologist with MOE, a 300 m radius is arbitrarily assigned as the zone where contamination is most likely. Therefore, the site assessment should be concentrated on this area.

Acknowledgements

We thank Mr. Sean Shea and Andrew Crooks for their useful insight and direction around the water supply. Mr. Todd French is recognized for his help in designing and implementing the project (TDF Watershed Solutions, Research & Management). The NHA is thanked for their help in planning the project.

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Contact Information

For more information regarding either this short report, watershed protection and/or drinking water, please contact the Ministry of Environment (Contact: Bruce Carmichael (Prince George), 250-565-6455) or the Northern Health Authority (Contact: Bruce Gaunt (Prince George), 250-565-2150 or Caroline Alexander (Fort St. John), 250-787-3355).

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Appendix A

Table 2. 2002/03 sample parameters, summaries of current results and associated B.C. drinking water guidelines.

Parameter	# of Values	Min.	Max.	Mean	Std. Dev.	MDL	D.W. Guideline	Guideline Type
General								
pH	6	7.9	8.3	8.1	0.15	0.1	6.5-8.5	aesthetic objective
Colour (TCU)	6	5	40	11.7	14.02	5	≤ 15	aesthetic objective
Specific Conductance (µS/cm)	6	293	784.5	519.2	203.73	1	≤ 700	maximum acceptable concentration
Turbidity (NTU)	5	2.55	33.15	17.67	13.940	0.1	≤ 5	maximum acceptable concentration
Hardness Total (mg/L)	6	196	455	302	111.9		≤ 500 $CaCO_3$ (Diss.)	aesthetic objective
Alkalinity (mg/L)	6	183	331	243	66.4	0.5		
Residue Non-Filterable (mg/L)	6	4	7.5	4.8	1.40	4		
Total Organic Carbon (mg/L)								
TOC	5	1.4	2.7	2.0	0.56	0.5	≤ 4	maximum, to control THM production
Anions (mg/L)								
Chloride Dissolved	6	2.2	6.95	4.14	2.022	0.5	≤ 250	aesthetic objective
Fluoride Dissolved	6	0.06	0.09	0.07	0.010	0.01	≤ 1.5	maximum acceptable concentration
Bromide Dissolved	6	0.1	0.1	0.1	0.00	0.1		
Nutrients (mg/L)								
Nitrate+Nitrite	6	0.002	0.010	0.005	0.003	0.002	≤ 45 (Nitrate)	maximum acceptable concentration
Phosphorus Total	2	0.007	0.009	0.008	0.001	0.002		
Phosphorus Total-Diss.	2	0.002	0.002	0.002	0.000	0.002		
Sulphate (mg/L)								
Sulphate	6	19.2	108.5	56.5	38.79	0.5	≤ 500	aesthetic objective
Metals Total (ug/L)								
Aluminum-T	6	0.3	0.8	0.45	0.197	0.3	≤ 200 (Diss.)	maximum acceptable concentration
Antimony-T	6	0.006	0.024	0.014	0.007	0.005	≤ 6	interim maximum acceptable concentration
Arsenic-T	6	0.1	0.6	0.3	0.17	0.1	≤ 25	interim maximum acceptable concentration
Barium-T	6	131	170.5	146.2	14.04	0.02	≤ 1000	maximum acceptable concentration
Beryllium-T	6	0.02	0.02	0.02	0.000	0.02		
Bismuth-T	6	0.02	0.02	0.02	0.000	0.02		
Cadmium-T	6	0.01	0.01	0.01	0.000	0.01	≤ 5	maximum acceptable concentration
Calcium-T (mg/L)	6	56.1	125	84.1	29.37	0.05		
Chromium-T	6	0.2	8.7	1.6	3.47	0.2	≤ 50	maximum acceptable concentration
Cobalt-T	6	0.005	0.128	0.033	0.050	0.005		
Copper-T	6	0.05	2.00	0.42	0.780	0.05	≤ 1000	aesthetic objective
Iron-T (mg/L)	5	0.39	2.55	1.37	0.928	0.005	≤ 0.3	aesthetic objective
Lead-T	6	0.01	0.085	0.023	0.031	0.01	≤ 10	maximum acceptable concentration
Lithium-T	6	4.27	10	7.37	2.717	0.05		
Magnesium-T (mg/L)	6	13.7	34.75	22.24	9.375	0.05	≤ 100 (Diss.)	aesthetic objective
Manganese-T	6	41.2	123.5	67.1	32.74	0.008	≤ 50	aesthetic objective
Molybdenum-T	6	1.02	2.25	1.37	0.445	0.05	≤ 250	maximum acceptable concentration
Nickel-T	6	0.05	0.57	0.14	0.212	0.05		
Selenium-T	6	0.2	0.3	0.22	0.041	0.2	≤ 10	maximum acceptable concentration
Silver-T	6	0.02	0.02	0.02	0.000	0.02		
Sodium-T (mg/L)	5	4.96	7.45	6.35	1.234	0.05	≤ 200	aesthetic objective
Strontium-T	6	102	236	151	54.8	0.005		
Thallium-T	6	0.002	0.003	0.002	0.000	0.002	≤ 2	maximum acceptable concentration
Tin-T	6	0.01	0.08	0.02	0.029	0.01		
Uranium-T	6	0.34	0.722	0.510	0.172	0.002	≤ 100	maximum acceptable concentration
Vanadium-T	6	0.47	3.29	1.796	1.090	0.06	≤ 100	maximum acceptable concentration
Zinc-T	6	0.3	1.6	0.71	0.463	0.1	≤ 5000	aesthetic objective

Table 4. Duplicate samples that exceeded precision acceptability criteria (<u><</u>25% difference when >5-fold MDL). All concentrations in µg/L unless otherwise indicated.

Parameter	MDL (µg/L)	October/02			January/03			March/03			April03			May/03		
		Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %	Conc. 1	Conc. 2	RPD %
Antimony-T	0.005	0.058	0.045	**25**												
Colour (Col. Units)	5										240	160	**40**			
Copper-T	0.05				0.55	0.78	**35**	1.69	2.32	**31**						
Copper-D	0.05	1.34	0.63	**72**												
Iron-T (mg/L)	0.005													13.8	10.7	**25**
Lithium-D	0.05	<0.05	0.33	**147**												
Phosphorus-T-D (mg/L)	0.002										0.013	0.002	**147**			
Phosphorus-T (mg/L)	0.002										0.084	0.012	**150**			
Thallium-D	0.002										0.012	0.009	**29**			
Turbidity (NTU)	0.1	3.9	2.86	**31**												
Vanadium-T	0.06	0.94	0.61	**43**												
Zinc-T	0.1				4.4	6.4	**37**									

RPD %=Relative Percent Difference
**Data are presented for the purpose of batch specific QA assessment. Most QA samples were not collected at Tumbler Ridge.*

Table 6. 2002/03 raw water quality data collected from the Tumbler Ridge drinking water supply.

Date	Total Coliform (CFU/100mL)	Fecal Coliform (CFU/100mL)	Enterococci (CFU/100mL)	E. Coli (CFU/100mL)	pH (pH Units)
08-Oct-02	<1	<1	<1	<1	8.1
13-Jan-03	<1	<1	<1		8.2
20-Mar-03	<1	<1	<1	<1	7.9
20-Mar-03	<1	<1	<1	<1	7.9
01-May-03	<2	<2	<2	<2	8
28-May-03	1	<1	<1	<1	8.2
21-Aug-03	<1	<1	<1	<1	8.3

True Colour (Col. Unit)	Specific Conductance (µS/cm)	Residues - NonFilt. (mg/L)	Turbidity (NTU)	Hardness - Total (mg/L)	Alkalinity - T as $CaCO_3$ (mg/L)
<5	293	<4		205	184
5	351	<4	3.36	211	185
40	787	7	33.1	455	331
40	782	8	33.2	455	331
5	687	4	26.5	390	288
5	620	5	22.8	352	286
10	380	<4	2.55	196	183

Bromide - Diss. (mg/L)	Chloride - Diss. (mg/L)	Fluoride - Diss. (mg/L)	Carbon - Tot. Org. (mg/L)	$NO_2 + NO_3$ (mg/L)	Phosphorus - Tot. Diss. (mg/L)
<0.1	2.7	0.07	2.5	<0.002	
<0.1	2.3	0.09		0.002	
<0.1	7.1	0.06	1.6	0.01	
<0.1	6.8	0.07	1.6	0.011	
<0.1	5.8	0.07	1.4	0.007	
<0.1	4.9	0.07	1.9	<0.002	<0.002
<0.1	2.2	0.06	2.7	0.005	<0.002

Phosphorus - Tot. (mg/L)	Sulfate (mg/L)	Aluminum - Tot. (µg/L)	Antimony - Tot. (µg/L)	Arsenic - Tot. (µg/L)	Barium - Tot. (µg/L)
	25.6	0.8	0.007	0.3	150
	22.9	<0.3	0.018	0.3	150
	108	<0.3	0.014	0.6	170
	109	<0.3	0.014	0.6	171
	88.9	0.5	0.024	0.2	138
0.007	73.7	0.5	0.006	0.4	138
0.009	19.2	<0.3	0.016	0.1	131

Beryllium - Tot. (µg/L)	Bismuth - Tot. (µg/L)	Cadmium - Tot. (µg/L)	Calcium - Tot. (mg/L)	Chromium - Tot. (µg/L)	Cobalt - Tot. (µg/L)
<0.02	<0.02	<0.01	59.4	<0.2	<0.005
<0.02	<0.02	<0.01	60.4	<0.2	<0.005
<0.02	<0.02	<0.01	125	<0.2	<0.005
<0.02	<0.02	<0.01	125	<0.2	<0.005
<0.02	<0.02	<0.01	107	<0.2	0.049
<0.02	<0.02	<0.01	96.8	<0.2	<0.005
<0.02	<0.02	<0.01	56.1	8.7	0.128

Copper - Tot. (µg/L)	Iron - Tot. (mg/L)	Lead - Tot. (µg/L)	Lithium - Tot. (µg/L)	Magnesium - Tot. (mg/L)	Manganese - Tot. (µg/L)
0.07		0.01	4.27	13.8	54.1
<0.05	0.661	<0.01	5.14	14.5	49.4
1.69	2.56	0.09	9.8	34.7	123
2.32	2.54	0.08	9.86	34.8	124
0.14	1.14	<0.01	10	29.8	41.2
0.18	2.11	<0.01	9.66	26.9	89.8
<0.05	0.394	<0.01	5.34	13.7	44.5

Molybdenum - Tot. (µg/L)	Nickel - Tot. (µg/L)	Selenium - Tot. (µg/L)	Silver - Tot. (µg/L)	Sodium - Tot. (mg/L)	Strontium - Tot. (µg/L)
1.02	<0.05	<0.2	<0.02		110
1.25	<0.05	0.3	<0.02	4.96	104
1.33	<0.05	0.2	<0.02	7.45	236
1.36	<0.05	<0.2	<0.02	7.45	236
2.25	<0.05	<0.2	<0.02	7.17	186
1.26	<0.05	<0.2	<0.02	7.13	167
1.11	0.57	<0.2	<0.02	5.06	102

Thallium - Tot. (µg/L)	Tin - Tot. (µg/L)	Uranium - Tot. (µg/L)	Vanadium - Tot. (µg/L)	Zinc - Tot. (µg/L)
<0.002	0.01	0.372	0.63	0.7
<0.002	<0.01	0.34	1.9	0.6
0.003	<0.01	0.72	1.83	0.6
<0.002	<0.01	0.723	2.06	0.7
<0.002	0.08	0.662	3.29	0.4
<0.002	<0.01	0.609	0.47	1.6
<0.002	<0.01	0.358	2.54	0.3