

**Assessment Study of
Water and Wastewater Systems and
Associated Water Management Practices
at the Kitsumkalum First Nation Community**

**for the
Indian and Northern Affairs Canada
BC Region**



CH2MHILL

August, 2002

Appendix C

Water Quality Test Results

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Is(are) under consultation

Table 3. Chemical Quality of Groundwater from Kitsumkalum I.R. No. 1 Wells 1-79 and 2-96 and Comparison to Drinking Water Limits

Parameter	Well 1-79		Well 2-96 (03/96) (3)	Drinking Water Limit (4)
	05/84 (1)	07/95 (2)		
Physical Tests				
Colour (CU)	<5.	<5.0	<5.0	15.
Conductivity (umhos/cm)		377	69.5	-
Total Dissolved Solids (mg/l)	228/96	-	35.	500
Total Hardness (mg/l) CaCO ₃	147	150	29.4	-
pH	7.1	7.02	6.16	6.5 - 8.5
Turbidity (NTU)	0.22	3.01	0.6	5.
Dissolved Anions (mg/l)				
Alkalinity as CaCO ₃	114	128	23.8	-
Chloride Cl	23	20.1	3.6	250.
Fluoride F	0.2	0.06	0.02	1.5
Silicon as SiO ₂	11.7	13.0	-	-
Sulfate SO ₄	25	38.3	2.9	500.
Sulphide S	-	-	<0.02	-
Nutrients (mg/l)				
Nitrate (NO ₃) N	0.108	0.061	0.022	10.
Nitrite (NO ₂) N	-	-	0.001	1.0
Total Metals (mg/l)				
Aluminum Al	-	-	<0.20	-
Arsenic As	-	<0.0001	0.0005	0.025
Barium Ba	-	0.041	0.020	1.0
Boron B	-	<0.10	<0.10	5.0
Cadmium Cd	-	<0.0002	<0.0002	0.005
Calcium Ca	48	46.8	10.4	-
Chromium Cr	-	<0.015	<0.015	0.05
Copper Cu	-	<0.010	<0.010	1.0
Iron Fe	<0.1	<0.280	0.334	0.3
Lead Pb	-	<0.001	<0.001	0.01
Magnesium Mg	6.6	7.96	0.848	-
Manganese Mn	<0.02	0.118	0.068	0.05
Mercury Hg	-	-	<0.00005	0.001
Potassium K	-	1.66	<2.0	-
Selenium Se	-	-	<0.0005	0.01
Sodium Na	19	18.7	<2.0	200.
Zinc Zn	-	0.056	<0.005	5.0
Organic Parameters (mg/l)				
Total Organic Carbon TOC	1.7	-	-	-
Bacteriological				
Fecal Coliform (colony counts/100 m/s)	<1	-	<1	0
Total Coliform (colony counts/100 m/s)	1	-	<1	- (5)

Sources of Information and Notes:

1. DeLCan Environmental Services Job No. 45-1433-C; dated May 10, 1984.
2. Analytical Service Laboratories Ltd. File No. F1976; dated July 28, 1995; all metals dissolved except for iron and manganese.
3. Analytical Service Laboratories Ltd. File No. F8778; dated April 12, 1996.
4. Maximum acceptable concentration as specified by Health Canada (1993).
5. No sample should contain more than 10 organisms per 100 ml and no consecutive samples should be positive.

2 BACKGROUND

2.1 WATER QUALITY

Table 1 is a summary of water quality parameters which do not consistently meet Health Canada water quality criteria. The laboratory reports are included in Appendix A.

Table 1: Water Quality Parameters Not In Compliance With Health Canada Criteria - Wells 2-96 and 3-99

SAMPLING DATE	WELL 2-96			WELL 3-99	HEALTH CANADA RANGE OR LIMIT
	3/96	1/97	1/97	12/99	
PARAMETER					
pH	6.16	6.8	6.5	6.81	6.5 - 8.5
Iron	0.334	1.08	0.9	0.27	0.3
Manganese	0.068	0.158	0.12	0.162	0.05

Notes:

All concentrations in mg/L except pH.

Results non-compliant with Health Canada Criteria are shown in bold.

The water from both wells exceeded the recommended manganese concentration limit for all samples taken. One of the samples marginally met the criteria for iron while all others exceeded it. The concentration limits recommended for iron and manganese by Health Canada are Aesthetic Objectives (AOs), as waters exceeding these limits often cause stains on plumbing fixtures and dishes, as well as laundry, particularly when using bleach. Waters with high iron and/or manganese concentrations may also have an astringent taste. Health Canada does not list Maximum Acceptable Concentrations (MACs) for these water quality parameters.

The pH of both well waters is generally low and in one sample was below the range recommended by Health Canada. Low pH water typically causes corrosion of metal piping and may result in low iron and manganese removal efficiencies for some treatment methods.

Hydrogen sulfide odours were detected during pump testing of Wells 2-96 and 3-99 although hydrogen sulfide was not detected by chemical analysis using a method detection limit of

0.02 mg/L. No odours were detected during the subsequent treatability testing. No hydrogen sulfide was detected during chemical analysis (same detection limit as before). During pump testing of Well 3-99, no odours were detected and no hydrogen sulfide was detected by chemical analysis (detection limit: 0.02 mg/L).

The USEPA is currently in the process of determining a new maximum contaminant level (MCL) for arsenic. Proposed MCLs range from 0.5 µg/L to 20 µg/L. Of the arsenic analyses performed with water from Wells 2-96 and 3-99, only the one for Well 3-99 was carried out with a detection limit below 0.5 µg/L. The arsenic concentration of this sample was 0.3 µg/L.

2.2 RESULTS OF 1997 TREATABILITY TESTING

The 1997 treatability testing report prepared by NovaTec included the following recommendations for Well 2-96:

1. Although the capital cost for Birm filtration is estimated to be slightly higher than manganese greensand filtration, the former is recommended for iron and manganese removal from water of Well 2-96 of the Kitsumkalum Band. Compared to manganese greensand filtration, Birm filtration has the advantage of not requiring potassium permanganate, a hazardous chemical. In addition, the estimated operations and maintenance costs of Birm are lower than those for manganese greensand filtration.
2. Birm filtration should only be carried out following an air entrainment/aeration step which is required to remove any hydrogen sulphide that may be present in the well water and to ensure satisfactory performance of the iron and manganese removal process.
3. A limestone contactor should be provided to raise the pH of the treated water if needed.

Testing to raise the pH of well water was carried out with a pressure contactor containing Calcite, a crushed marble material consisting mainly of calcium carbonate. The pH adjustment capability of the contactor was evaluated by varying the flowrates through the pressure contactor and recording the resulting pH. Figure 1 is a presentation of the pH achieved at various volumetric loading rates (flow per volume of calcite). In addition, a well water sample was saturated with calcium carbonate by keeping a large amount of calcite in contact with the water for over 12 hrs. The saturation pH was 8.25. The sample was then filtered through a 0.45µm membrane filter to remove any marble fines and analyzed for calcium. A comparison the untreated well water

calcium concentration indicated that one litre of well water can dissolve about 42 mg of calcium carbonate.

Treatability testing showed that iron and manganese removal was generally better at the raw water pH than at the calcium carbonate saturation pH of 8.25. For iron and manganese treatability testing, pH adjustment was carried out with caustic soda to simplify the experimental set-up.

Table 4. Chemical Quality of Groundwater from Kitsumkalum I.R. No. 1 Wells and Comparison to Drinking Water Limits

Parameter	Well 3-99 (1)	Well 2-96 (2)	Well 1-79		Drinking Water Limit (5)
			(3)	(4)	
Sampling Date	12/99	03/96	05/84	07/95	
Physical Tests					
Colour (CU)	<5	<5.0	<5.	<5.0	15.
Conductivity (umhos/cm)	70	69.5	-	377	-
Total Dissolved Solids (mg/l)	42	35.	-	-	500
Total Hardness (mg/l) CaCO ₃	28.9	29.4	147	150	-
pH	6.81	6.16	7.1	7.02	6.5 - 8.5
Turbidity (NTU)	0.4	0.6	0.22	3.01	5.(6)
Dissolved Anions (mg/l)					
Alkalinity as CaCO ₃	27	23.8	114	128	-
Chloride Cl	1.2	3.6	23	20.1	250.
Fluoride F	<0.02	0.02	0.2	0.06	1.5
Sulfate SO ₄	3	2.9	25	38.3	500.
Sulphide S	<0.02	<0.02	-	-	-
Nutrients (mg/l)					
Nitrate (NO ₃) N	<0.1	0.022	0.108	0.061	10.
Nitrite (NO ₂) N	<0.1	0.001	-	-	1.0
Total Metals (mg/l)					
Aluminum Al	0.024	<0.20	-	-	-
Arsenic As	0.0003	0.0005	-	<0.0001	0.025
Barium Ba	0.018	0.020	-	0.041	1.0
Boron B	<0.05	<0.10	-	<0.10	5.0
Cadmium Cd	<0.0002	<0.0002	-	<0.0002	0.005
Calcium Ca	10.3	10.4	48	46.8	-
Chromium Cr	<0.001	<0.015	-	<0.015	0.05
Copper Cu	<0.001	<0.010	-	<0.010	1.0
Iron Fe	0.27	0.334	<0.1	<0.280	0.3
Lead Pb	<0.001	<0.001	-	<0.001	0.01
Magnesium Mg	0.78	0.848	6.6	7.96	-
Manganese Mn	0.162	0.068	<0.02	0.118	0.05
Mercury Hg	<0.00005	<0.00005	-	-	0.001
Potassium K	0.44	<2.0	-	1.66	-
Selenium Se	<0.001	<0.0005	-	-	0.01
Sodium Na	1.75	<2.0	19	18.7	200.
Zinc Zn	<0.005	<0.005	-	0.056	5.0
Uranium U	0.00002	-	-	-	0.10
Organic Parameters (mg/l)					
Total Organic Carbon TOC	1.6	-	1.7	-	-
Bacteriological					
Fecal Coliform (colony counts/100 m/s)	<1	<1	<1	-	0
Total Coliform (colony counts/100 m/s)	<1	<1	1	-	- (7)

Sources of Information and Notes:

1. Analytical Service Laboratories Ltd. (ASL) File L1341, dated December 24, 1999.
2. ASL File No. F8778, dated April 12, 1996.
3. DeLCan Environmental Services Job No. 45-1433-C; dated May 10, 1984.
4. ASL File No. F1976; dated July 28, 1995; all metals dissolved except for iron and manganese.
5. Maximum acceptable concentration as specified in Guidelines for Canadian Drinking Water Quality (GCDWQ, Health Canada, Sixth Edition, 1996), which have been adopted by B.C. Ministry of Health as the basis for assessing water potability.
6. At the point of consumption, as per GCDWQ, a turbidity of 5 NTU is permitted, but maximum acceptable source turbidity is 1 NTU, with some relaxation permitted for groundwater sources.
7. No sample should contain more than 10 total coliform organisms per 100 ml, none of which should be faecal, and no consecutive samples should be positive.

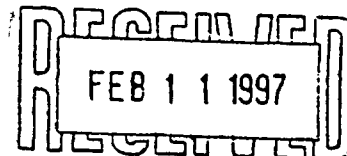


To: NOVATEC CONSULTANTS INCORPORATED
224 West 8th Ave.
Vancouver, B.C.
V5Y 1N5

Workorder: 30849
Received: 29-Jan-97
Completed: 05-Feb-97

Attn: MARTIN VOGEL

Re: R2 WATER SAMPLE



ANALYSIS
OF
WATER SAMPLES

METHODOLOGY

The numbers next to the parameter names refer to limits from the Canadian Drinking Water 1996 Maximum Guidelines. All units are in milligrams per litre (mg/L=ppm) unless otherwise stated. The symbol "<" means less than the value shown, and ">" means greater than the value shown. Limits in () including pH indicate Aesthetic Objectives. Hardness >500 usually considered unacceptable. Analytical methodology is in accordance with procedures described in publications of the American Public Health Association, B.C. Ministry of the Environment and Environment Canada - Conservation and Protection.

ACCREDITATION

Quanta Trace is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL), by the Standards Council of Canada (SCC), and by Washington State Department of Ecology for specific tests. Quanta Trace is also registered in the B.C. Ministry of Environment Laboratory Registration Program.



To: NOVATEC CONSULTANTS INCORPORATED

W/O: 30849 Page 1

Sample type	water
Identification	R2
Lab Reference #	30849-000

CARBON	
total orgnc	C
Results in	2.
	mg/L

SOLIDS	
dissolved	(500)
	64.

PHYSICAL PARAMETERS	
conduct.	uS/cm
	76.
turbid NTU	1/(5)
	2.1
colour TCU	(15)
	17.
pH	(6.5-8.5)
	6.8

CHEMICAL PARAMETERS		- ANIONS	
total alk.	CaCO3		26.
fluoride	1.5	<	1.
chloride	(250)		6.9
nitrite N	1	<	0.5
nitrate N	10	<	0.1
sulfate	(500)		4

TOTAL HARDNESS	
as CaCO3	[500]
	37.0

To: NOVATEC CONSULTANTS INCORPORATED

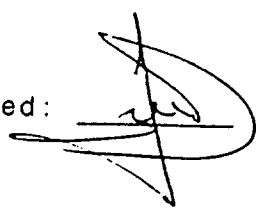
Sample type	water
Identification	R2
Lab Reference #	30849-000

CHEMICAL PARAMETERS - CATIONS	
calcium Ca	12.4
magnesium Mg	0.94
Sodium (200)	1.85
potassium K	0.4

CHEMICAL PARAMETERS - METALS	
aluminum 0.2	0.01
arsenic 0.025	< 0.02
barium 1	0.0250
boron 5	< 0.01
cadmium 0.005	< 0.0005
chromium 0.05	< 0.001
copper (1)	< 0.002
iron (0.3)	1.08
lead 0.01	< 0.005
manganese (0.05)	0.158
mercury 0.001	< 0.001
selenium 0.01	< 0.01
uranium 0.1	< 0.06
zinc (5)	0.001

antimony Sb	< 0.02
beryllium Be	< 0.0002
bismuth Bi	< 0.02
cobalt Co	< 0.001
lithium Li	< 0.002
molybdenum Mo	< 0.005
nickel Ni	< 0.002
phosphorus P	< 0.06
silicon Si	3.48
silver Ag	< 0.001
strontium Sr	0.060
sulfur S	1.3
thorium Th	< 0.005
tin Sn	< 0.005
titanium Ti	< 0.001
vanadium V	< 0.002
zirconium Zr	< 0.001

Results are for internal use only. Qanta Trace liability is limited to the testing fee paid.

Approved: 

DATE: January 31, 1997

JOB NO: JB 1624M
LR NO: 23214

CLIENT: NovaTec Consultants Inc.
224 West 8th Avenue
Vancouver, B.C.
V5Y 1N5

SAMPLING DATE: See Below
SAMPLING AGENT: Client

The sample(s) submitted
by the agent have been
tested as requested and
we report as follows:

Attn: Martin Vogel

SAMPLE: Sample # 1: PRH Jan 30/97
Sample # 2: BRH
Sample # 3: MR
Sample # 4: SA30A
Sample # 5: SA30C1
Sample # 6: S2
Sample # 7: BAH
Sample # 8: KCK
Sample # 9: KCN
Sample # 10: R1
Sample # 11: CSF
Sample # 12: C10

	Iron mg/L	Manganese mg/L	Sodium mg/L	Calcium mg/L	Magnesium mg/L	Potassium mg/L
Sample # 1	0.9*	0.13*				
Sample # 2	0.1	0.04				
Sample # 3 <	0.1 <	0.02				
Sample # 4	0.8*	0.08*				
Sample # 5	0.7*	0.05				
Sample # 6	0.9*	0.11*				
Sample # 7	0.8*	0.10*	17.0			
Sample # 8 <	0.1 <	0.02	6.0	0.5 <	0.1	24
Sample # 9 <	0.1 <	0.02	18.0 <	0.1 <	0.1 <	0.1
Sample # 10	0.9*	0.12*	3.0	10.0	0.9	0.5
Sample # 11				29.0		
Sample # 12				43.0		

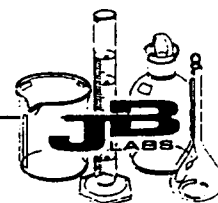
* Indicates Outside of Guidelines for Canadian Drinking Water Quality
and / or the BC Safe Drinking Water Regulation.
< = less than



JB Laboratories Ltd.
water/wastewaters

John E. Evanoff, M.Sc.
Barbara M. Klassen, B.Sc.

Analysis performed according to "A Laboratory Manual for the Chemical Analysis of water,
Wastewaters and Biological Tissues", Chemistry Laboratory, Water Resource Service and/or
"Standard Methods/Water and Wastewater", American Public Health Association.



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Is(are) under consultation