

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

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



August, 2002

Appendix C

Water Quality Test Results

Page(s) 005153 to\à 005182

Is(are) under consultation



LOWER NICOLA INDIAN BAND

73 SHULUS, HIGHWAY 8, Merritt, B.C. V1K 1N2
Phone (250) 378-5157 - Fax (250) 378-6188

June 11, 2002

Health Canada
c/o Nicola Tribal Association
Box 188
Merritt, BC
V1K 1B8

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JUN 14 2002

CH2MHILL CANADA LTD.

Attention: Rita Manuel, Environmental Health Officer

Dear Ms. Manuel:

**RE: Release of Information
Community Water & Wastewater Assessments**

Please be advised that we give your office permission to forward copies of the March 2002 water quality test results to CH2M Hill. We also request that you forward copies to Rick Fernades of Indian and Northern Affairs Canada who is coordinating this project.

Indian and Northern Affairs Canada have retained CH2M Hill, engineering consultants, to complete a public health assessment of the four water systems operated by the Lower Nicola Indian Band.

If you have any concerns about forwarding this information, please do not hesitate to contact me at (250)378-5157. Thank you for tending to this matter.

Yours Truly,

Garry Lafferty
Executive Director

cc: Chief Arthur Dick
~~XXXXXXXXXXXXXXXXXXXX~~

Page(s) 005184 to\à 005191

Is(are) under consultation

Rocky Pines

APPENDIX D

Analytical Chemistry Certificates
Canadian Drinking Water Guidelines
Analytical Methodology

TABLE 1
ROCKY PINES WATERWELLS
CHEMICAL ANALYSIS OF DRINKING WATER SAMPLES

SAMPLE INFORMATION

Source: Well No. 2 - August 1988
 Well No. 3 - March 1990

<u>PHYSICAL TESTS</u>	<u>ACCEPTABLE CANADIAN STANDARDS</u>	<u>WELL No. 2</u>	<u>WELL No. 3</u>
PH	6.5 - 8.5	7.67	7.20
Conductivity	- - -	400	4.20
Colour (Pt-Co scale)	15	L2	- - -
Turbidity (NTU)	5	0.50	- - -
Hardness	- - -	167	402
<u>SOLIDS</u>			
Total Dissolved	500	262	- - -
<u>DISSOLVED ANIONS (mg/L)</u>			
Alkalinity: Bicarbonate	500	220	- - -
Alkalinity: Carbonate	500	L0.5	205
Alkalinity: Hydroxide	500	L0.5	- - -
Sulfates	500	30	32
Nitrites and Nitrates	10	L.004	0.150
Fluorides	1.5	0.3	0.18
Sulfide	- - -	- - -	0.08
<u>DISSOLVED METALS (mg/L)</u>			
Calcium Ca	200	44.6	107.0
Iron Fe	0.30	0.14	- - -
Manganese Mn	0.05	0.26	0.01
Sodium Na	20	42.1	9.4
Magnesium Mg	0.05	13.6	32.8
<u>TOTAL METALS</u>			
Iron Fe	0.30	0.20	0.02
Manganese Mn	0.05	0.27	0.01

Note: "L" denotes "less than".



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Client Code: KALGRO

Name KALA GROUNDWATER CONS. LTD. Address: #207, 220 - 4TH AVE., KAMLOOPS, B.C. V2C 3N8 Attn: Sandy/Paul Phone: (250) 372-9194 Fax: (250) 372-9398	Workorder: 32973 WO (Other): PO Num: Project: 97209 Date Sampled: 06/02/98 Date Received: 10-Feb-98 Date Reported: 23-Feb-98
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Metal Analysis

	Detection Limit	Units	32973-1
			Lower Nicola Well #3
<i>Dissolved Semi-Trace Metals Scan In Water</i>			
Aluminum	0.01	mg/L	<0.01
Antimony	0.02	mg/L	<0.02
Arsenic	0.02	mg/L	<0.02
Barium	0.0005	mg/L	0.0434
Beryllium	0.0002	mg/L	<0.0002
Bismuth	0.02	mg/L	<0.02
Cadmium	0.0005	mg/L	<0.0005
Calcium	0.01	mg/L	61.5
Chromium	0.001	mg/L	<0.001
Cobalt	0.001	mg/L	<0.001
Copper	0.002	mg/L	0.004
Iron	0.003	mg/L	<0.003
Lead	0.005	mg/L	<0.005
Lithium	0.002	mg/L	<0.002
Magnesium	0.01	mg/L	16.1
Manganese	0.0005	mg/L	0.0056
Mercury	0.0001	mg/L	<0.0001
Molybdenum	0.005	mg/L	<0.005
Nickel	0.002	mg/L	<0.002
Phosphorus	0.05	mg/L	0.08
Potassium	0.2	mg/L	2.8
Selenium	0.02	mg/L	<0.02
Silicon	0.05	mg/L	9.07
Silver	0.001	mg/L	<0.001
Sodium	0.05	mg/L	11.3
Strontium	0.005	mg/L	0.236
Sulphur	0.1	mg/L	5
Thorium	0.005	mg/L	<0.005
Tin	0.005	mg/L	<0.005
Titanium	0.001	mg/L	<0.001
Uranium	0.05	mg/L	<0.06
Vanadium	0.002	mg/L	0.006
Zinc	0.001	mg/L	0.008
Zirconium	0.001	mg/L	<0.001



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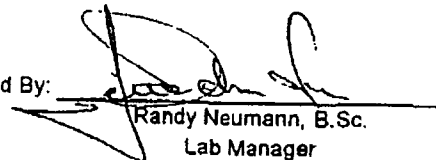
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Metal Analysis

	32973-1		Lower Nicola Well #3
	Detection Limit	Units	
Total Semi-Trace Metals Scan in Water			
Aluminum	0.01	mg/L	<0.01
Antimony	0.02	mg/L	<0.02
Arsenic	0.02	mg/L	<0.02
Barium	0.0005	mg/L	0.0437
Beryllium	0.0002	mg/L	<0.0002
Bismuth	0.02	mg/L	<0.02
Cadmium	0.0005	mg/L	<0.0005
Calcium	0.01	mg/L	62.2
Chromium	0.001	mg/L	<0.001
Cobalt	0.001	mg/L	<0.001
Copper	0.002	mg/L	0.007
Iron	0.003	mg/L	0.008
Lead	0.005	mg/L	<0.005
Lithium	0.002	mg/L	<0.002
Magnesium	0.01	mg/L	16.3
Manganese	0.0005	mg/L	0.0062
Mercury	0.0001	mg/L	<0.0001
Molybdenum	0.005	mg/L	<0.005
Nickel	0.002	mg/L	<0.002
Phosphorus	0.05	mg/L	0.16
Potassium	0.2	mg/L	2.8
Selenium	0.02	mg/L	<0.02
Silicon	0.05	mg/L	9.19
Silver	0.001	mg/L	<0.001
Sodium	0.05	mg/L	11.4
Strontium	0.005	mg/L	0.237
Sulphur	0.1	mg/L	5.1
Thorium	0.005	mg/L	<0.005
Tin	0.005	mg/L	<0.005
Titanium	0.001	mg/L	<0.001
Uranium	0.06	mg/L	<0.06
Vanadium	0.002	mg/L	0.006
Zinc	0.001	mg/L	0.008
Zirconium	0.001	mg/L	<0.001

Approved By:



Randy Neumann, B.Sc.
Lab Manager

PAGE 2 of 5

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Microbiological Analysis

	Detection Limit	Units	32973-1 Lower Nicola Well #3
Background Count			
Background Count	1	cfu/100 mL	<1
Bacterial Identification			
Bacterial Identification			Pseudomonas Fluorescens
Standard Plate Count			
Standard Plate Count	1	cfu/mL	670
Total and Fecal Coliforms (MF)			
Total Coliforms	1	cfu/100 mL	<1
Fecal Coliforms	1	cfu/100 mL	<1

Approved By:


 Randy Neumann, B.Sc.
 Lab Manager



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Workorder: 32973

WO (Other):

PO Num:

Project: 97209

Date Sampled: 06/02/98

Date Received: 10-Feb-98

Date Reported: 23-Feb-98

Water Analysis

	Detection Limit	Units	32973-1 Lower Nicola Well #3
Alkalinity, total			
Total Alkalinity	5	g CaCO ₃ /l	327
Chloride in Water			
Chloride	0.1	mg/L	13
Colour			
Colour	5	TCU	40
Electrical Conductivity			
Electrical Conductivity	0.01	µS/cm	460
Fluoride in Water			
Fluoride	0.04	mg/L	0.12
Gross Alpha			
Gross Alpha		Bq/L	na
Gross Beta			
Gross Beta		Bq/L	na
Hardness			
Hardness (CaCO ₃ equiv)	5	mg/L	223
Nitrate + Nitrite Nitrogen			
Nitrate-N (+ Nitrite-N)	0.005	mg/L	0.44



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Water Analysis

	Detection Limit	Units	32973-1 Lower Nicola Well #3
Nitrate - Nitrogen in Water			
Nitrate-N	0.05	mg/L	0.31
Nitrite Nitrogen			
Nitrite-N	0.003	mg/L	0.13
pH in Water			
pH	0.01	pH	8.21
Sulphate in Water			
Sulphate	1	mg/L	45
Total Dissolved Solids			
Total Dissolved Solids	5	mg/L	274
Turbidity			
Turbidity	1	NTU	<1
Gross alpha			
Gross alpha	0.24	Bq/L	<0.24
Gross beta			
Gross beta	0.14	Bq/L	<0.14

Approved By:


 Randy Neumann, B.Sc.
 Lab Manager



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Metal Analysis

	32999-1		Lower Nickala Well #1
	Detection Limit	Units	
<i>Dissolved Semi-Trace Metals Scan in Water</i>			
Aluminum	0.01	mg/L	<0.01
Antimony	0.02	mg/L	<0.02
Arsenic	0.02	mg/L	<0.02
Barium	0.0005	mg/L	0.0423
Beryllium	0.0002	mg/L	<0.0002
Bismuth	0.02	mg/L	<0.02
Cadmium	0.0005	mg/L	<0.0005
Calcium	0.01	mg/L	51.1
Chromium	0.001	mg/L	<0.001
Cobalt	0.001	mg/L	<0.001
Copper	0.002	mg/L	0.013
Iron	0.003	mg/L	<0.003
Lead	0.005	mg/L	<0.005
Lithium	0.002	mg/L	0.002
Magnesium	0.01	mg/L	20.6
Manganese	0.0005	mg/L	0.278
Mercury	0.0001	mg/L	<0.0001
Molybdenum	0.005	mg/L	0.007
Nickel	0.002	mg/L	<0.002
Phosphorus	0.05	mg/L	0.1
Potassium	0.2	mg/L	3
Selenium	0.02	mg/L	<0.02
Silicon	0.05	mg/L	9.49
Silver	0.001	mg/L	<0.001
Sodium	0.05	mg/L	16.7
Strontium	0.005	mg/L	0.366
Sulphur	0.1	mg/L	5.6
Thorium	0.005	mg/L	<0.005
Tin	0.005	mg/L	<0.005
Titanium	0.001	mg/L	<0.001
Uranium	0.05	mg/L	<0.06
Vanadium	0.002	mg/L	0.004
Zinc	0.001	mg/L	0.014
Zirconium	0.001	mg/L	<0.001

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Workorder: 32999

WO (Other):

PO Num:

Project: 97209

Date Sampled: 10/02/98

Date Received: 11-Feb-98

Date Reported: 23-Feb-98

Metal Analysis cont'd

	Detection Limit	Units	32999-1
			Lower Nickala Well #1
Total Semi-Trace Metals Scan in Water			
Aluminum	0.01	mg/L	<0.01
Antimony	0.02	mg/L	<0.02
Arsenic	0.02	mg/L	<0.02
Barium	0.0005	mg/L	0.0434
Beryllium	0.0002	mg/L	<0.0002
Bismuth	0.02	mg/L	<0.02
Cadmium	0.0005	mg/L	<0.0005
Calcium	0.01	mg/L	52.7
Chromium	0.001	mg/L	<0.001
Cobalt	0.001	mg/L	<0.001
Copper	0.002	mg/L	0.015
Iron	0.003	mg/L	0.06
Lead	0.005	mg/L	<0.005
Lithium	0.002	mg/L	0.003
Magnesium	0.01	mg/L	21.4
Manganese	0.0005	mg/L	0.285
Mercury	0.0001	mg/L	<0.0001
Molybdenum	0.005	mg/L	0.008
Nickel	0.005	mg/L	<0.005
Phosphorus	0.05	mg/L	0.11
Potassium	0.2	mg/L	3.3
Selenium	0.01	mg/L	<0.01
Silicon	0.05	mg/L	9.74
Silver	0.001	mg/L	<0.001
Sodium	0.05	mg/L	17.1
Strontium	0.005	mg/L	0.374
Sulphur	0.1	mg/L	5.9
Thorium	0.005	mg/L	<0.005
Tin	0.005	mg/L	<0.005
Titanium	0.001	mg/L	<0.001
Uranium	0.06	mg/L	<0.06
Vanadium	0.002	mg/L	0.004
Zinc	0.001	mg/L	0.019
Zirconium	0.001	mg/L	<0.001

Approved By:

Randy Neumann, B.Sc.
 Lab Manager

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Microbiological Analysis

	Detection Limit	Units	32999-1 Lower Nickala Well #1
Background Count			
Background Count	1	cfu/100 mL	<1
Bacterial Identification			
Bacterial Identification			-
Standard Plate Count			
Standard Plate Count	1	cfu/mL	<1
Total and Fecal Coliforms (MF)			
Total Coliforms	1	cfu/100 mL	<1
Fecal Coliforms	1	cfu/100 mL	<1

Approved By:

Randy Neumann, B.Sc.
Lab Manager



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Workorder: 32999

WO (Other):

PO Num:

Project: 97209

Date Sampled: 10/02/98

Date Received: 11-Feb-98

Date Reported: 23-Feb-98

Water Analysis

	Detection Limit	Units	32999-1 Lower Nickala Well #1
Alkalinity, total			
Total Alkalinity	5	g CaCO ₃ /	811
Chloride in Water			
Chloride	0.1	mg/L	1.8
Colour			
Colour	5	TCU	<5
Electrical Conductivity			
Electrical Conductivity	0.01	µS/cm	480
Fluoride in Water			
Fluoride	0.04	mg/L	0.14
Hardness			
Hardness (CaCO ₃ equiv)	5	mg/L	220
Nitrate + Nitrite Nitrogen			
Nitrate-N (+ Nitrite-N)	0.005	mg/L	0.14

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 Phone: (250) 372-9194
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Workorder: 32999

WO (Other):

PO Num:

Project: 97209

Date Sampled: 10/02/98

Date Received: 11-Feb-98

Date Reported: 23-Feb-98

Water Analysis

	Detection Limit	Units	32999-1 Lower Nickala Well #1
Nitrate - Nitrogen in Water			
Nitrate-N	0.05	mg/L	0.14
Nitrite Nitrogen			
Nitrite-N	0.003	mg/L	<0.003
pH in Water			
pH	0.01	pH	8.27
Sulphate in Water			
Sulphate	1	mg/L	53
Total Dissolved Solids			
Total Dissolved Solids	5	mg/L	310
Turbidity			
Turbidity	1	NTU	<1

Approved By: _____

Randy Neumann
 Randy Neumann, B.Sc.
 Lab Manager



NORWEST LABS

INFORMATION SHEET

WATERS

CONTROL NUMBER

W 25821

RESULTS & INVOICE TO: COMPANY: <u>KFILA GROUNDWATER</u> ADDRESS: <u>207-220 4th AVE</u> CITY/TOWN: <u>KAMLOOIS</u> PROVINCE: <u>BC</u> POSTAL CODE: <u>V2C 3N6</u> ATTENTION: <u>PAUL BRACKETT</u> PHONE: <u>250 372 7194</u> FAX: <u>250 372 9398</u>	COPY OF RESULTS TO: COMPANY: ADDRESS: CITY/TOWN: PROVINCE: POSTAL CODE: ATTENTION: PHONE: FAX: CELL:	WORK ORDER NO.: DATE STAMP:
---	--	--

PURCHASE ORDER NO.: 	PROJECT REF.: <u>97209</u>	REF/QUOTE NO.: <u>97-1016</u>
--------------------------------	--------------------------------------	---

DATE SAMPLED: 11/17/98
 NUMBER OF SAMPLES: 1
 WATER:
 LIO WASTE:
 OTHER (SPECIFY):

SPECIAL INSTRUCTIONS (SEE OVER FOR IMPORTANT SAMPLE INFORMATION INSTRUCTIONS AND ANALYSIS CODES)
QUANTITY REQUIRED: 1 D 0 M 0 Y
 % SURCHARGE WILL APPLY TO RUSHES: _____
 QA REPORT:

SAMPLE CUSTODY: SAILED BY: <u>LIJGU</u> COMPANY: <u>LIJGU</u> DATE: <u>FEB 10/98</u>	RECEIVED BY: <u>KAM</u> COMPANY: <u>KAM</u> DATE: <u>FEB 10/98</u>	RELINGUISSED BY: COMPANY: DATE:	RECEIVED BY: COMPANY: DATE:
--	--	---------------------------------------	-----------------------------------

SITE ID.	SAMPLE DESCRIPTION	OTHER	ANALYSIS PACKAGE CODES (USE CODES LISTED ON THE REVERSE OF THIS SHEET)	LAB CODING
1	<u>Lower Nicola</u>		<u>Package 3</u>	
2				
3			<u>Please call to</u>	
4			<u>confirm analysis</u>	
5				
6				
7				
8				
9				
10				
11				
12				
13				

ONTARIO: P 4 (403) 458-5522 FAX (403) 438-0366
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 SASKATCHEWAN: PH (306) 550-4314 FAX (306) 534-8998
 MANITOBA: PH (431) 329-0256 FAX (431) 327-8527
 BRITISH COLUMBIA: PH (204) 562-2630 FAX (204) 275-8012

NOTE: Please complete this form in its entirety to ensure correct testing and reporting requirements.
 ACCREDITED BY THE STANDARDS COUNCIL OF CANADA FOR SPECIFIC TESTS.

Parameter	CDWQG 1996 Drinking Water MAC/AO	CDWQC 1996 Bathing Water MAC
pH (units)	6.5-8.5 AO	6.3-8.5
Colour (CTU)	<15 AO	100
Specific Conductance (uS/cm)	-	<1000
Total Dissolved Solids (mg/L)	<500 AO	-
Turbidity (NTU)	<5 MAC/AO	50
Total Hardness (mg/L)	-	<800
Total Alkalinity (mg/L)	-	-
Bicarbonate (mg/L)	-	-
Carbonate (mg/L)	-	-
Dissolved Chloride (mg/L)	<250 AO	<250
Dissolved Fluoride (mg/L)	1.5 MAC	-
Nitrate Nitrogen (mg/L)	45 MAC	50
Nitrite Nitrogen (mg/L)	3.2 MAC	-
Sulfate (mg/L)	<500 AO	<500
Total Coliform (CFU/0.1L)	<1 MAC	<20
Fecal Coliform (CFU/0.1L)	<1 MAC	<10
Standard Plate Count	200 background MAC	-
TOTAL METALS (mg/L)		
Aluminum	0.2 MAC	-
Antimony	-	-
Arsenic	0.025 MAC	0.05
Barium	1 MAC	-
Beryllium	-	-
Bismuth	-	-
Calcium	-	-
Cadmium	0.005 MAC	-
Cobalt	-	-
Chromium	0.05 MAC	-
Copper	<1.0 AO	-
Iron	<0.3 AO	-
Lead	0.01 MAC	-
Lithium	-	-
Magnesium	-	-
Manganese	<0.05 AO	-
Molybdenum	-	-
Nickel	-	-
Phosphorus	-	-
Potassium	-	-
Selenium	0.01 MAC	-
Silicon	-	-
Silver	-	-
Sodium	200 AO	-
Strontium	-	-
Sulphur	-	-
Tin	-	-
Titanium	-	-
Uranium	0.1 MAC	-
Vanadium	-	-
Zinc	<5.0 AO	-

- CDWQG = Canadian Drinking Water Quality Guidelines
- Bathing water standards are summarized from McGregor – Environment Canada, 1989
- < = Less than
- = Dissolved metal guideline
- MAC = Maximum Allowable Health Criteria
- AO = Aesthetic Objective Criteria

Environmental Health Directorate
Health Canada

Summary of Guidelines for Canadian Drinking Water Quality (83-95)
Federal-Provincial Subcommittee on Drinking Water

Summary of Guidelines for Radiological Parameters

In setting dose guidelines for radionuclides in drinking water, it is recognized that water consumption contributes only a portion of the total radiation dose and that some radionuclides present are natural in origin and therefore cannot be excluded. Consequently, maximum acceptable concentrations (MACs) for radionuclides in drinking water have been derived based on a committed effective dose of 0.1 mSv from one year's consumption of drinking water. This dose represents less than 5% of the average annual dose attributable to natural background radiation.

To facilitate the monitoring of radionuclides in drinking water, the reference level of dose is expressed as an activity concentration, which can be derived for each radionuclide from published radiological data. The National Radiological Protection Board has calculated dose conversion factors (DCFs) for radionuclides based on metabolic and dosimetric models for adults and children. Each DCF provides an estimate of the 50-year committed effective dose resulting from a single intake of 1 Bq of a given radionuclide.

The MACs of radionuclides in public water supplies are derived from adult DCFs, assuming a daily water intake of 2 L, or 730 L/year, and a maximum committed effective dose of 0.1 mSv, or 10% of the International Commission on Radiological Protection limit on public exposure.

$$\text{MAC (Bq/L)} = \frac{1 \times 10^{-4} \text{ (Sv/year)}}{730 \text{ (L/year)} \cdot \text{DCF (Sv/Bq)}}$$

When two or more radionuclides are found in drinking water, the following relationship should be satisfied:

$$\frac{c_1}{\text{MAC}_1} + \frac{c_2}{\text{MAC}_2} + \dots + \frac{c_n}{\text{MAC}_n} \leq 1$$

where c_i and MAC_i are the observed and maximum acceptable concentrations, respectively, for each contributing radionuclide.

Water samples may be initially screened for radioactivity using techniques for gross alpha and gross beta activity determinations. Compliance with the guidelines may be inferred if the measurements for gross alpha and gross beta activity are less than 0.1 Bq/L and 1 Bq/L, respectively, as these are lower than the strictest MACs. Sampling and analyses should be carried out often enough to accurately characterize the annual exposure. If the source of the activity is known, or expected, to be changing rapidly with time, then the sampling frequency should reflect this factor. If there is no reason to suppose that the source varies with time, then the sampling may be done annually. If measured concentrations are consistent and well below the reference levels, this would be an argument for reducing the sampling frequency. On the other hand, the sampling frequency should be maintained, or even increased, if concentrations are approaching the reference levels. In such a case, the specific radionuclides should be identified and individual activity concentrations measured.

Sample ID : Well #3
 Location : Merritt, BC
 Site : Lower Nicola
 Sampling Date : February
 Geology :
 Watertype : Ca-Mg-SO4

Sum of Anions (meq/l) : 1.31
 Sum of Cations (meq/l) : 5.02
 Balance: : 58.5%

Total dissolved solids : 6.3 meq/l 151.5 mg/l

Hardness	: meq/l	°f	°g	mg/l CaCO3
Total hardness	: 4.44	22.22	12.45	222.2
Permanent hardness	: 4.44	22.22	12.45	222.2
Temporary hardness	: 0.0	0.00	0.00	0.0
Alkalinity	: 0.0	0.00	0.00	0.0

(1 °f = 10 mg/l CaCO3/l 1 °g = 10 mg/l CaO)

Major ion composition

	mg/l	mmol/l	meq/l	meq%
Na	11.4	0.496	0.496	7.831
K	2.8	0.072	0.072	1.137
Ca	62.2	1.552	3.104	49.008
Mg	16.3	0.671	1.341	21.172
Cl	13.0	0.367	0.367	5.794
SO4	45.0	0.468	0.937	14.794
HCO3	0.0	0.0	0.0	0.0

Ratios

	mg/l	mmol/l	Comparison to Seawater	
			mg/l	mmol/l
Ca/Mg	3.816	2.315	0.319	0.194
Ca/SO4	1.382	3.313	0.152	0.364
Na/Cl	0.877	1.352	0.556	0.858

Dissolved Minerals:

	mg/l	mmol/l
Halite (NaCl)	: 0.605	0.0103
Carbonate (CaCO3)	: 41.333	0.4133
Dolomite (CaMg(CO3)2)	: 123.44	0.671
Anhydrite (CaSO4)	: 63.807	0.468
SiO2 as Quartz	: 7.061	0.118
or Feldspar (NaAlSi3O8)	: 30.835	0.118

SampleID : Well #1
 Location : Merritt, BC
 Site : Lowe Nicola
 Sampling Date : February
 Geology :
 Watertype : Ca-Mg-Na-SO4
 :
 Sum of Anions (meq/l) : 1.16
 Sum of Cations (meq/l) : 5.24
 Balance: : 63.7%

Total dissolved solids : 6.4 meq/l 150.4 mg/l
 Hardness : meq/l °f °g mg/l CaCO3
 Total hardness : 4.39 21.95 12.29 219.5
 Permanent hardness : 4.39 21.95 12.29 219.5
 Temporary hardness : 0.0 0.00 0.00 0.0
 Alkalinity : 0.0 0.00 0.00 0.0
 (1 °f = 10 mg/l CaCO3/l 1 °g = 10 mg/l CaO)

Major ion composition

	mg/l	mmol/l	meq/l	meq%
Na	17.1	0.744	0.744	11.615
K	3.3	0.084	0.084	1.311
Ca	52.7	1.315	2.63	41.059
Mg	21.4	0.88	1.761	27.492
Cl	1.8	0.051	0.051	0.796
SO4	53.0	0.552	1.104	17.235
HCO3	0.0	0.0	0.0	0.0

Ratios

	mg/l	mmol/l	Comparison to Seawater	
			mg/l	mmol/l
Ca/Mg	2.463	1.494	0.319	0.194
Ca/SO4	0.994	2.383	0.152	0.364
Na/Cl	9.5	14.65	0.556	0.858

Dissolved Minerals:

	mg/l	mmol/l
Halite (NaCl) :	0.084	0.0014
Dolomite (CaMg(CO3)2) :	162.063	0.88
Anhydrite (CaSO4) :	75.15	0.552
SiO2 as Quartz :	7.484	0.125
or Feldspar (NaAlSi3O8) :	32.68	0.125

Sample Lower Nicola (Well#1)

TempC = 8.0 pH = 8.3
 TDS = 310.0 COND = 480.0
 HARD = 220.0 DENS = 1.0
 y-cor = 0.0 y-cor = 0.0
 i ts = mg/L rock = 0.0

	mg/L	mmole/L	meq/L	% meq/L
Na+	16.7	0.7264	0.7264	14.4
K +	3.0	0.0767	0.0767	1.5
Ca++	51.1	1.2750	2.5499	50.4
Mg++	20.6	0.8473	1.6946	33.5
Cl-	1.8	0.0508	0.0508	4.4
SO4--	53.0	0.5517	1.1035	94.8
HCO3-	0.0	0.0000	0.0000	0.0
CO3--	0.0	0.0000	0.0000	0.0
SiO2	9.5	0.1579	0.0000	0.0
Li+	0.0	0.0003	0.0003	0.0
Sr++	0.4	0.0042	0.0084	0.2
Ba++	0.0	0.0003	0.0006	0.0
Fe++	0.0	0.0001	0.0001	0.0
NO3-	0.1	0.0023	0.0023	0.2
F-	0.1	0.0074	0.0074	0.6
Br-	0.0	0.0000	0.0000	0.0
B	0.0	0.0000	0.0000	0.0

LANGELIER INDEX = 0.00 SAR = 0.5
 Conductivity = 480 umho Est. Cond. = 506 umho

Analytical checks and comparisons

Sum cations = 5.0570 Sum anions = 1.1639
 BALANCE = 62.58 %
 TDS entered = 310 mg/L
 TDS calc = 156 mg/L TDS(180) calc = 156 mg/L
 Entered TDS - TDS(calc) diff= 49.6 % Entered TDS - TDS(180) diff= 49.6 %

Conductivity = 480 umho
 TDS(entered)/Cond ratio = 0.65 Usual range = 0.55 to 0.75
 TDS(calc)/Cond = 0.33 Usual range = 0.55 to 0.75
 Conductivity/Sum-cations = 95 Usual range = 90 - 110

Entered and calculated density
 Meas. Density = 1.0000 Calc. Density = 1.0002

Entered and calculated hardness
 Meas. hardness= 220.0 mg/L CaCO3 Calc. hardness= 212.4 mg/L CaCO3

Element ratios
 Na/(Na+Cl) = 93.5 % Usually > 50%
 Ca/(Ca + SO4) = 69.8 % Usually > 50%
 K/(Na + K) = 9.6 % Usually < 20%
 Mg/(Mg+Ca) = 39.9 % Usually < 40%

Carbonate/bicarbonate at pH = 8.27
 Meas HCO3 = 0.0 mg/L Meas CO3 = 0.0 mg/L
 Calc HCO3 = 0.0 mg/L Calc CO3 = 0.0 mg/L

Sample Lower Nicola (Well#1)
SOURCE ROCK ESTIMATE

CO ₂ (mmol/L) =	0.16	
Al ₂ O ₃ /SiO ₂ =		HCO ₃ not analysed
SiO ₂ /(Na+K-Cl) =	0.21	Cation exchange
(Na+K-Cl)/(Na+K-Cl+Ca) =	0.37	Plagioclase weathering possible
Na/(Na + Cl) =	0.93	Albite or ion exchange
Mg/(Mg+Ca) =	0.40	Granitic weathering
Ca/(Ca + SO ₄) =	0.70	Ca source other than gypsum carbonates or silicates
(Ca + Mg)/SO ₄ =	3.8	Dedolomitization unlikely
TDS calculated =	156 mg/L	Silicate weathering possible
Cl/sum anions =	0.04	Silicate or carbonate weathering
HCO ₃ /sum anions =	0.00	Sea water, brine, or evaporites
Langelier Index =		

Mass Balance Calculation

Carbonate option		
Mineral	Dissolves	Precipitates
HALITE	0.051	
CALCITE	0.214	
DOLOMITE	0.847	
GYPSUM	0.552	
ION EXCH	0.338	
CO ₂ GAS		-1.908

Silicate option		
Mineral	Dissolves	Precipitates
HALITE	0.051	
ALBITE(K)	0.676	
ANORTHIT(K)		-0.124
DIOPSIDE	0.847	
GYPSUM	0.552	
CO ₂ GAS		-3.817

Analysed silica = 9 Silica from albite and diopside = 142 - 183

TEMPERATURE ESTIMATES IN DEGREES C

Good for temperatures 20 - 350 C

Mg-Li	-->	21
Na-Li	-->	65
Na-K-Ca (Mg corrected)	-->	28

Good for low temperatures 30 - 70 C

Chalcedony

--> 5

Good for temperatures > 70 C

Quartz-no steam loss	-->	38
Quartz-maximum steam loss	-->	46

Do not use for oil-field waters
May not be useful below 150 C

Na-K (Fournier)	-->	273
Na-K (Truesdell)	-->	280
Na-K-Ca (t < 100 C)	-->	28
Na-K-Ca (t > 100 C)	-->	163

Sample Lower Nicola (Well #3)

TempC =	8.0	pH =	8.2
TDS =	274.0	COND =	460.0
HARD =	223.0	DENS =	1.0
x-cor =	0.0	y-cor =	0.0
units =	mg/L	rock =	0.0

	mg/L	mmole/L	meq/L	% meq/L
Na+	11.3	0.4915	0.4915	9.9
K +	2.8	0.0716	0.0716	1.4
Ca++	61.5	1.5344	3.0689	61.8
Mg++	16.1	0.6622	1.3244	26.7
Cl-	13.0	0.3667	0.3667	27.9
SO4--	45.0	0.4685	0.9369	71.3
HCO3-	0.0	0.0000	0.0000	0.0
CO3--	0.0	0.0000	0.0000	0.0
SiO2	9.1	0.1509	0.0000	0.0
Li+	0.0	0.0003	0.0003	0.0
Sr++	0.2	0.0027	0.0054	0.1
Ba++	0.0	0.0003	0.0006	0.0
Fe++	0.0	0.0001	0.0001	0.0
NO3-	0.3	0.0050	0.0050	0.4
F-	0.1	0.0063	0.0063	0.5
Br-	0.0	0.0000	0.0000	0.0
B	0.0	0.0000	0.0000	0.0

LANGELIER INDEX =	0.00	SAR	=	0.3
Conductivity =	460 umho	Est. Cond.	=	496 umho

Analytical checks and comparisons

Sum cations =	4.9628	Sum anions =	1.3149
		BALANCE =	58.11 %
TDS entered =	274 mg/L	TDS(180) calc =	159 mg/L
TDS calc =	159 mg/L	Entered TDS - TDS(180) diff =	41.8 %
Entered TDS - TDS(calc) diff =	41.8 %		

Conductivity = 460 umho	
TDS(entered)/Cond ratio =	0.60 Usual range = 0.55 to 0.75
TDS(calc)/Cond =	0.35 Usual range = 0.55 to 0.75
Conductivity/Sum-cations =	93 Usual range = 90 - 110

Entered and calculated density	
Meas. Density =	1.0000 Calc. Density = 1.0002

Entered and calculated hardness	
Meas. hardness =	223.0 mg/L CaCO3 Calc. hardness = 219.9 mg/L CaCO3

Element ratios	
Na/(Na+Cl) =	57.3 % Usually > 50%
Ca/(Ca + SO4) =	76.6 % Usually > 50%
K/(Na + K) =	12.7 % Usually < 20%
Mg/(Mg+Ca) =	30.1 % Usually < 40%

Carbonate/bicarbonate at pH = 8.21			
Meas HCO3 =	0.0 mg/L	Meas CO3 =	0.0 mg/L
Calc HCO3 =	0.0 mg/L	Calc CO3 =	0.0 mg/L

Sample Lower Nicola (Well #3)
SOURCE ROCK ESTIMATE

SiO ₂ (mmol/L) =	0.15	
CO ₃ /SiO ₂ =		HCO ₃ not analysed
SiO ₂ /(Na+K-Cl) =	0.77	Cation exchange
(Na+K-Cl)/(Na+K-Cl+Ca) =	0.11	Plagioclase weathering unlikely
Na/(Na + Cl) =	0.57	Albite or ion exchange
Mg/(Mg+Ca) =	0.30	Granitic weathering
Ca/(Ca + SO ₄) =	0.77	Ca source other than gypsum carbonates or silicates
(Ca + Mg)/SO ₄ =	4.7	Dedolomitization unlikely
TDS calculated =	159 mg/L	Silicate weathering possible
Cl/sum anions =	0.28	Sea water, brine or evaporites possible
HCO ₃ /sum anions =	0.00	Sea water, brine, or evaporites
Langelier Index =		

Carbonate option

Mineral	Dissolves	Precipitates
HALITE	0.367	
CALCITE	0.466	
DOLOMITE	0.662	
GYPSUM	0.468	
ION EXCH	0.062	
CO ₂ GAS		-1.791

Silicate option

Mineral	Dissolves	Precipitates
HALITE	0.367	
ALBITE(K)	0.125	
ANORTHIT(K)	0.404	
DIOPSIDE	0.662	
GYPSUM	0.468	
CO ₂ GAS		-3.581

Analysed silica = 9 Silica from albite and diopside = 87 - 95

TEMPERATURE ESTIMATES IN DEGREES C

Good for temperatures 20 - 350 C

Mg-Li	-->	23
Na-Li	-->	78
Na-K-Ca (Mg corrected)	-->	21

Good for low temperatures 30 - 70 C

Chalcedony	-->	3
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Good for temperatures > 70 C

Quartz-no steam loss	-->	36
Quartz-maximum steam loss	-->	45

Do not use for oil-field waters
May not be useful below 150 C

Na-K (Fournier)	-->	310
K (Truesdell)	-->	332
Na-K-Ca (t < 100 C)	-->	21
Na-K-Ca (t > 100 C)	-->	171

Appendix D
Wastewater Quality Test Results

No wastewater information was seen