PACIFIC HYDROLOGY CONSULTANTS LTD. Consulting Hydrogeologists

Suite 201, 1537 West 8th Avenue, VANCOUVER, B.C. V6J 1T5
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February 1, 2001

Mr. and Mrs. Joseph Robinsmith
22303 Lougheed Highway
MAPLE RIDGE, B.C. V2X 2T3

Subject: **Evaluation of Groundwater Quantity and Quality from a Drilled Well Proposed as a Domestic Water Supply for a New Residence at 26440 Cunningham Avenue, Maple Ridge, B.C.**
PHCL Reference Number R722101

Dear Sirs:

1.0 INTRODUCTION

The purpose of this letter by Pacific Hydrology Consultants Ltd. (PHCL) is to provide our evaluation of pumping test data and other information for a well located at 26440 Cunningham Avenue, Maple Ridge, in order to establish the suitability of the well as a source of domestic water. The subject well is to supply a new residence on a parcel of land legally described as Lot 14, Sec. 7, Twp. 15, N.W.D., Plan 54091 A legal site plan showing the location of the well is included in the attachments.

The Robinsmith well was constructed by Nor-West Drilling (1998) Ltd. of Langley, B.C.; the litholog of sediments encountered in the drilling of the well and details of well construction are shown on Nor-West's "Well Log" contained in the attachments. The capacity of the well was tested by pumping carried out on January 24 and 25 by E.D.S. Pumps & Plumbing Ltd.; the data collected during this pumping test are also attached.

At the end of the well capacity test on January 25, water samples were collected by E.D.S., who submitted the samples to Analytical Service Laboratories (ASL) for routine chemical and bacteriological analyses. The ASL report on water quality is included in the attachments.

The water well record provided by Nor-West Drilling shows that the subject well is a rock well which obtains water from several fracture zones located between 27.4 and 45.7 m (90 and 150 ft). As described on the well log, the sediments above the bedrock consist of 10.4 m (34 ft) of permeable sediments (sand and gravel) overlying 3.6 m (12 ft) of less permeable compact sand and gravel with clay lenses. The low permeability of the 3.6 metres of surficial sediments above the bedrock gives protection from possible contamination by surface water.

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2.0 WELL CAPACITY TESTING

2.1 Test Procedure

The capacity test of the subject well, which lasted 24 hours, was carried out on January 24 and 25, using the permanent submersible pump with a control valve on the discharge. The flow was measured by means of a manifold of Dole valves of several capacities. Combinations of Dole valves were used to adjust the rate of flow. The water level was measured by an electric water level indicator lowered in a permanent measuring tube.

Pumping started at a rate of 0.63 *l*ps (8.3 igpm) which was reduced to 0.50 *l*ps (6.7 igpm) at 12 minutes. As shown on the attached pumping test data sheets, pumping continued at a rate of 0.50 *l*ps to 4 hours, after which several adjustments in rate were made leading to the setting of a final rate of 0.41 *l*ps (5.4 igpm) at 300 minutes after the initial start. Pumping continued at 0.41 *l*ps for the remainder of the 24-hour pumping period. Following the termination of pumping, the recovery of the water level was observed for four hours.

2.2 Test Results

Data collected by E.D.S. Pumps during the test of the subject well are attached, along with plots of the data using standard procedures. The data during pumping are plotted with drawdown vs log of time in minutes since pumping started; the plot of the recovery data shows residual drawdown vs the log of the ratio, time in minutes since pumping started/time in minutes since pumping stopped. For comparison, the drawdown and recovery plot are contained on the same page, one above the other.

The drawdown data and plot show that drawdown increased steadily for about 100 minutes, after which it increased more rapidly until the pumping rate was reduced to 0.32 *l*ps (4.2 igpm) at 240 minutes. Following the final rate adjustment to 0.41 *l*ps (5.4 igpm) at 300 minutes, the water level rose and became fairly steady at about 28 m (drawdown of about 17½ m) during the last half of the pumping period. The plot of the recovery data shows that the water level recovered along a smooth curve, typical of water level recovery in a rock well, and was within 1.1 m (3.6 ft) of the pre-pumping static water level at four hours after pumping was terminated.

3.0 WELL CAPACITY RATING

Total available drawdown in the subject well, assuming that the pump is set at 10 m (33 ft) above the bottom of the well, is about 42.4 m (139 ft).

At the final test rate of 0.41 *l*ps (5.4 igpm), only 41% of the total available drawdown was used; therefore, the theoretical capacity of the well for domestic use is more than the test rate of 0.41 *l*ps (35,424 *l*/day), and clearly much more than 2,250 *l*/day for single domestic supply required by District of Maple Ridge regulations (By-Law No. 5452-1996).

4.0 GROUNDWATER QUALITY

Appendix D contains the water quality results provided by Analytical Service Laboratories (ASL) for water samples collected near the end of the 24-hour pumping test of the Robinsmith well.

The chemical analysis provided by ASL shows that groundwater from the subject well is a very soft water (hardness = 11.4 mg/*l*) which is quite low in dissolved mineralization (total dissolved solids = 59 mg/*l*). The water is suitable for domestic use, with all parameters analyzed within the limits of the **Guidelines for Canadian Drinking Water Quality** (Health Canada, Sixth Edition, 1996), which have been adopted by B.C. Ministry of Health for assessing potability. Not unexpectedly, considering the hydrogeologic conditions, no coliform bacteria were detected so the water also satisfies bacteriological guidelines of B.C. Ministry of Health.

5.0 CONCLUSIONS

1. As noted above, the subject Robinsmith well at 26440 Cunningham Avenue in Maple Ridge has a tested theoretical capacity more than the final test rate of 0.41 *l*ps (5.4 igpm; 6.5 USgpm) and well beyond requirements specified in District of Maple Ridge By-law No. 5452-1996.

2. The fractured rock aquifer from which the subject well withdraws water is naturally protected from direct surface contamination by a substantial thickness of sediments of low permeability above the bedrock surface.

3. Groundwater from the subject well satifies B.C. Ministry of Health requirements for all parameters checked and is suitable for domestic consumption without treatment.

6.0 CLOSURE

This letter and attachments have been prepared to satisfy District of Maple Ridge with respect to the suitability of a water well located at 26440 Cunningham Avenue in Maple Ridge, B.C. as a source of domestic water for a new residence.

The letter has been prepared from information provided by others, including: Joseph Robinsmith, Nor-West Drilling (1998) Ltd., E.D.S. Pumps and Plumbing Ltd., and Analytical Service Laboratories Ltd.

If, for any reason, PHCL can be of further assistance with certification of this well, please do not hesitate to contact the undersigned at the address on the letterhead.

Yours truly,
PACIFIC HYDROLOGY CONSULTANTS LTD.

Ed Livingston

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
E. LIVINGSTON

Ed Livingston, P. Eng.
Associate Consultant

Attachments - (Schedule "B", District of Maple Ridge By-Law No. 5452-1996 and Required Documents)

NorWest DRILLING (1998) LTD.
23191 Fraser Highway, Box 3446, Langley, B.C. V3A 4R8
Days & Evenings Tel: (604) 534-4108 Fax: (604) 534-3389

WELL LOG

OWNER MR. JOSEPH ROBINSMITH

ADDRESS 23651 - 112B AVE.
MAPLE RIDGE , B.C. v2W 1W7

LOCATION 26440 CUNNINGHAM AVE.
WHONNOCK, B.C.

JAN.8 19~~x~~ 2001

Date Begun JAN.4/01 Completed JAN.5/01

Yield 7 Gallons per minute

Static Water Level 31 feet from surface

Pumping Water Level 150 feet from surface

Casing Used 50 ft 10 inches

Bottom of Casing 48 feet from surface

Stick-up above ground 2ft 10 in. feet

Screen Used N/A

Top of Screen feet from surface

Bottom of Screen feet from surface

Sources of Water 3 g.p.m. at 90ft-100ft feet

Sources of Water 2 g.p.m. at 100ft-120ft feet

Sources of Water 2 g.p.m. at 130ft-150ft feet

Rig No. AR#1

Driller T. OSTER / L. BULBACK

RECOMMENDED PUMP SET AT 150 FT. RATE 7 G.P.M.

Depth	Material
0	
8	BACKFILL
19	SAND,SOME GRAVEL
26	WET SAND,SOME GRAVEL
34	COMPACT SAND & GRAVEL
46	COMPACT SAND & GRAVEL WITH GREY CLAY LENSES
203	SAND STONE WITH LAYERS OF SHALE

PUMPING TEST - DRAWDOWN DATA

Project: **Mr. & Mrs. Joseph Robinsmith**

Well: Domestic Source for One Residence
Location: 26440 Cunningham Avenue, WHONOCK, B.C.
Static Water Level: 10.565 m (34.66 ft)
Well Completion: 61.9 m (203 ft) deep well in rock with water-yielding fractures between 27.4 and 45.7 m (90 and 150 ft)
Datum: Top of well casing stickup, at 0.855 m (2.8 ft) above ground

DATE (m/d/yr) & TIME (hr:min:sec)	ELAPSED TIME t(min)	DISTANCE TO WATER (m)	DRAWDOWN (m)	PUMPING RATE (igpm)	PUMPING RATE (*l*ps)	REMARKS
01/24/01						
10:48:00	0.0	10.565	0.000			Static water level; start pump.
10:49:00	1.0	11.950	1.385	8.3	0.63	
10:49:30	1.5	12.975	2.410			
10:50:00	2.0	14.315	3.750			
10:50:30	2.5	14.960	4.395			
10:51:00	3.0	15.615	5.050			
10:51:30	3.5	16.220	5.655			
10:52:00	4.0	16.735	6.170			
10:52:30	4.5	17.355	6.790			
10:53:00	5.0	17.860	7.295			
10:54:00	6.0	18.795	8.230			
10:55:00	7.0	19.625	9.060			
10:56:00	8.0	20.430	9.865			
10:57:00	9.0	21.175	10.610			
10:58:00	10.0	21.840	11.275			
11:00:00	12.0	23.040	12.475	8.3	0.63	Reduce pumping rate.
11:02:00	14.0	23.865	13.300	6.7	0.50	
11:04:00	16.0	24.500	13.935			
11:06:00	18.0	25.050	14.485			
11:08:00	20.0	25.520	14.955			
11:13:00	25.0	26.565	16.000			
11:18:00	30.0	27.350	16.785			
11:23:00	35.0	27.970	17.405			
11:28:00	40.0	28.475	17.910			
11:33:00	45.0	29.010	18.445			
11:38:00	50.0	29.355	18.790			
11:48:00	60.0	29.865	19.300			
11:58:00	70.0	30.735	20.170			
12:08:00	80.0	31.735	21.170			
12:18:00	90.0	32.140	21.575			
12:28:00	100.0	32.780	22.215			
12:48:00	120.0	33.820	23.255	6.7	0.50	

PUMPING TEST - DRAWDOWN DATA

Project: **Mr. & Mrs. Joseph Robinsmith**

Well: Domestic Source for One Residence

Static Water Level: 10.565 m (34.66 ft)

DATE (m/d/yr) & TIME (hr:min:sec)	ELAPSED TIME t(min)	DISTANCE TO WATER (m)	DRAWDOWN (m)	PUMPING RATE (igpm)	PUMPING RATE (*l*ps)	REMARKS
01/24/01						
13:18:00	150.0	35.175	24.610			
13:48:00	180.0	37.035	26.470			
14:48:00	240.0	40.475	29.910	6.7	0.50	Reduce pumping rate.
14:53:00	245.0	39.405	28.840	4.2	0.32	
14:58:00	250.0	38.355	27.790			
15:03:00	255.0	37.100	26.535			
15:08:00	260.0	35.755	25.190	4.2	0.32	Increase pumping rate.
15:13:00	265.0	35.010	24.445	5.4	0.41	
15:18:00	270.0	34.450	23.885			
15:23:00	275.0	33.800	23.235			
15:28:00	280.0	33.340	22.775	5.4	0.41	Increase pumping rate.
15:33:00	285.0	33.555	22.990	6.3	0.47	
15:38:00	290.0	33.700	23.135			
15:43:00	295.0	33.840	23.275			
15:48:00	300.0	33.865	23.300	6.3	0.47	Reduce pumping rate to final.
15:53:00	305.0	32.870	22.305	5.4	0.41	
15:58:00	310.0	31.905	21.340			
16:03:00	315.0	31.215	20.650			
16:08:00	320.0	30.620	20.055			
23:08:00	740.0	28.060	17.495			
01/25/01						
06:14:00	1166.0	28.010	17.445	5.4	0.41	
09:48:00	1380.0	28.025	17.460			
10:48:00	1440.0	28.100	17.535	5.4	0.41	Stop pump.

PUMPING TEST - RECOVERY DATA

Project: **Mr. & Mrs. Joseph Robinsmith**

Well: Domestic Source for One Residence
Location: 26440 Cunningham Avenue, WHONOCK, B.C.
Static Water Level: 10.565 m (34.66 ft)
Final Drawdown: 17.535 m (57.51 ft)
Datum: Top of well casing stickup, at 0.855 m (2.8 ft) above ground

DATE (m/d/yr) & TIME (hr:min:sec)	ELAPSED TIME SINCE PUMPING STARTED t(min)	ELAPSED TIME SINCE PUMPING STOPPED t'(min)	RATIO (t/t')	DISTANCE TO WATER (m)	RESIDUAL DRAWDOWN (m)	REMARKS
01/25/01						
10:48:00	1440.0	0.0		28.100	17.535	Stop pump.
10:49:00	1441.0	1.0	1441.0	26.635	16.070	
10:49:30	1441.5	1.5	961.0	26.050	15.485	
10:50:00	1442.0	2.0	721.0	25.555	14.990	
10:50:30	1442.5	2.5	577.0	25.040	14.475	
10:51:00	1443.0	3.0	481.0	24.560	13.995	
10:51:30	1443.5	3.5	412.4	24.150	13.585	
10:52:00	1444.0	4.0	361.0	23.725	13.160	
10:52:30	1444.5	4.5	321.0	23.310	12.745	
10:53:00	1445.0	5.0	289.0	22.920	12.355	
10:54:00	1446.0	6.0	241.0	22.215	11.650	
10:55:00	1447.0	7.0	206.7	21.545	10.980	
10:56:00	1448.0	8.0	181.0	20.990	10.425	
10:57:00	1449.0	9.0	161.0	20.460	9.895	
10:58:00	1450.0	10.0	145.0	19.985	9.420	
11:00:00	1452.0	12.0	121.0	19.170	8.605	
11:02:00	1454.0	14.0	103.9	18.515	7.950	
11:04:00	1456.0	16.0	91.0	17.960	7.395	
11:06:00	1458.0	18.0	81.0	17.475	6.910	
11:08:00	1460.0	20.0	73.0	17.050	6.485	
11:13:00	1465.0	25.0	58.6	16.220	5.655	
11:18:00	1470.0	30.0	49.0	15.650	5.085	
11:23:00	1475.0	35.0	42.1	15.115	4.550	
11:28:00	1480.0	40.0	37.0	14.730	4.165	
11:33:00	1485.0	45.0	33.0	14.455	3.890	
11:38:00	1490.0	50.0	29.8	14.195	3.630	
11:48:00	1500.0	60.0	25.0	13.780	3.215	
11:58:00	1510.0	70.0	21.6	13.430	2.865	
12:08:00	1520.0	80.0	19.0	13.190	2.625	
12:18:00	1530.0	90.0	17.0	12.980	2.415	
12:28:00	1540.0	100.0	15.4	12.830	2.265	

PUMPING TEST - RECOVERY DATA

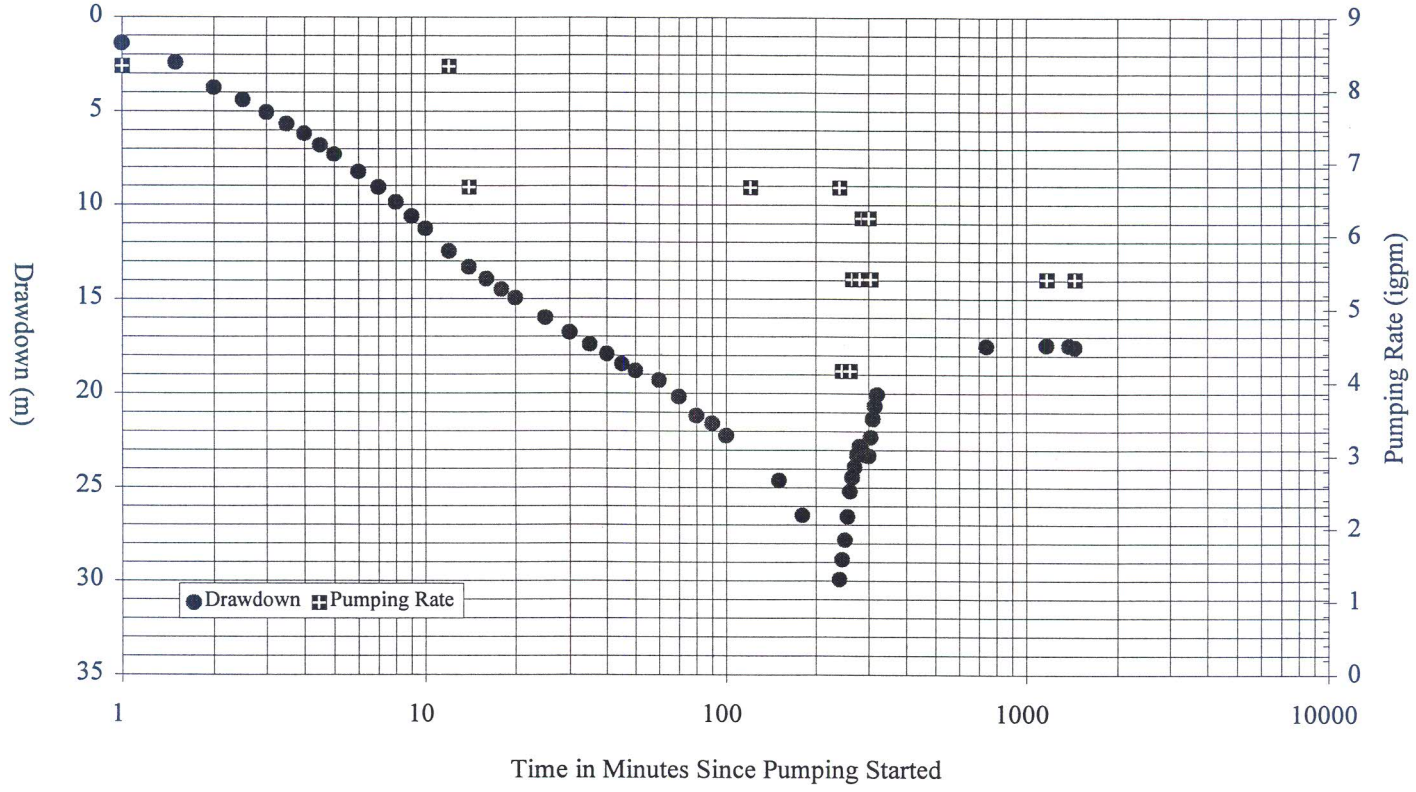
Project: **Mr. & Mrs. Joseph Robinsmith**

Well: Domestic Source for One Residence

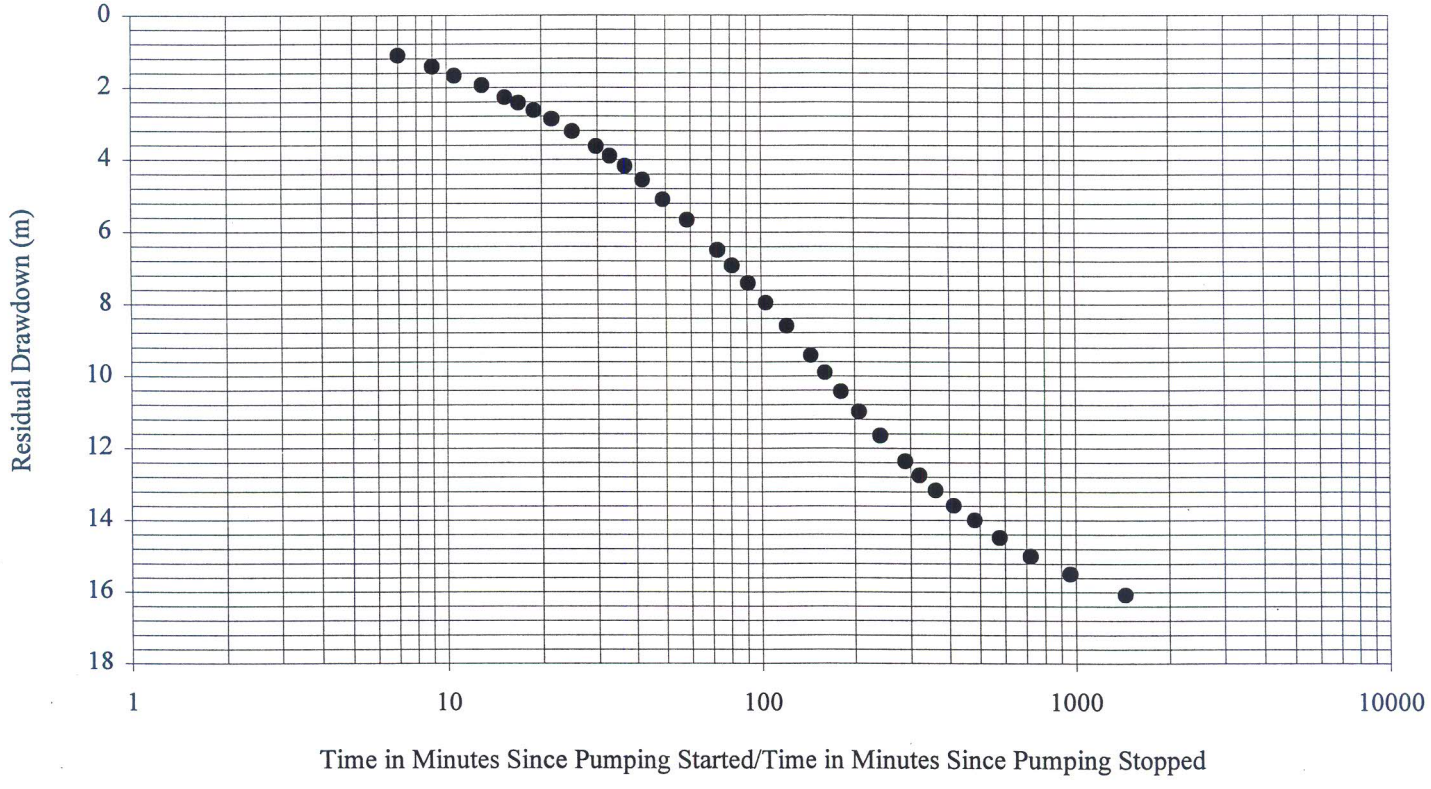
Static Water Level: 10.565 m (34.66 ft)

DATE (m/d/yr) & TIME (hr:min:sec)	ELAPSED TIME SINCE PUMPING STARTED t(min)	ELAPSED TIME SINCE PUMPING STOPPED t'(min)	RATIO (t/t')	DISTANCE TO WATER (m)	RESIDUAL DRAWDOWN (m)	REMARKS
01/25/01						
12:48:00	1560.0	120.0	13.0	12.495	1.930	
13:18:00	1590.0	150.0	10.6	12.230	1.665	
13:48:00	1620.0	180.0	9.0	11.985	1.420	
14:48:00	1680.0	240.0	7.0	11.670	1.105	

Time-Drawdown Plot for January 24-25, 2001 Pumping Test of Robinsmith Well at 26440 Cunningham Avenue, Maple Ridge



Time-Recovery Plot for January 24-25, 2001 Pumping Test of Robinsmith Well at 26440 Cunningham Avenue, Maple Ridge



RESULTS OF ANALYSIS - Water

File No. M6311

Sample ID			Sample 1
Physical Tests			
Colour	(CU)		<5
Conductivity	(umhos/cm)		126
Total Dissolved Solids			59
Hardness	CaCO3		11.4
pH			8.34
Turbidity	(NTU)		1.7
Dissolved Anions			
Alkalinity-Total		CaCO3	54
Chloride	Cl		0.8
Fluoride	F		0.43
Sulphate	SO4		4
Nutrients			
Nitrate Nitrogen		N	<0.1
Nitrite Nitrogen		N	<0.1
Bacteriological Tests[1]			
Coliform Bacteria - Fecal			<1
Coliform Bacteria - Total			<1
Total Metals			
Aluminum	T-Al		0.031
Arsenic	T-As		0.0009
Barium	T-Ba		0.001
Boron	T-B		0.22
Cadmium	T-Cd		<0.0002
Calcium	T-Ca		3.89
Chromium	T-Cr		<0.001
Copper	T-Cu		<0.001
Iron	T-Fe		<0.03
Lead	T-Pb		<0.001
Magnesium	T-Mg		0.42
Manganese	T-Mn		0.019
Mercury	T-Hg		<0.00005
Potassium	T-K		0.12
Selenium	T-Se		<0.001
Sodium	T-Na		22.3
Uranium	T-U		<0.00001
Zinc	T-Zn		<0.005

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except for pH, Colour (CU), Conductivity (umhos/cm), and Turbidity (NTU).
< = Less than the detection limit indicated.
[1]Coliform results are expressed as Colony Forming Units (CFU) per 100 mL.

Appendix 1 - REGULATORY CRITERIA

File No. M6311

Health Canada

Guidelines for Canadian Drinking Water Quality, Sixth Ed., 1996.
All limits are Maximum Acceptable Concentration (MAC) unless otherwise indicated.
Limits expressed as milligrams per litre except pH, Turbidity, Colour, and Coliform Bacteria.

			Lower Limit	Upper Limit		Notes
Physical Tests						
Colour	(CU)		-	15	CU	1
Total Dissolved Solids			-	500	mg/L	1
Hardness	CaCO3		-	-		2
pH			6.5	8.5		1
Turbidity	(NTU)		-	5	NTU	1, 4
Dissolved Anions						
Chloride	Cl		-	250	mg/L	1
Fluoride	F		-	1.5	mg/L	
Sulphate	SO4		-	500	mg/L	1, 5
Nutrients						
Nitrate Nitrogen		N	-	10.0	mg/L	
Nitrite Nitrogen		N	-	1.0	mg/L	
Bacteriological Tests						
Coliform Bacteria - Fecal			-	0		
Coliform Bacteria - Total			-	-		6
Total Metals						
Arsenic	T-As		-	0.025	mg/L	7
Barium	T-Ba		-	1.0	mg/L	
Boron	T-B		-	5.0	mg/L	7
Cadmium	T-Cd		-	0.005	mg/L	
Chromium	T-Cr		-	0.05	mg/L	
Copper	T-Cu		-	1.0	mg/L	1, 3
Iron	T-Fe		-	0.3	mg/L	1
Lead	T-Pb		-	0.01	mg/L	3, 8
Manganese	T-Mn		-	0.05	mg/L	1
Mercury	T-Hg		-	0.001	mg/L	
Selenium	T-Se		-	0.01	mg/L	
Sodium	T-Na		-	200	mg/L	1
Uranium	T-U		-	0.10	mg/L	
Zinc	T-Zn		-	5.0	mg/L	1, 3

1 Aesthetic Objective (AO) (taste, odour, appearance, etc.)
2 Maximum not established, levels > 200 mg/L are considered poor but may be tolerated (AO).
3 At point of consumption.
4 1 NTU maximum allowed for water entering distribution systems.
5 There may be a laxative effect in some individuals when sulphate levels exceed 500 mg/L.
6 No sample should contain more than 10 organisms per 100mL and no consecutive samples should be positive (MAC).
7 Interim Maximum Acceptable Concentration (IMAC)
8 First drawn water may be high, flush system before sampling(MAC)

SCHEDULE "B"

BY-LAW NO. 5452-1996

Certificate of Water Quantity and Potability

1. Quantity

(a) I, EDMUND LIVINGSTON, a Professional Engineer registered with the Association of Professional Engineers and Geoscientists of British Columbia, hereby certify:

(i) that I have caused tests to be performed on the well(s) located on the premises located at

26440 Cunningham Avenue, Maple Ridge

(address)

and described as:

Lot 14, Sec. 7,

(legal description)

Twp. 15, N.W.D., Plan 54091

(ii) that, based on the said tests and my knowledge of the said premises, I am of the opinion that the said well(s) will be capable of yielding at least 2,250 litres of water per day on a year round basis.

(b) The following are attached hereto:

(i) a site plan showing the location of the wells(s);
(ii) well drilling log(s);
(iii) well pumping test record;
(iv) draw down and recovery data;
(v) data regarding water purification system (if applicable)

Dated the first day of February, 2001

E. Livingston

Professional Engineer

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA E. LIVINGSTON

2. Potability

I, _____, am authorized to provide water potability analysis by the Ministry of Health and declare that based on the chemical analysis of a sample of water taken from the above described well(s), I hereby certify that the water from the said well(s) is potable and meets acceptable Provincial drinking water standards.

Dated the first day of February, 2001 Authorizing Officer E. Livingston