CERTIFICATION OF WATER QUANTITY AND QUALITY FOR LOT 1 OF A PROPOSED RURAL SUBDIVISION NORTHWEST OF THE INTERSECTION OF DEWDNEY TRUNK ROAD AND BELL STREET IN THE DISTRICT OF MISSION

(District of Mission Subdivision Application S90-70 and File PRF-15-40)

Prepared for

MR. R. CHADWICK
30471 Dewdney Trunk Road
MISSION, B. C. V2V 6H5

Prepared by

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MAY 7, 1991

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May 7, 1991

Mr. R. Chadwick
30471 Dewdney Trunk Road
MISSION, B. C. V2V 6H5

Subject: **Certification of Water Quantity and Quality for Lot 1 of a Proposed Rural Subdivision Northwest of the Intersection of Dewdney Trunk Road and Bell Street in the District of Mission**
District of Mission Subdivision Application S90-70 and File PRF-15-40

Dear Sir:

This letter is further to discussions between Mr. R. Chadwick, Property Owner, and Mr. Ed Livingston, P. Eng., of Pacific Hydrology Consultants Ltd., onsite at 30471 Dewdney Trunk Road on December 10, 1990, at the start of the test of a new dug well on Lot 1 to be created from subdividing a 2.016 hectare parcel into two. This letter is also further to several telephone discussions during and following the test.

1.0 INTRODUCTION

The purpose of this letter is to present information to confirm that the quantity of groundwater from the dug well on Lot 1 of the proposed rural subdivision of Lot 3, $SE\frac{1}{4}$, Sec. 23, Tp. 15, Plan 7683, Except Part on Plan 42340, New Westminster District, will, as required under District of Mission Bylaw No. 2203-1990, "...provide a quantity of water not less than 2500 litres per day per parcel and provide a

.../2

sustained yield of 9 litres per minute for a minimum of four hours". This letter also presents a laboratory certificate showing the quality of groundwater yielded by the well and provides the required hydrogeologic impact assessment with respect to:

(i) Impact of each proposed well on neighbour wells both within and adjacent to the proposed subdivision, and

(ii) Long term impact of the proposed well on the source aquifer.

The regional topographic setting of the proposed Chadwick Subdivision is shown on Figure 1 in Appendix A; Figure 2 shows the relative positions of wells and wastewater disposal fields on the two lots of the proposed Subdivision.

We understand that the dug well on Lot 1 of the proposed Chadwick Subdivision was constructed by Louie's Excavating in the summer of 1990, by digging with an excavator in compact stony silt to a depth of 6 m (20 ft), at which depth the hole reached water-bearing silty sand. A 6.5 m (21 ft) length of 0.9 m (3 ft) diameter PVC corrugated plastic casing was then placed in the hole on a bed of sand and drain rock, following which the hole was backfilled with drain rock almost to ground surface. The well has a tight-fitting PVC cover. The well is located about 9 m (30 ft) from a small perennial creek that flows southwestward through the subject property to Hayward Lake. The well is located on a terrace at an elevation of 2 to 3 m ($6\frac{1}{2}$ to 10 ft) above the creek bed; the static water level in the well is more than one metre above the creek, showing that the well is intercepting groundwater moving toward the creek and is not drawing water directly from the creek.

.../3

2.0 HYDROGEOLOGY

The proposed Chadwick Subdivision is located in an area of thick overburden at the base of the southeast-facing slope of Blue Mountain. According to Geological Survey of Canada Map 1485A, **Surficial Geology Mission British Columbia,** the subject Property is underlain by the Fort Langley Formation which is described in that area as "glaciomarine stony silt to loamy clay, 8 to 100 m thick". This is sediment deposited from glacial meltwater under marine conditions at the end of the last glacial episode in the Fraser Valley Area, when sea level was about 200 m (650 ft) higher than present sea level.

At the site of the existing drilled well, which supplies the Chadwick Residence on Lot 2 of the proposed subdivision, the surficial sediments underlying the site are at least 67.1 m (220 ft) thick. The driller's log of the 150 mm (6") diameter well is as follows:

0 - 3.0 m (0 - 10 ft)	brown sand clay
3.0 - 6.1 m (10 - 20 ft)	grey clay
6.1 - 24.4 m (20 - 80 ft)	silty sand
24.4 - 33.8 m (80 - 111 ft)	gravel and boulders
33.8 - 50.3 m (111 - 165 ft)	volcanic rock
50.3 - 57.9 m (165 - 190 ft)	till, dense
57.9 - 61.0 m (190 - 200 ft)	sand and gravel
61.0 - 65.5 m (200 - 215 ft)	silty sand and gravel
65.5 - 67.1 m (215 - 220 ft)	silty sand.

The driller's record states that the hole was backfilled to 60.4 m (198 ft) and that a 3.35 m (11 ft) long screen assembly consisting of 0.254 mm (0.010") slot Johnson stainless steel screen was installed between 57.0 and 60.4 m (187 and 198 ft). The estimated yield of the well by the driller was 18.9 L/min (5 USgpm). The static water level at the time of well construction in 1980 was reported to be 53.4 m (175 ft) below ground.

.../4

The Water Well Location Map for the subject area shows that the nearest drilled well outside the subject property is located about 1220 m (4000 ft) to the west along Dewdney Trunk Road. This well was drilled for Stave Gardens Community Association by A & H Construction in 1974. The driller's log for the well is as follows:

0 - 18.3 m (0 - 60 ft)	hardpan
18.3 - 29.6 m (60 - 97 ft)	till with boulders.

Apparently the hole was never completed as a well because of broken drill pipe at 29.6 m (97 ft), but the record states "very little water".

The two well records detailed above show that the overburden in the area of the Chadwick Property is quite thick - over 30 m (100 ft). The log of the Chadwick Well is quite remarkable in that it shows that the well was drilled through volcanic rock from 33.8 to 50.3 m (111 to 165 ft) below which drilling encountered glacial overburden to the total depth of the well of 67.1 m (220 ft). We are not aware of any volcanic flows in the Lower Fraser Valley area that are as recent as the glacial deposits. All things considered, the most likely explanation is that the rock between 33.8 to 50.3 m is a very large landslide block which was later covered with glacial debris. In any case, the log of the Chadwick Well on Lot 2 indicates that, at the subject Property, there is a deep aquifer which can supply water to domestic wells.

The proposed Chadwick Subdivision, at its location near the foot of the southeast-facing slope of Blue Mountain, is situated within the discharge zone of a groundwater flow system which is recharged further up the Mountain to the northwest. In this situation, water recharges the flow system mostly in the winter months, moving slowly through fractures in bedrock and also through the overburden to eventually discharge into Hayward Lake. The paths of flow tend to be quite complex because of variations in the permeability of

.../5

PUMP TEST – DRAWDOWN DATA

10-12	DECEMBER	1990
DAY	MONTH	YEAR

CONTRACTOR -

PROJECT CHADWICK

Location Northwest of the intersection of Dewdney Trunk Road and Bell Street

Well Dug Well on Proposed Lot 1 Pumping Rate (Q) See below

Datum Point Top of well casing Elevation of Datum Point -

Static Water Level 2.16 ft (0.66 m) Screen Location 0.9 m (3 ft) diameter dug well to 6.1 m (20 ft)

TIME HR.	TIME MIN.	ELAPSED TIME t (MIN.)	DISTANCE TO WATER	DRAWDOWN (ft)		SECONDS TO FILL 22 LITRES	PUMPING RATE (L/min)	REMARKS
10	05		2.16					Start pump.
10	06	1				165	8.0	Increase rate.
10	10	5	2.33	0.17				
10	13	8	2.50	0.34		95	13.9	
10	46	41	4.00	1.84		70	18.9	
12	40	155	7.00	4.84		100	13.2	
15	30	325	9.33	7.17		120	11.0	
16	40	395	10.33	8.17		120	11.0	
18	40	515	11.25	9.09		135	9.8	
22	40	735	13.42	11.26		150	8.8	
11/09	00	1375	19.33	17.17		600	2.2	Reduce rate.
12	30	1585	19.16	17.00		600	2.2	
15	30	1765	19.00	16.84		600	2.2	
19	30	2005	19.00	16.84		600	2.2	
12/09	00	2815	18.16	16.00		600	2.2	Stop pump.

PUMP TEST – RECOVERY DATA

12-16	DECEMBER	1990
DAY	MONTH	YEAR

PROJECT CHADWICK

Well Dug Well on Proposed Lot 1

Datum Point Top of well casing Elevation of Datum Point -

Static Water Level 2.16 ft (0.66 m) Final Drawdown 16.00 ft (4.88 m)

TIME		ELAPSED TIME SINCE PUMPING STARTED	ELAPSED TIME SINCE PUMPING STOPPED	RATIO (t/t')	DISTANCE TO WATER	RESIDUAL DRAWDOWN (ft)		REMARKS
HR.	MIN.	t (min.)	t' (min.)					
12/09	00	2815			18.16	16.00		Stop pump.
12	00	2995	180	16.6	17.25	15.09		
16	30	3265	450	7.25	15.75	13.59		
20	00	3475	660	5.27	14.92	12.76		
13/10	30	4345	1530	2.84	12.25	10.09		
15	00	4615	1800	2.56	11.75	9.59		
14/07	00	5575	2760	2.02	9.25	7.09		
12	00	5875	3060	1.92	9.00	6.84		
18	00	6235	3420	1.82	8.33	6.17		
15/09	00	7135	4320	1.65	5.33	3.17		
18	00	7675	4860	1.58	3.50	1.33		
16/09	00	8575	5760	1.49	2.67	0.50		

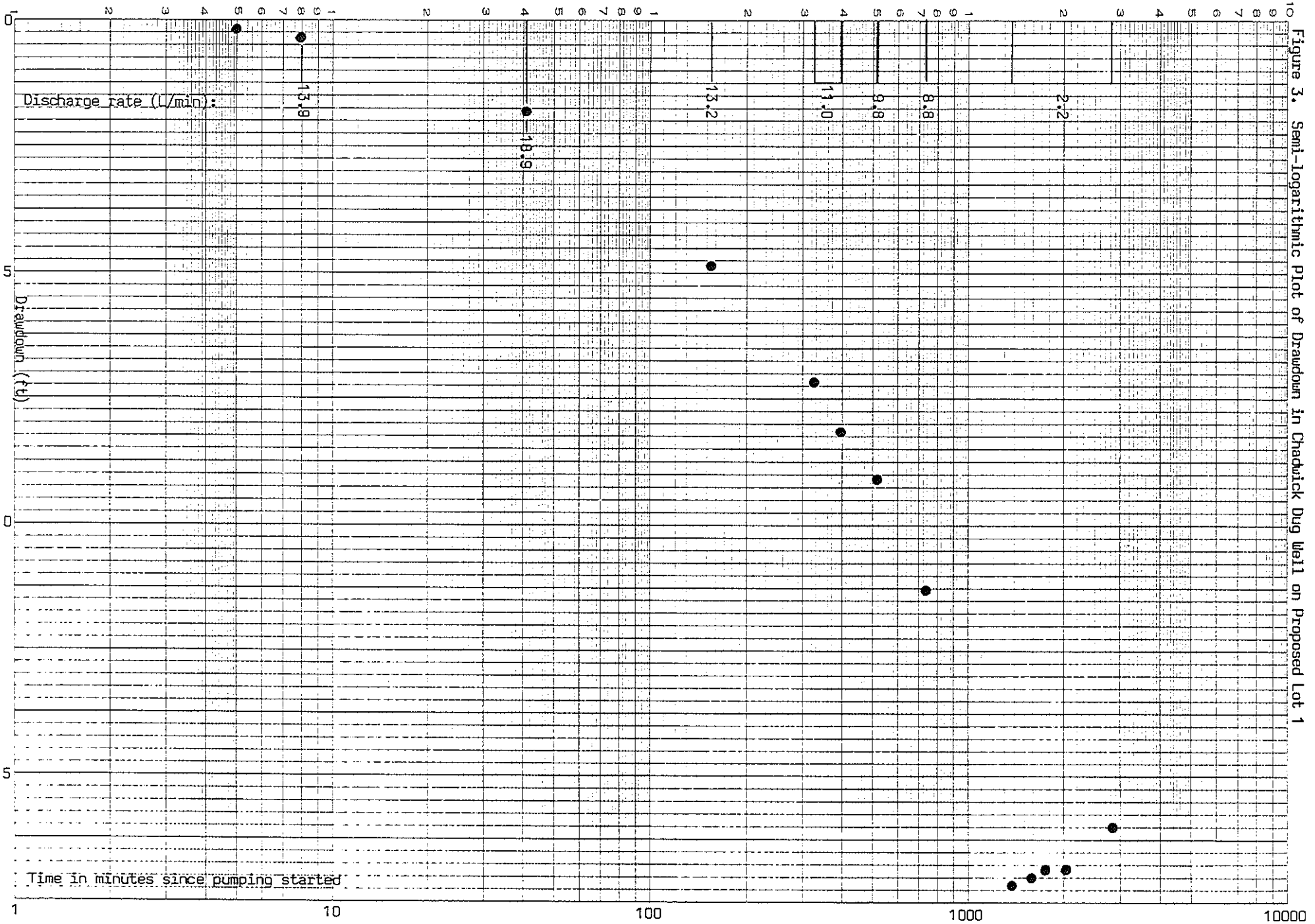
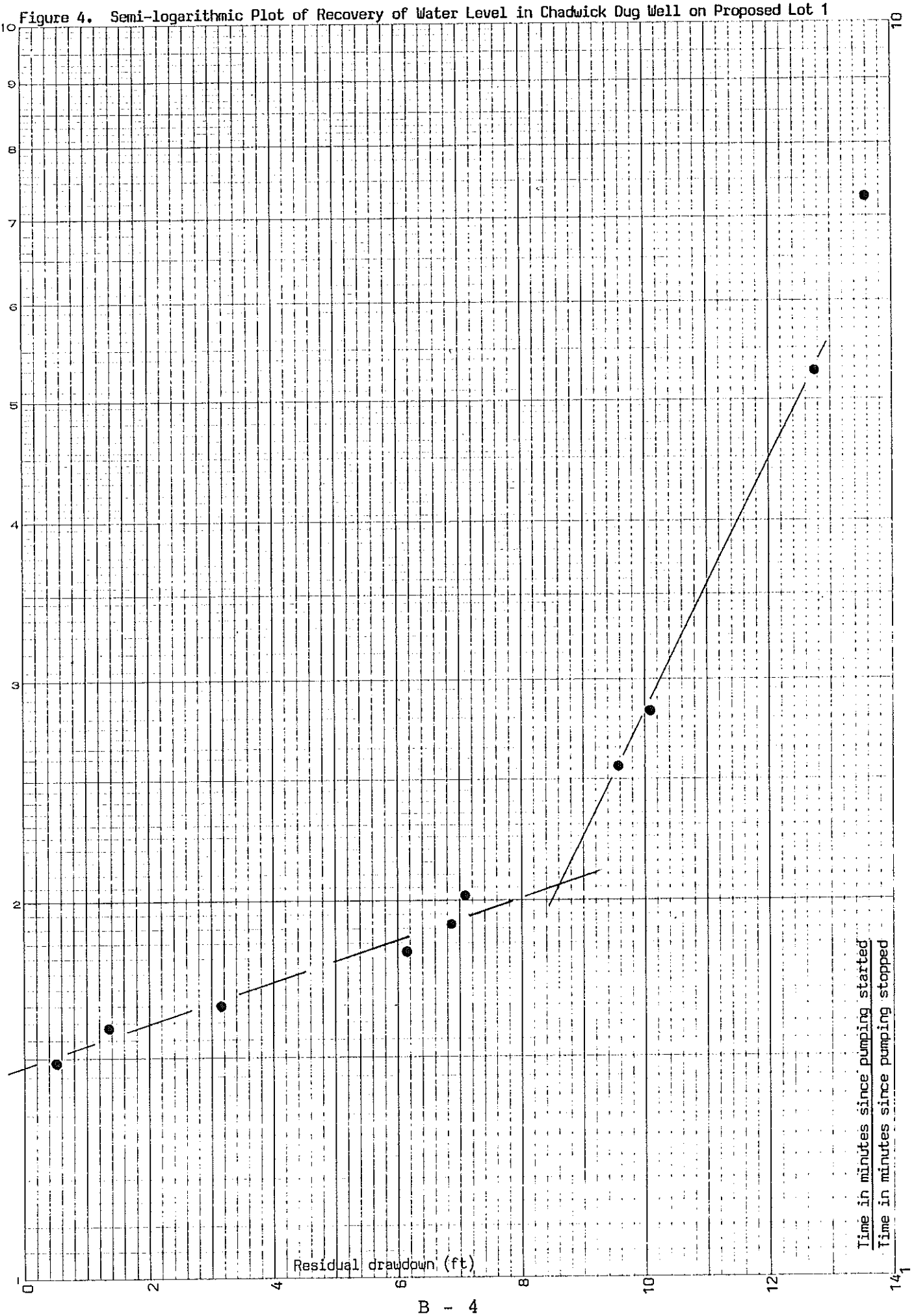


Figure 3. Semi-Logarithmic Plot of Drawdown in Chadwick Dug Well on Proposed Lot 1

Figure 4. Semi-logarithmic Plot of Recovery of Water Level in Chadwick Dug Well on Proposed Lot 1



the sediments within the path of flow and also because of the irregular topography. However, the essential feature of the discharge zone is that the water table tends to be fairly shallow with rather small fluctuations, as opposed to the recharge zone where the water table is at greater depth and is subject to large seasonal fluctuations.

As shown by the deep static water level in the well on Lot 2 of the proposed Chadwick Subdivision, there is more than one scale of groundwater flow system active on the subject property.

3.0 WELL CAPACITY

To determine the capacity of the Chadwick Well, a pumping test was carried out by the owner under the direction and supervision of Pacific Hydrology, using standard methods and procedures. A small electric sump pump, equipped with a control valve, pumped water through a garden hose to the small creek. Water levels were measured by a graduated steel tape and the rate of pumping was measured by timing the filling of a container of known volume - a bucket with a volume of 22 litres (4.84 igal).

Pumping started at the maximum capacity of the pump, about 18.9 L/min (4.2 igpm). The pumping rate decreased gradually as the water level was drawn down increasing the head on the pump. The water level almost reached the bottom of the well at about 1000 minutes, after which the flow was restricted by a valve to achieve a stable pumping level. The well was pumped for about 24 hours at the reduced rate of 2.2 L/min (0.48 igpm); during this time the water level in the well recovered by about 0.3 m (1 ft). The pump was shut off at 2815 min (1.95 days) after the start of the test and the water level was measured occasionally during the period of recovery which lasted 5760 min (4.0 days).

.../6

The data collected during the pumping test of the well on Lot 1 of the proposed Chadwick Subdivision are included in Appendix B, along with standard straight line plots of the data on semi-logarithmic graph paper. The plot of the drawdown (Figure 3, Page B - 3) shows that approximate stability of the water level occurred at the final pumping rate of 2.2 L/min (0.48 igpm). The recovery of the water level following the termination of the pumping was slow, but complete recovery is indicated, as shown on Figure 4 (Page B - 4). We, therefore, rate the well at 2 L/min (2880 L/day) for continuous pumping.

The capacity of the subject well is very close to the 2500 L/day required by District of Mission Bylaw 2203-1990. However, in spite of the fact that the test did not take place at the ideal time of year, there are indications that the well capacity satisfies the minimum requirements:

1. The water level in the well rose during the last 1440 minutes (one day) of pumping at a rate of 2.2 L/min.

2. The recovery is slow but the plot shows that complete recovery to the pre-pumping static level will occur.

3. The recovery data show that the rate at which water entered the well during the first 1.86 m (6.09 ft) of recovery - which took 1530 minutes - was more than the required minimum, as shown by the following calculation:

   To allow for drain rock outside of the casing assume that the well diameter = 1.52 m (5 ft).

   Volume recovery per minute = $(0.76)^2(1.86\ m)\ \frac{1000\ L/m^3}{1530\ min} = 2.21\ L/min = 3182\ L/day.$

4. The well is located in a groundwater discharge area near a perennial stream.

.../7

We suggest also that the fact that the Chadwick Property is underlain by a productive aquifer containing good quality water, as shown by the drilled well on Lot 2 of the proposed Subdivision, should be taken into consideration. A resident on Lot 1 who wishes to use more than the capacity of the dug well can be sure of obtaining adequate water from a deep drilled well.

All things considered, we have no hesitation in certifying the dug well on Lot 1 of the proposed Chadwick Subdivision as being capable of yielding 9 L/min for four hours and 2500 litres per day, as specified under District of Mission Bylaw 2203-1990.

4.0 GROUNDWATER QUALITY

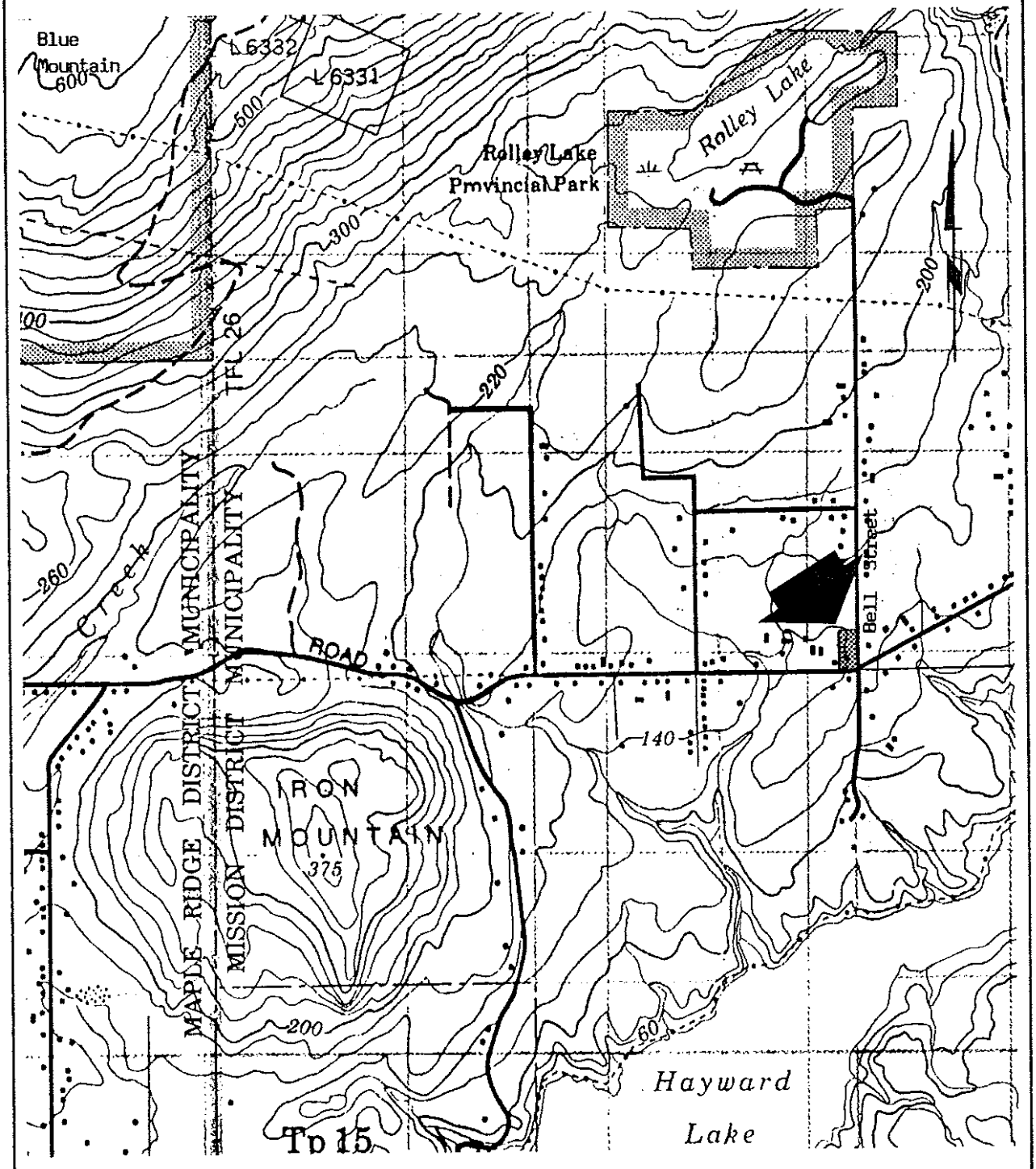
Appendix C contains a certificate of analysis from Norwest Labs, for chemical and bacteriological analyses carried out on water samples collected from the Chadwick Well near the end of the pumping test. The samples meet B.C. Ministry of Health's **British Columbia Drinking Water Quality Standards 1978** for all parameters checked except for coliform bacteria. Under the prevailing conditions, where the sand aquifer is overlain by about 6 m (20 ft) of compact stony silt, the bacteria in the sample does not indicate pollution of the source but, rather, either contamination during sampling because of handling or because of the sampling equipment. Obviously resampling is required after proper disinfection procedures have been carried out in order to confirm that the water can meet B.C. Ministry of Health's bacteriological requirements for potable water.

.../8

APPENDIX A

AREA LOCATION MAP AND SUBDIVISION PLAN

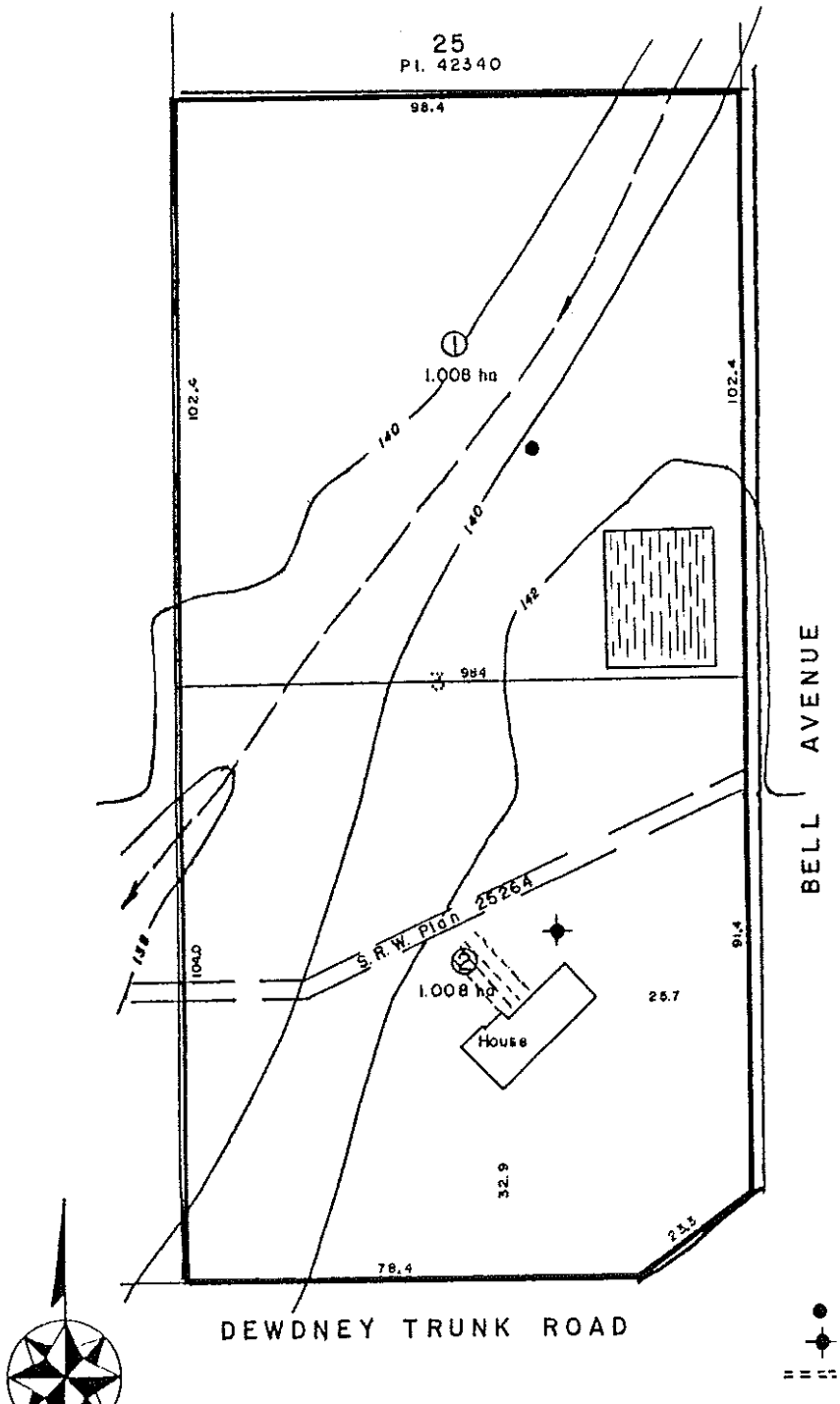
FIGURE 1	AREA LOCATION MAP - CHADWICK SUBDIVISION AT 30471 DEWDNEY TRUNK ROAD, MISSION



Notes:

1. The base map is 1:50,000 scale topographic map N.T.S. 92G/1, **Mission**, enlarged to a scale of approximately 1:30,000; contour interval is 20 metres.
2. ◆▒ indicates the location of the proposed Chadwick Subdivision.

PLAN SHOWING LOCATION OF PROPOSED SUBDIVISION OF LOT 3 S.E. 1/4 SEC. 23 TP. 15 PLAN 7683 EXCEPT PART ON PLAN 42340 N.W.D.



(Note that facilities locations are not surveyed and locations should be considered relative only.)

ISSUED TO Mr. R. Chadwick	NOT TO BE USED TO ESTABLISH PROPERTY LINES. ISSUED FOR APPLICATION PURPOSES ONLY. WE CANNOT ASSUME RESPONSIBILITY FOR UNAUTHORIZED USE. DIMENSIONS ACCORDING TO LAND TITLE OFFICE RECORDS
YOUR FILE: / CLIENT:	
SCALE: 1:1250 metric / FIGURE 2	CIVIC ADDRESS: 30471 Dewdney Trunk Road, Mission, B.C.
OUR FILE: 8704284-1	

D. GEORGE FENNING B.C. LAND SURVEYOR
19264 DAVISON ROAD, PITT MEADOWS, B.C. V0M 1P0 465-5511

APPENDIX B

PUMPING TEST DATA AND PLOTS

APPENDIX C

GROUNDWATER QUALITY

TELEPHONE (604) 530-4344
FACSIMILE (604) 534-9996

NORWEST LABS

"Keeping B.C. Growing"

WATER ANALYSIS REPORT

W.O. NUMBER : 1627
LAB. NUMBER : 910256

SAMPLE RECEIVED : 01-22-1991
ANALYSIS COMPLETED : 01-25-1991
SAMPLE RETAINED FOR 30 DAYS

SAMPLE SUBMITTED BY :

ROB CHADWICK
30471 DEWDNEY TRUNK ROAD
MISSION, B.C. V2V 6H5

SAMPLE IDENTIFICATION : WELL WATER - 30471 DEWDNEY TRUNK

ANALYTICAL RESULTS			GUIDELINES FOR DRINKING WATER
pH	6.61		pH values between 6.5 & 8.5 considered acceptable
Electrical Conductivity	0.08	ms/cm	Values above 1.0 ms/cm indicate increasing salt content
Total Dissolved Solids	103	mg/l	Objective level 500 mg/l; higher values indicate high salts
Total Suspended Solids	0	mg/l	Values above 250 mg/l indicate increasing levels of sediment
Ammonium-N	0.0	mg/l	Acceptable values below 0.5 mg/l; objective level below 0.01 mg/l
Potassium	0.0	mg/l	No acceptable level set; values normally in the 0.5 to 10 mg/l range
Calcium	5.8	mg/l	Below 200 mg/l acceptable; objective level below 75 mg/l
Magnesium	1.7	mg/l	Below 150 mg/l acceptable; objective level below 50 mg/l
Sodium	4.9	mg/l	Below 300 mg/l acceptable; over 20 mg/l high for low sodium diets
Iron	0.00	mg/l	Above 0.3 mg/l may cause staining & deposits; objective limit 0.05 mg/l
Copper	0.03	mg/l	Below 1.0 mg/l acceptable; objective limit below 0.01 mg/l
Zinc	0.00	mg/l	Below 5.0 mg/l acceptable; objective limit below 1.0 mg/l
Manganese	0.00	mg/l	Below 0.05 mg/l acceptable; objective limit below 0.01 mg/l
Phosphate-P	0.0	mg/l	No acceptable limit set; below 0.2 mg/l desirable
Sulphate-S	0.2	mg/l	Below 500 mg/l acceptable; objective limit below 250 mg/l
Nitrate-N	0.7	mg/l	Below 10 mg/l acceptable: high values may indicate contamination
Chloride	6.4	mg/l	Below 250 mg/l acceptable
Fluoride	0.54	mg/l	Values up to 1.2 mg/l desirable; under 1.5 mg/l acceptable
Boron	0.04	mg/l	Below 5.0 mg/l acceptable
Carbonate	0	mg/l	Presence indicates alkaline water
Bicarbonate	27	mg/l	Presence indicates mildly alkaline water
Hardness (CaCO3 equiv)	21	mg/l	Soft waters are less than 75 mg/l; hard waters above 150 mg/l
Total coliforms	30/100ml		Above 2/100 ml unacceptable
Fecal coliforms	2/100ml		Greater than 0/100ml unacceptable

COMMENT: WATER IS UNSAFE TO DRINK

Results quoted as zero indicate concentrations below the following detection limits:
Less than 0.01 mg/l Fe, Cu, Zn, Mn, B
Less than 0.05 mg/l Na, Ca, Mg, K, PO4-P, NH4-N, NO3-N
Less than 0.10 mg/l Cl, Fl, SO4-S; Less than 1 mg/l TDS, TSS, carbonate & bicarbonate