



**KLOHN LEONOFF YUKON**  
CONSULTING ENGINEERS

Our File: PB 3936 05  
WP 554

YUKON TERRITORY  
WATER BOARD

January 31, 1991

MAR 30 11 47 AM '91

REC'D BY: \_\_\_\_\_

APPL. NO: \_\_\_\_\_

Village of Teslin  
Teslin, Yukon  
Y0A 1B0

Ms. Sharon Sterritt  
Chief Administrative Officer

Installation of Monitoring Wells for the  
Wetlands Sewage Treatment System

Dear Madam:

**1. INTRODUCTION**

**1.1 Background**

This letter report presents the results of a seepage monitoring program carried out by Klohn Leonoff Yukon Ltd. at the Teslin Sewage Lagoons. The work described herein was carried out in accordance with our letter proposal dated September 26, 1990.

**1.2 Scope of Work**

The scope of work included installing two monitoring wells down gradient of the lagoons, developing and response testing each well and sampling for water chemistry.

**2. MONITORING WELL INSTALLATION**

**2.1 General**

The monitoring wells were drilled between November 2 and 4, 1990 using a C.M.E. 750 hollow-stem auger drilling rig. Logging of the wells was carried out by visual classification of the cuttings. The well logs are presented in Appendix I. Each well was constructed of 50 mm diameter threaded PVC pipe with a three metre section of slotted

screen surrounded by a sand pack. A bentonite seal was placed above the slotted screen and the well was completed with a steel, lockable cover. Each hole was developed until sediment-free. A location plan showing the position of both monitoring wells is included in Appendix IV.

## **2.2 Monitoring Well No. 1 (DH90-01)**

Monitoring well DH90-01 was drilled to a total depth of 10.5 m. Road gravels were encountered in the first 300 mm, and were underlain by 6.4 m of stiff, dry clay. The clay was underlain in turn by 0.6 m of gravel overlying saturated silty sands. The hole was terminated 3.2 m into the silty sand formation. Water was encountered in the gravels at an elevation of 714.8 m (depth 6.7 m), and subsequently rose to an elevation of 716.3 m (depth 5.2 m).

## **2.3 Monitoring Well No. 2 (DH90-02)**

Monitoring well DH90-02 was drilled to a total depth of 14.7 m. Road gravels were encountered in the first 300 mm, and were underlain by 11 m of clay. The clay was underlain by 2.9 m of saturated sandy silts. Water was encountered at an elevation of 709.7 m (depth 11.3 m), and subsequently rose to an elevation of 711 m (depth 10 m). The hole was terminated at refusal in a hard till-like formation underlying the silts.

# **3. DATA ANALYSIS**

## **3.1 General**

Both wells were allowed to stabilize for a few days following installation. Response tests and groundwater sampling were carried out on November 8, 1990. Resistivity and pH tests were carried out on site and water samples from each well were collected for analysis by ASL Laboratories and Health and Welfare, Canada, Whitehorse. The laboratory results are presented in Appendix II.

### 3.2 Response Tests

Response tests were carried out on each well to estimate the hydraulic conductivity of the soil.

Response (falling head) tests impose a hydraulic stress within a well, allowing observation of well response in re-establishing equilibrium. The response data is mathematically related to the hydraulic conductivity of the soil. The response test data were analyzed using the Horslev method (Freeze and Cherry, 1979). Results of the response tests are presented in Appendix III. The permeability for DH90-01 and DH90-02 was calculated to be  $3.17 \times 10^{-6}$  m/s and  $8.89 \times 10^{-8}$  m/s, respectively.

### 3.3 Water Chemistry

The groundwater underlying the lagoon site can be described as a calcium-carbonate water of neutral pH, with elevated total dissolved solids (TDS), electrical conductance (EC), biological oxygen demand (BOD<sub>5</sub>) and chemical oxygen demand (COD). Other water quality parameters, such as nitrate, are present at background concentrations. This chemistry is indicative of recently recharged groundwater. The source of the recharge, based on the water chemistry, appears to be filtered, secondary treated effluent from the adjacent sewage lagoons.

Several points are noteworthy regarding the comparative water chemistry of monitoring wells DH90-01 and DH90-02. First, the TDS and EC concentrations increase from DH90-01 to DH90-02, although DH90-02 is further downgradient from the lagoons, with EC values of 1440 and 2080  $\mu\text{mhos/cm}$ , respectively. This is not what would normally be expected if the lagoons were the source of the dissolved constituents. However, a review of the available lagoon chemistry data (Klohn Leonoff, 1989) indicates that EC values for the lagoons range from 494 to 630  $\mu\text{mhos/cm}$ . This would indicate that the water-bearing formations are the source of the dissolved constituents, with mineral

dissolution and ion exchange occurring between the recharged lagoon effluent and the formation materials.

The reverse relationship is observed with respect to organic constituents, with COD levels for DH90-01 and DH90-02 of 319 mg/L and 71 mg/L, oil and grease concentrations of 9 mg/L and <1.0 mg/L, and BOD<sub>5</sub> concentrations of 24.8 mg/L and 6.6 mg/L, respectively. These data indicate a significant source of organic loading in the vicinity of DH90-01, namely the lagoons, as well as a significant level of effluent renovation between the two monitoring wells. Finally, no coliform populations were detected in water samples from either monitoring well, indicating the substantial filtration capacity of the soil formations underlying the lagoons.

The one exception to the above is the increase in ammonia nitrogen from 0.087 mg/L to 1.24 mg/L from DH90-01 to DH90-02. This phenomenon may be attributable to decay of organics in the soil formations, which would provide a natural source of ammonia to groundwater.

4.

#### CONCLUSIONS

The following conclusions are made with regard to seepage from the sewage lagoons:

- 1) Seepage losses are occurring from the sewage lagoons, based on both site water balance calculations (Klohn Leonoff, 1989) and the results of the monitoring well installations.
- 2) The primary direction of flow appears to be towards the southwest, and Teslin Lake.
- 3) Significant levels of effluent renovation are occurring within the subsurface between the lagoons and the monitoring wells.

January 31, 1991

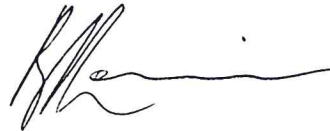
- 4) Seepage from the lagoons does not appear to represent an environmental concern.

Yours very truly,

KLOHN LEONOFF YUKON LTD.



Cormac Nolan, B.A.I.



R.J. Lorimer, P.Eng.  
Project Manager

CN/bfb  
Encl.

PB 3936 05  
WP 554

- 6 -

January 31, 1991

References

Klohn Leonoff, 1989. Teslin Wetlands Sewage Treatment Feasibility Study.  
Unpublished.

APPENDIX I  
MONITORING WELL LOGS

# TEST HOLE LOG

VERTICAL SCALE : 1:100				DATE DRILLED : NOVEMBER 2nd 1990				UNCONFINED COMPRESSION $\sigma_{p2}$																																																																																																																																							
<b>SAMPLE DATA</b>				DRILL TYPE : C.M.E. 750		PIEZOMETER DETAILS		100    200    300    400 ● FIELD VANE    ▲ LAB VANE    ■ 3 DE'																																																																																																																																							
HAMMER MASS : 63.5 kg				ELEV. GROUND (m) : 721.5    APPROX.				PLASTIC    WATER    LIQUID LIMIT    CONTENT    LIMIT X    O    X																																																																																																																																							
DROP HEIGHT : .762 m				CO-ORDINATES (m) :				10    20    30    40%																																																																																																																																							
DEPTH (m)   SAMPLE TYPE   BLOWS 0.15 m   SAMPLE NO.																																																																																																																																															
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KLOHN LEONOFF YUKON

CONSULTING ENGINEERS

**JOB No. :** PB 3936-0501

**PROJECT :** LAGOON MONITORING WELLS

**LOCATION :** TESLIN, YUKON

**HOLE No. :** DH90-01

**DATE :** NOV. 1990

**PLATE :**



# TEST HOLE LOG

VERTICAL SCALE : 1:100				DATE DRILLED : NOVEMBER 3rd. & 4th 1990		UNCONFINED COMPRESSION kPa																			
<b>SAMPLE DATA</b>				DRILL TYPE : C.M.E. 750						<table border="1" style="width: 100%; text-align: center;"> <tr> <td>100</td><td>200</td><td>300</td><td>400</td> </tr> <tr> <td>● FIELD VANE</td><td>△ LAB VANE</td><td>■ PEN</td><td></td> </tr> <tr> <td>PLASTIC LIMIT X</td><td>WATER CONTENT ○</td><td>LIQUID LIMIT X</td><td></td> </tr> <tr> <td>10</td><td>20</td><td>30</td><td>40%</td> </tr> </table>				100	200	300	400	● FIELD VANE	△ LAB VANE	■ PEN		PLASTIC LIMIT X	WATER CONTENT ○	LIQUID LIMIT X	
100	200	300	400																						
● FIELD VANE	△ LAB VANE	■ PEN																							
PLASTIC LIMIT X	WATER CONTENT ○	LIQUID LIMIT X																							
10	20	30	40%																						
HAMMER MASS : 63.5 kg				ELEV. GROUND (m) : 721 APPROX.		PIEZOMETER DETAILS																			
DROP HEIGHT : .762 m				CO-ORDINATES (m) :																					
DEPTH (m)				SAMPLE TYPE		DESCRIPTION OF MATERIALS																			
BLOWS 0.15 m				SAMPLE NO.																					
SYMBOLS				0.5 GRAVEL (road)																					
				CLAY -stoney -sandy																					
SYMBOLS				11.3		BENTONITE 711.0 8/11/1990																			
				sandy SILT -saturated																					
SYMBOLS				14.0 14.2		BENTONITE																			
				BEDROCK/LARGE BOULDER  END OF DRILL HOLE AT REFUSAL																					
SYMBOLS				On site water quality tests pH = 8.4 Resistivity = 2300 micromhos/cm																					



**KLOHN LEONOFF YUKON**  
CONSULTING ENGINEERS

JOB No. : PB 3936-0501	
PROJECT : LAGOON MONITORING WELLS	
LOCATION TESLIN , YUKON	
HOLE No. : DH90-02	
DATE: NOV. 1990	PLATE:

APPENDIX II

WATER CHEMISTRY RESULTS

## RESULTS OF ANALYSIS - Water

File No. 3936B  
Page 3

Parameter	MW No.1    MW No.2	
	Nov08/90	Nov08/90
<u>Dissolved Metals</u>		
Aluminum    D-Al	<0.20	<0.20
Antimony    D-Sb	<0.20	<0.20
Arsenic      D-As	<0.20	<0.20
Barium       D-Ba	0.322	0.045
Beryllium    D-Be	<0.005	<0.005
Bismuth      D-Bi	<0.10	<0.10
Boron        D-B	<0.10	<0.10
Cadmium      D-Cd	<0.010	<0.010
Calcium      D-Ca	166	112
Chromium     D-Cr	<0.015	<0.015
Cobalt       D-Co	<0.015	<0.015
Copper       D-Cu	<0.010	<0.010
Iron          D-Fe	<0.015	<0.015
Lead          D-Pb	<0.050	<0.050
Magnesium    D-Mg	60.7	190
Manganese    D-Mn	0.898	0.314
Molybdenum   D-Mo	<0.030	0.054
Nickel        D-Ni	0.606	<0.020
Phosphorus   D-P	<0.30	<0.30
Selenium      D-Se	<0.20	<0.20
Silicon       D-Si	8.72	6.64
Silver        D-Ag	<0.015	<0.015
Strontium     D-Sr	0.890	0.694
Vanadium     D-V	<0.030	<0.030
Zinc          D-Zn	<0.005	<0.005

&lt; = less than

Results are expressed as milligrams per litre.

RESULTS OF ANALYSIS - Water

File No. 3936B  
Page 2

Parameter	MW No.1		MW No.2	
	Nov08/90		Nov08/90	
<b><u>Physical Tests</u></b>				
Conductivity	umhos/cm	1440	2080	
Total Dissolved Solids		620	980	
pH		7.51	7.95	
Total Suspended Solids		90000	678	
<b><u>Dissolved Anions</u></b>				
Alkalinity	CaCO3	408	425	
<b><u>Nutrients</u></b>				
Ammonia Nitrogen	N	0.087	1.24	
Nitrate Nitrogen	N	<0.005	0.220	
Total Dissolved Phosphate	P	0.015	0.270	
<b><u>Other Tests</u></b>				
Chemical Oxygen Demand	COD	319	71	
Oil and Grease		9.0	<1.0	
<b><u>Bacteriological Tests</u></b>				
Biochem.Oxygen Demand-Tot	BOD-5	24.8	6.6	

< = less than

Results are expressed as milligrams per litre except for pH, and Conductivity (umhos/cm).



Environmental Health Division  
Medical Services Branch  
# 2 Hospital Road  
Whitehorse, Yukon  
Y1A 3H8

RECEIVED  
JAN 24 1991

January 18, 1991

Bob Lorimer  
c/o Klohn Leonoff Yukon Ltd.  
2 - 203A Main St.  
Whitehorse, Yukon  
Y1A 2B2

Dear Mr. Lorimer:

**RE: BACTERIOLOGICAL WATER SAMPLE RESULTS  
TESLIN AND MacPHERSON**

The bacteriological water results for the three water samples submitted to us for analysis are ...

<u>LOCATION</u>	<u>TOTAL COLIFORMS</u>	<u>FAECAL COLIFORMS</u>
Teslin Monitoring Well # 1 at Wetlands	NIL	NIL
Teslin Monitoring Well # 2 at Wetlands	NIL	NIL
MacPherson Well	NIL	NIL

If you have any queries regarding this matter, please don't hesitate to contact me at 667-8350.

Yours truly,

Robert Phillips, C.P.H.I.(C),  
Sr. Environmental Health Officer

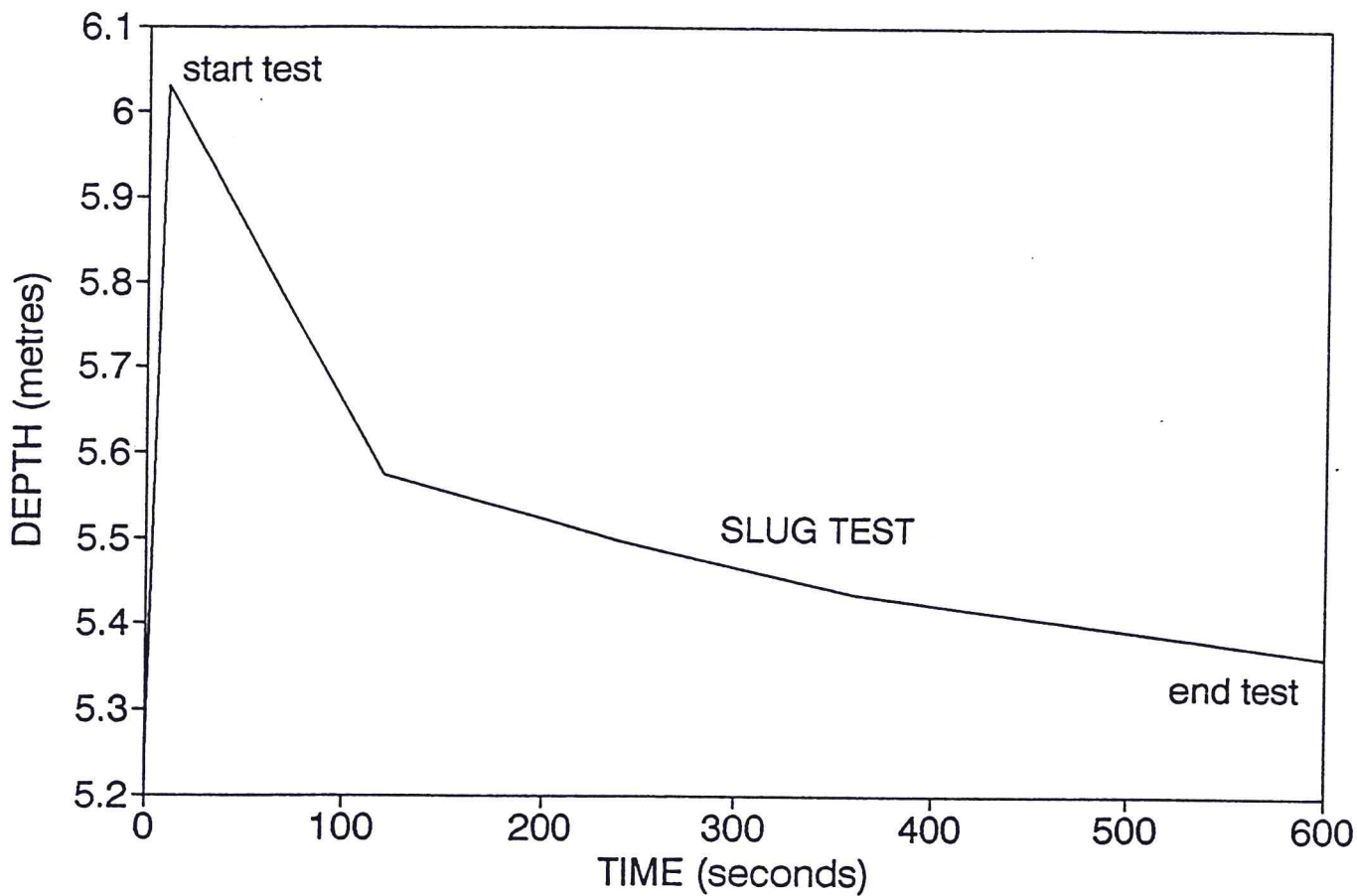
RP/cg

**RECEIVED**  
JAN 24 1991

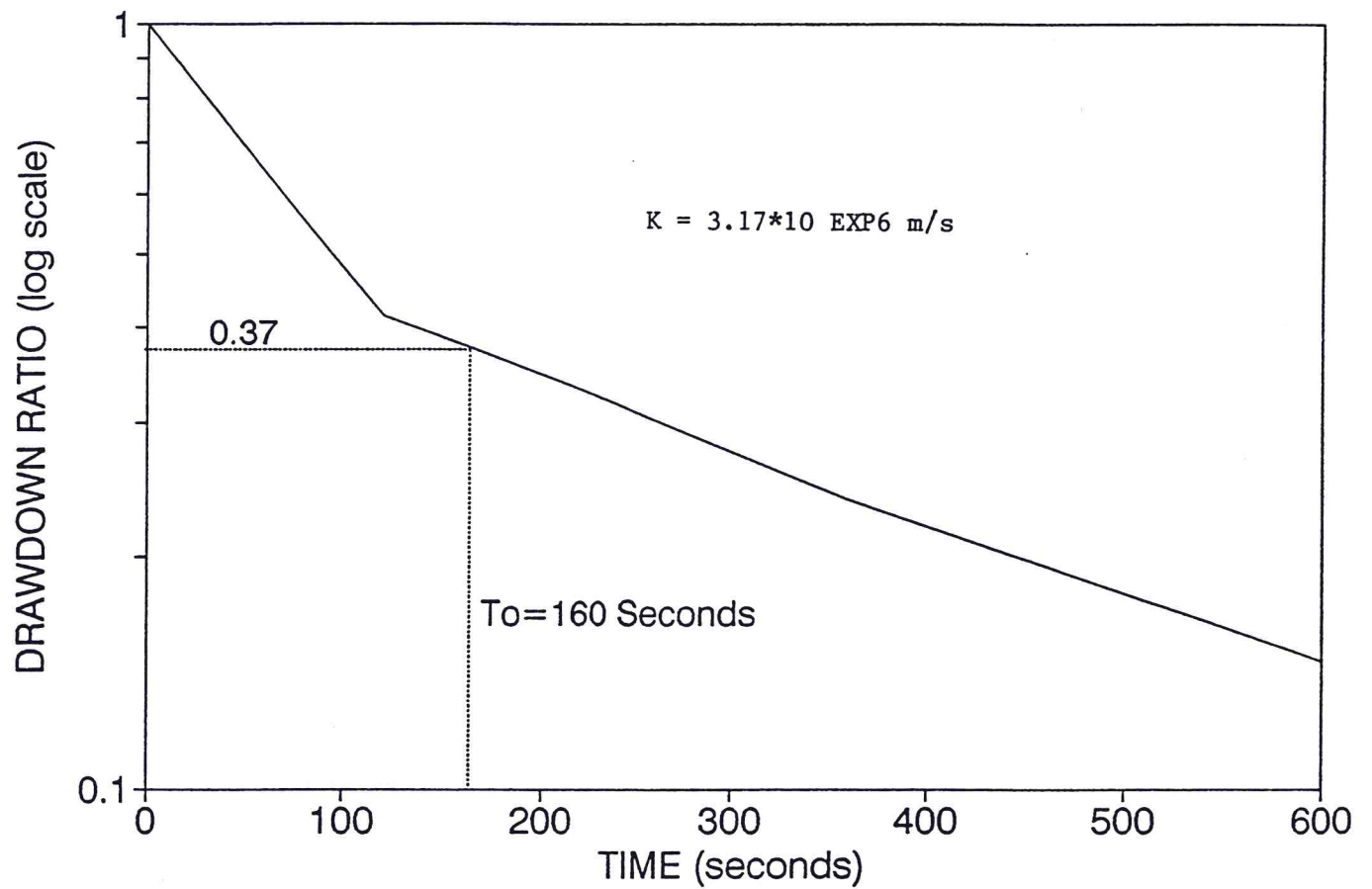
APPENDIX III

RESPONSE TESTS

# TESLIN WETLAND SEWAGE TREATMENT PROJECT MONITORING WELL No.1

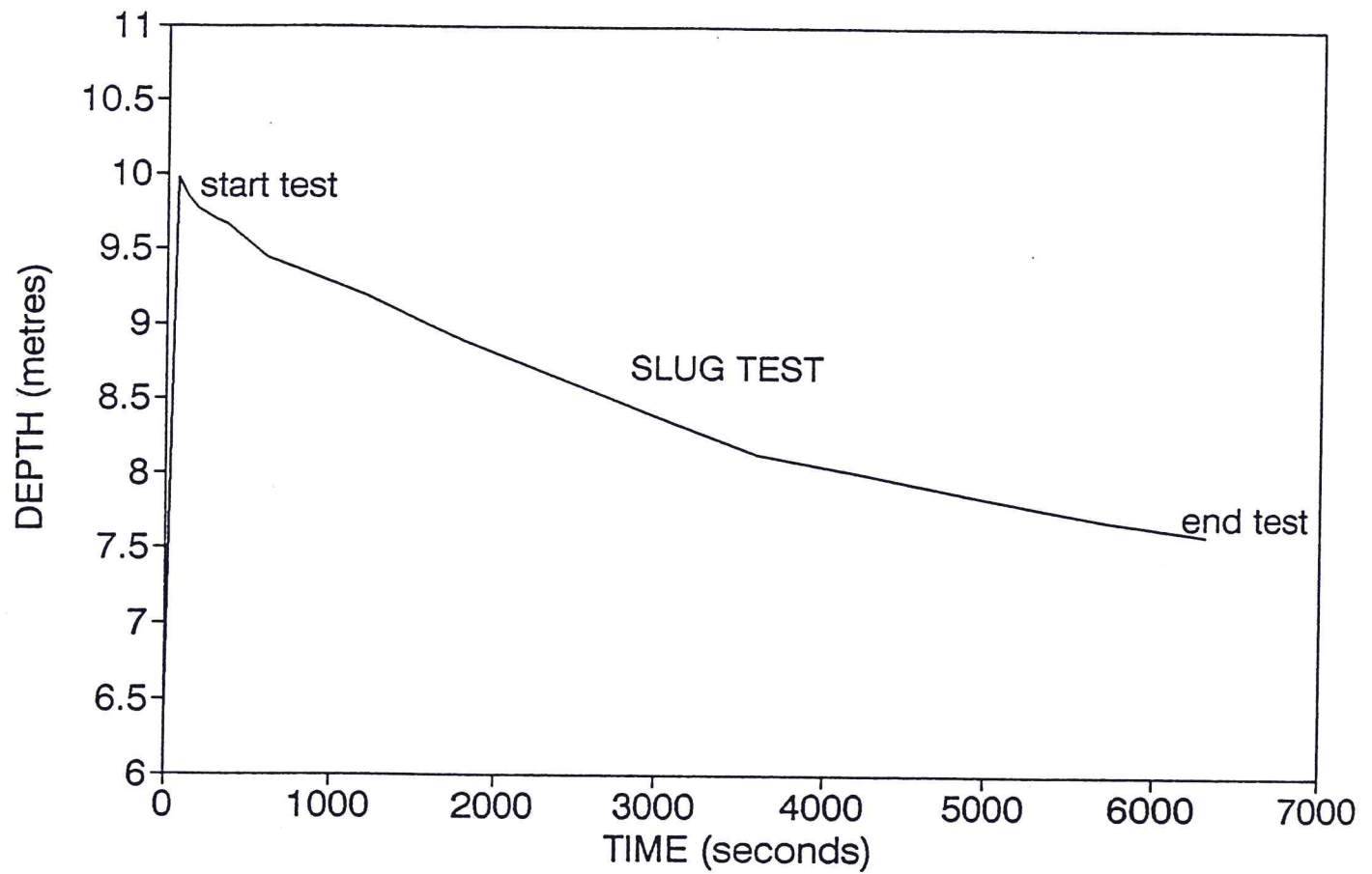


# TESLIN WETLAND SEWAGE TREATMENT PROJECT MONITORING WELL No.1

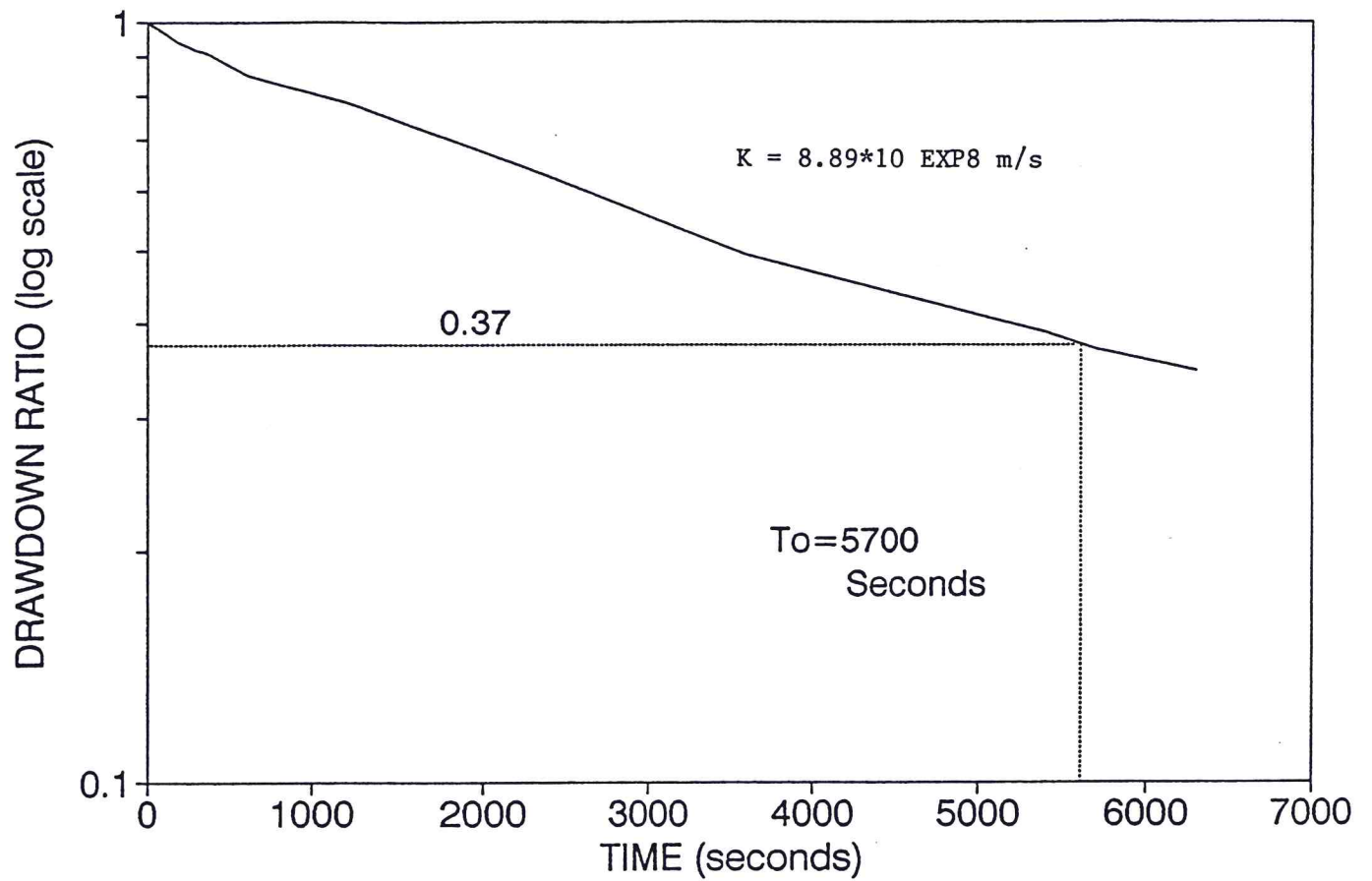




# TESLIN WETLAND SEWAGE TREATMENT PROJECT MONITORING WELL No.2

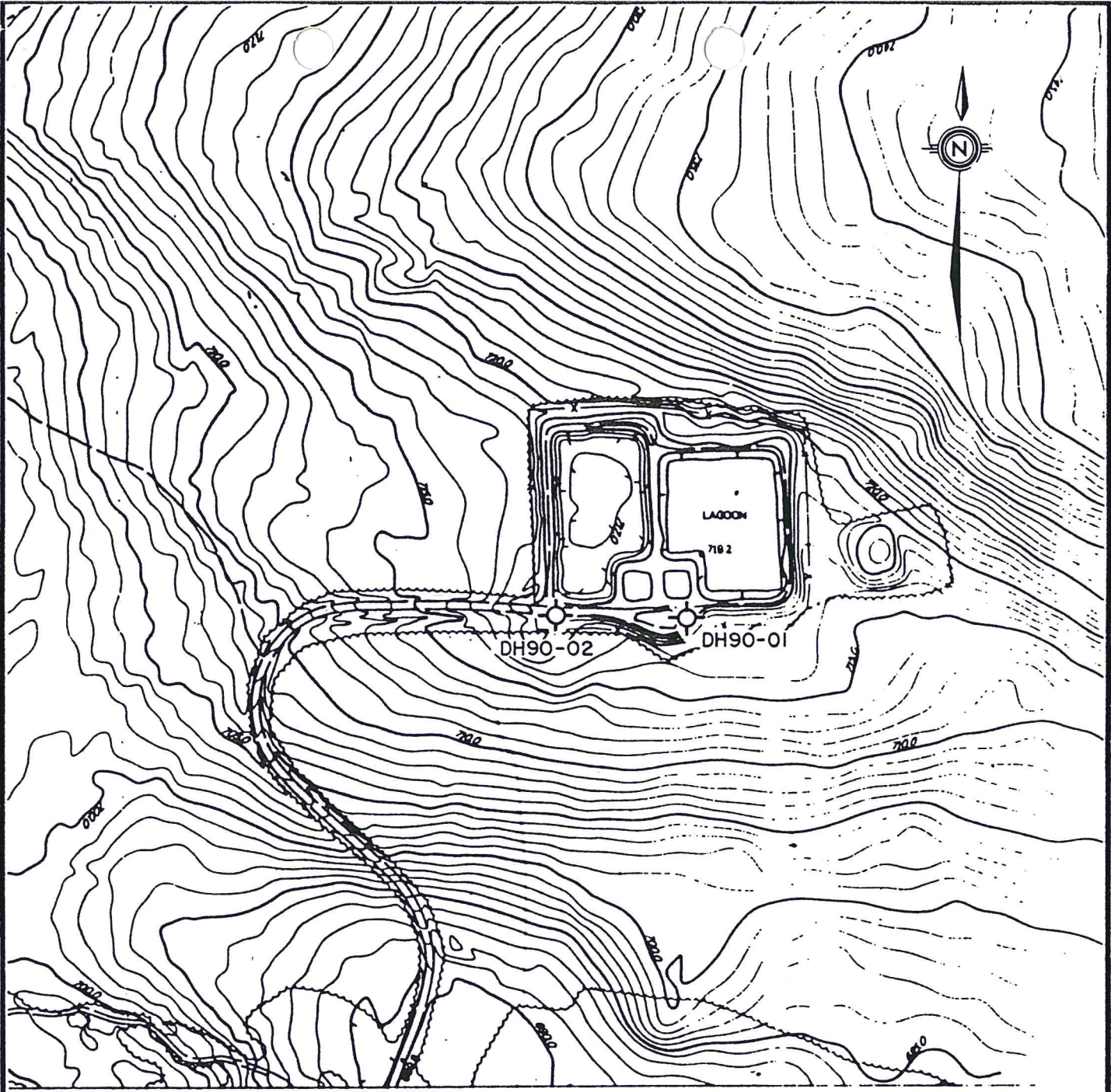


# TESLIN WETLAND SEWAGE TREATMENT PROJECT MONITORING WELL No.2



APPENDIX IV

LOCATION PLAN



**LEGEND**

 MONITORING WELL LOCATIONS

AS A MUTUAL PROTECTION TO OUR CLIENT, THE PUBLIC AND OURSELVES, ALL REPORTS AND DRAWINGS ARE SUBMITTED FOR THE CONFIDENTIAL INFORMATION OF OUR CLIENT FOR A SPECIFIC PROJECT AND AUTHORIZATION FOR USE AND OR PUBLICATION OF DATA, STATEMENTS, CONCLUSIONS OR ABSTRACTS FROM OR REGARDING OUR REPORTS AND DRAWINGS IS RESERVED PENDING OUR WRITTEN APPROVAL.

SCALE 1:5000



**KLOHN LEONOFF YUKON**  
CONSULTING ENGINEERS

PROJECT TESLIN SEWAGE LAGOON  
MONITORING WELL INSTALLATIONS

TITLE SITE PLAN SHOWING  
MONITORING WELL LOCATIONS

CLIENT: VILLAGE OF TESLIN

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
APPROVED	PB 3936 05	A	

NO. 780