HYDROGEOLOGICAL STUDY

STONEY LAKE ROAD "NORTH" LANDFILL SITE

Township of Douro

Prepared for
The Township of Douro

Project No. L.R. 7777-096

Prepared by

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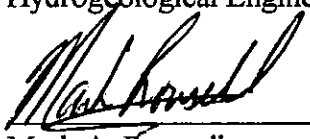

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1.0 INTRODUCTION

Lakefield Research was contracted by The Township of Douro on March 17, 1994, to conduct a hydrogeological study of the Stoney Lake Road "North" Landfill Site.

The purpose of this study was to provide sufficient information to permit an understanding of the hydrogeology of the site and to identify current and potential future impacts due to landfilling activities. The work conducted involved the following major components:

- a background data review;
- installation of test wells;
- a sampling program; and
- data analysis and reporting.

1.1 Background Information

The Corporation of the Township of Douro holds title to the Provisional Certificate of Approval (PC of A) No. A340901 which was issued for the Stoney Lake Road "North" Waste Disposal Site. The original PC of A was issued on February 23, 1971, by the Department of Energy and Resources Management (the predecessor of the Ministry of Environment). An amended PC of A was issued by the Ministry of Environment and Energy (MOEE), formerly the Ministry of the Environment (MOE), on September 17, 1982.

1.2 Site Description

The Stoney Lake Road "North" Landfill is located in the west half of Lot 21, Concession 4 in the Township of Douro. The landfill is 150 meters north of Peterborough County Road No. 6 (Stoney Lake Road) (Figure 1).

2.0 REGIONAL SETTING

2.1 Topography and Drainage

The Stoney Lake Road Landfill site is adjacent to a low-lying area where surface conditions are wet and marshy. Agricultural pastureland borders the northern and western perimeters of the site. The eastern boundary of the site is bordered by the Provincially significant Galesburg Wetland (Class 2). The southern perimeter is bordered by Peterborough County Road #6 and mixed bush. Surface water from the landfill site and the bordering pasturelands drains to the south-east, toward the Wetland.

Most of the area is densely covered with glacial deposits, formed from the retreat of the Wisconsin ice sheet during the Pleistocene Epoch. The features surrounding the Stoney Lake Road Landfill include moraines, drumlins, and kames.

2.2 Hydrogeology

Thirty MOEE well logs have been reviewed within an area of the landfill, which is contained within the coordinates represented by 719051mE to 722660mE, and 4925000mN to 4927150mN. Four of these wells were dry, twenty-four wells produced fresh water, five wells produced sulphurous water, and one was of unknown water quality. All of the thirty wells reviewed within the area were completed in limestone bedrock.

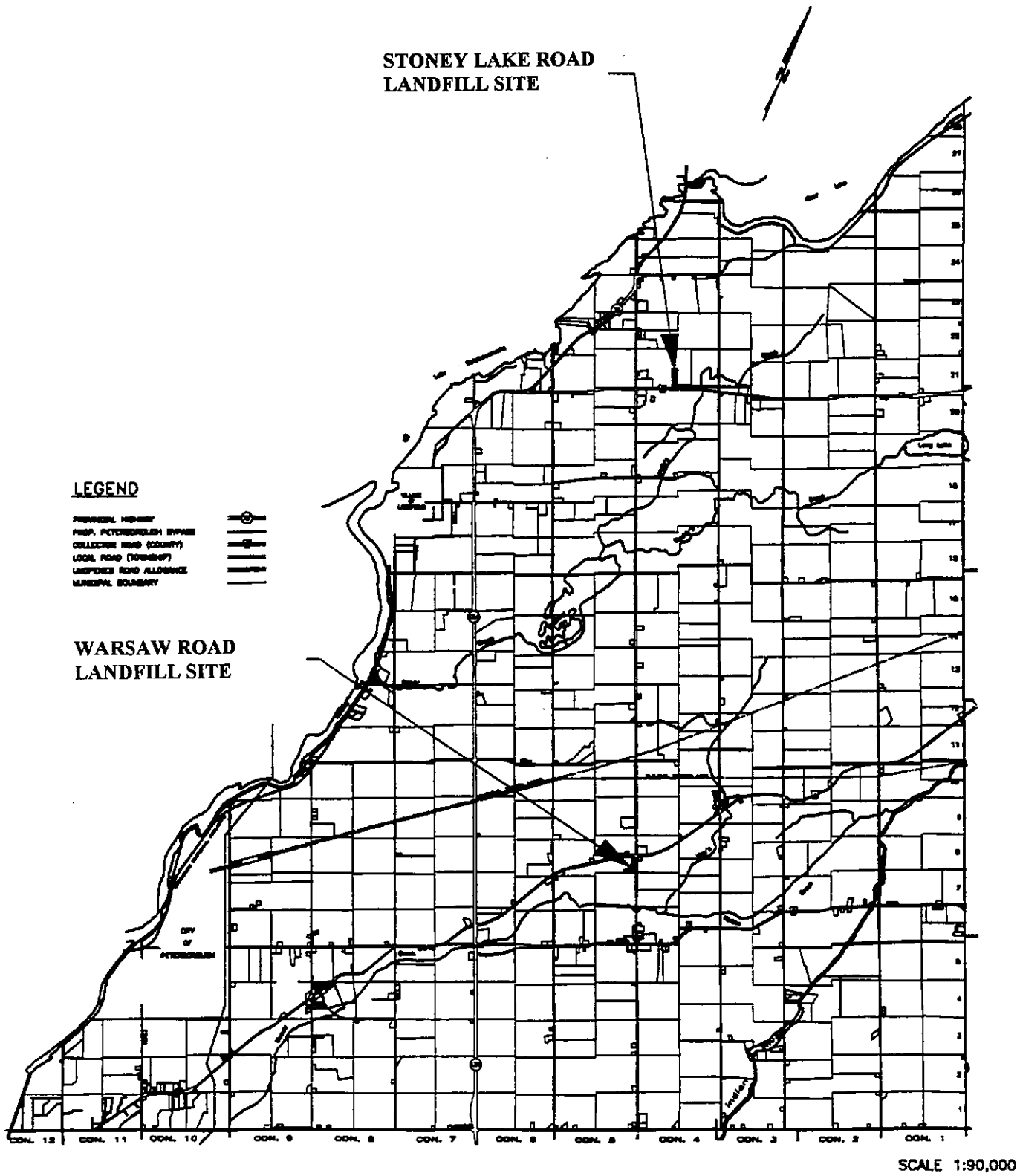

Figure No. 1

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Site Location Map
Stoney Lake Road Landfill

The well depths varied from 3 meters to 64 meters. Twenty wells were completed at depths less than 15 meters and six wells were completed at depths between 15 and 23 meters. Only one well was completed at a depth between 23 and 30 meters, and three wells were completed at depths between 30 and 64 meters.

The water table level in the thirty wells varied from between 0.3 meters to 15.25 meters, below grade. The water table was recorded at less than 8 meters depth in twenty-five wells. The water table in three wells was located between 8 and 15 meters, and for two wells, the water table depth was recorded between 15 and 23 meters below grade.

3.0 FIELD PROGRAM

Five ground water test wells were drilled and constructed at the Township of Douro, Stoney Lake Road "North" Landfill Site in July of 1994. These wells, TW1, TW2, TW3, TW4, and TW5, were installed to permit sampling of the shallow overburden aquifer, where present, and the deeper bedrock aquifers. The wells were located up and down gradient of the landfill site.

3.1 Drilling Program

Test well, TW2, was located at the northern boundary of the site. Test wells TW1, TW3, and TW4 were located within the landfill. Test well, TW5, was located south of the landfill site. The test well locations are shown on Figure 2.

The wells were drilled by Tri-Ontario Drilling of Fenelon Falls, Ontario, using a 150 mm mud rotary drilling rig.

All of the wells were drilled into the shallow bedrock aquifer. Table 1 lists the depth to bedrock and the depth to the water table noted during drilling.

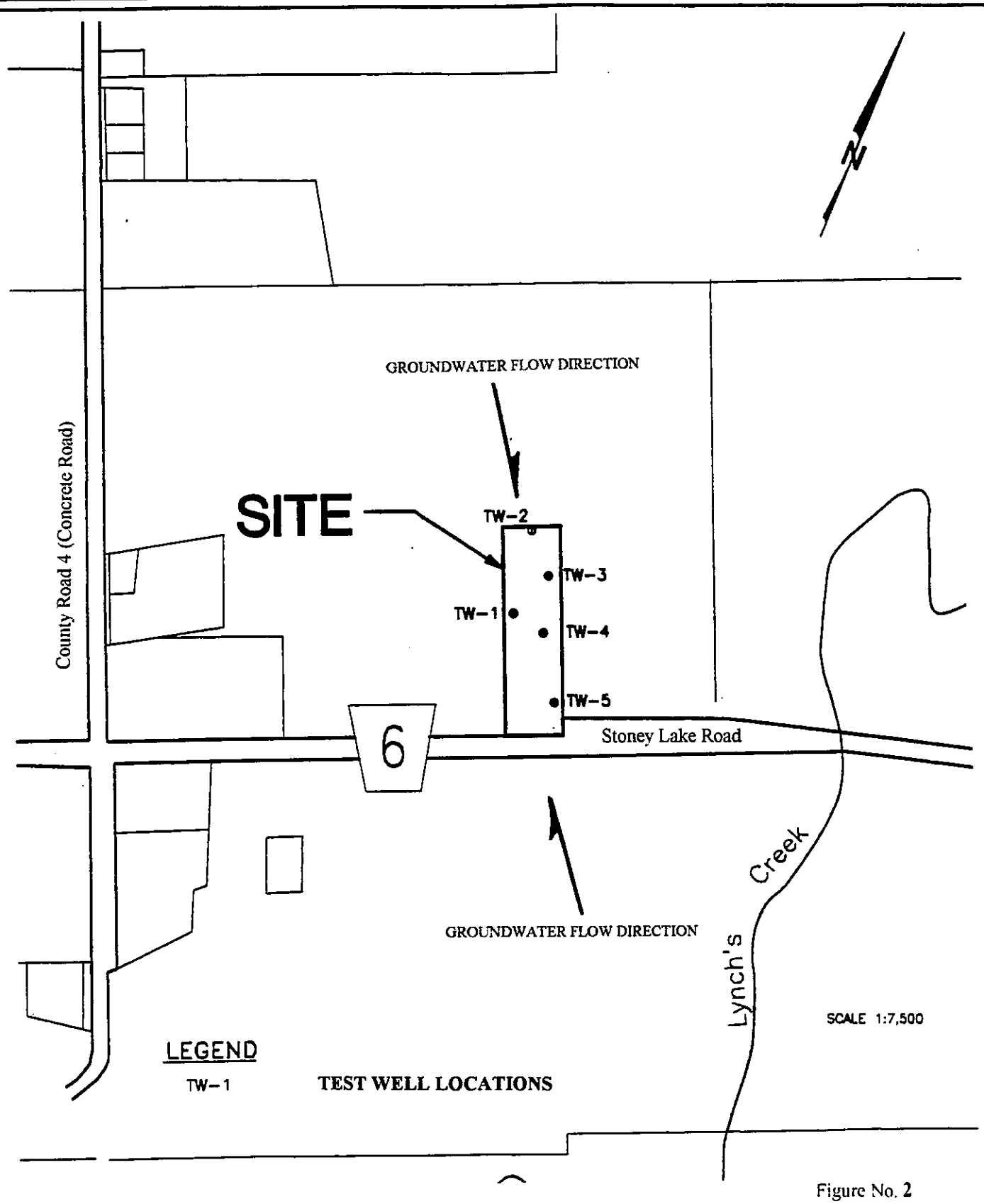

Figure No. 2

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Test Well Locations and Groundwater Flow Direction

Table 1. Depths to Bedrock and Water Table

Well	Depth to Bedrock (m)	Depth to Water Table (m)
TW1	5.20	6.18
TW2	1.80	3.64
TW3	4.87	7.16
TW4	5.40	7.05
TW5	3.65	3.90

3.2 Piezometer Construction

Two piezometers were installed at each of the drilled wells. Each piezometer was constructed using threaded 50 mm diameter schedule 40 PVC pipe and a 1.5 meter #10 slot screen. Filter sand was backfilled around the screen and a bentonite seal was placed above the filter sand to insure hydraulic isolation of the screened interval. The remaining depth to surface was backfilled with drill cuttings.

The slot screens at well TW1 were installed over the depth interval from 7.0 meters to 5.5 meters below grade (TW1-1) and from 4.51 meters to 3.01 meters below grade (TW1-2). Filter sand was backfilled around the screened pipe. Bentonite was placed between the 4.51 meter and 5.53 meter interval below grade, and from surface to 2.0 meters below grade.

The first piezometer screen at test well TW2, TW2-1, was installed from the bottom of the well, at 7.97 meters, up to 6.47 meters below grade. The second screen (TW2-2) was installed over the depth interval between 5.45 meters and 3.95 meters below grade. A bentonite seal was placed from 6.4 meters to 5.45 meters below ground level for TW2-1 and from surface to 3.93 meters below surface for TW2-2.

The slot screens at well TW3 were installed between 7.54 meters and 6.04 meters below grade (TW3-1) and between 4.4 meters and 2.9 meters below surface. A bentonite seal was placed above each screened intake at 5.5 meters and 3.65 meters below surface at TW3-1 and from 2.0 meters to ground surface at TW3-2.

Piezometer TW4-1 was constructed with the intake screen between 7.31 meters below grade and the bottom of the hole at 10 meters. Piezometer TW4-2 was located between 5.8 meters and 4.3 meters below grade. A bentonite seal was placed between 5.8 meters and 7.31 meters below grade at TW4-1, and from surface to 3.65 meters below grade at TW4-2.

The first piezometer screen at test well TW5 (TW5-1) was installed between 6.7 meters and 5.2 meters below grade. The second piezometer screen, TW5-2, was installed between 4.57 meters and 3.07 meters below grade. A bentonite seal was placed over the depth intervals from 5.18 meters to 4.57 meters and from 3.05 meters to surface.

Well logs and piezometer "as built" diagrams are included in Appendix B.

3.3 Water Level Measurement

All test wells at the Stoney Lake Road landfill site were monitored during the summer program. The sampling program was conducted during July 25 and 26, 1994.

Static water levels were measured in the piezometers using an electric water level indicator. Piezometric elevations of the ground water were calculated using the measured water levels and the ground elevations at the wells. Elevation data was obtained from the survey conducted by The Greer Galloway Group Inc., Engineers and Planners in August, 1994. Table 2 summarizes the piezometric elevation data collected during the summer.

The elevations in Table 2 were based on an assumed benchmark elevation of 100.00 meters. The benchmark used was a nail and washer in the east face of the most northerly hydro pole in the Stoney Lake Road Landfill Site (Greer Galloway Group Inc., August 1994).

Table 2: Summary of Water Table Elevations (July, 1994)*

Test Well	Ground Elevation	Stick-up	Water Level Below Top of PVC Pipe	Water Level Below Ground Elevation	Water Table Elevation
TW1-1	99.06	0.75	6.93	6.18	92.88
TW2-1	98.97	0.80	6.38	5.58	93.39
TW2-2	98.97	0.80	3.62	2.82	96.15
TW3-1	99.62	0.69	7.13	6.44	93.18
TW4-1	98.85	0.98	7.05	6.07	92.78
TW5-1	95.97	0.88	3.65	2.77	93.2
TW5-2	95.97	0.88	3.65	2.77	93.2

*all measurements are in meters

3.4 Water Sampling

After recording the static water levels, the piezometers in the wells were developed by removing a calculated volume of water equivalent to three times the standing bore volume in each piezometer. Of the ten piezometers, TW1-2, TW3-2 and TW4-2 were dry. Piezometer TW1-1, had an insufficient volume of water to collect a representative sample. The remaining piezometers were sampled following piezometer development. Environmental water sample containers were filled with the samples obtained from the recovery of each piezometer. The samples were stored in coolers, with ice packs, and delivered to the Lakefield Research Environmental laboratory (LREL). Water samples were delivered to the LREL the same day of collection.

Five surface water locations were identified, SW1 through to SW5 (Figure 3). Samples were collected from water sources upstream and downstream of the landfill site on July 26, 1994. Two of the identified surface water sample locations, SW3 and SW5, were dry during the sampling program. These two locations are expected to be wet during spring conditions.

All samples were stored in coolers and transported to the LREL for analysis the same day.

Four residential wells (RW1, RW2, RW3, and RW4) in the vicinity of the landfill site were also sampled during the July, 1994 sampling program. Figure 4 shows the location of each of the residential wells sampled.

4.0 SITE HYDROGEOLOGY

The hydrostratigraphy, hydraulic gradients, ground water flow directions, and hydraulic conductivity are summarized in the following sections.

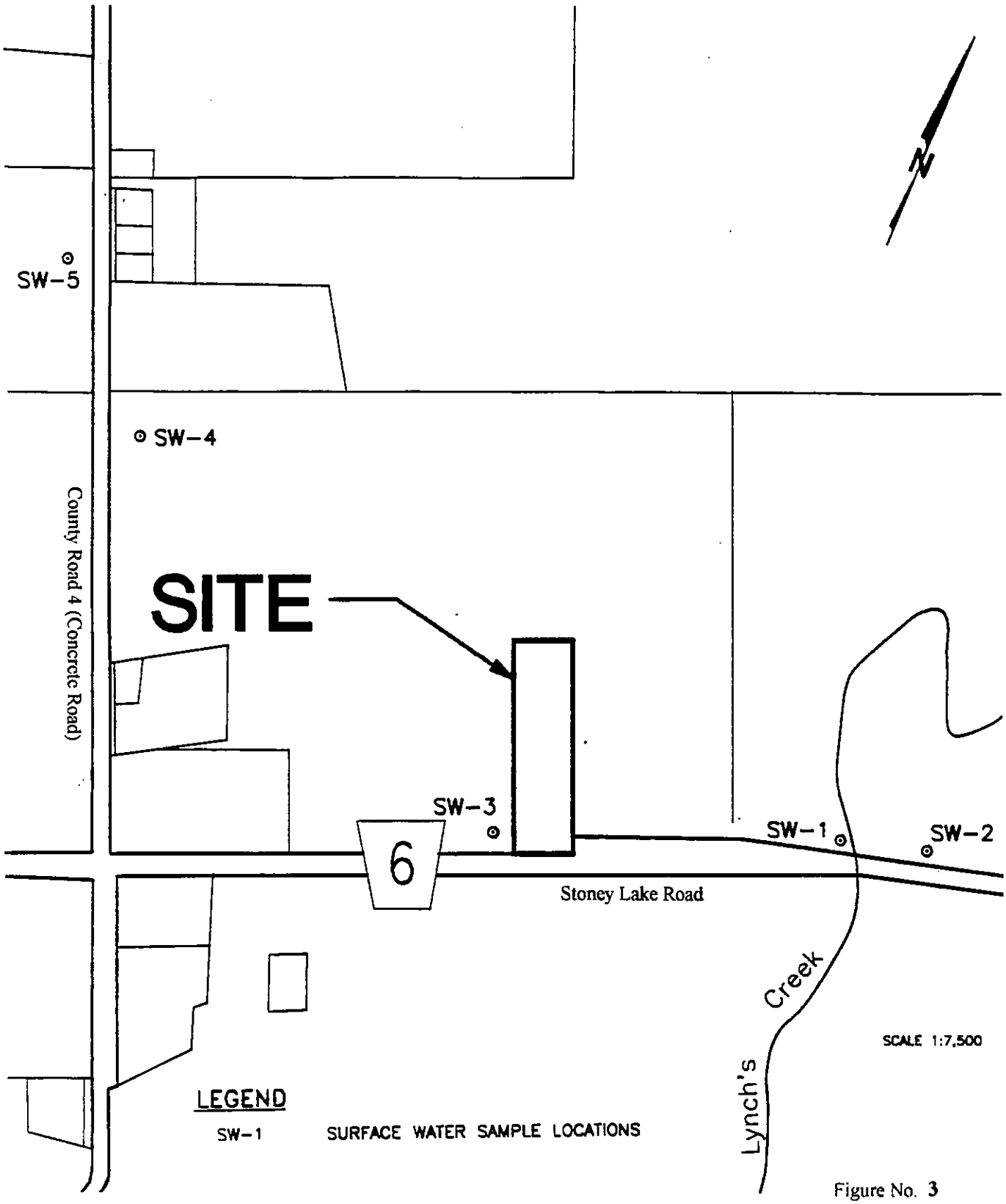

Figure No. 3

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Surface Water Sampling Locations

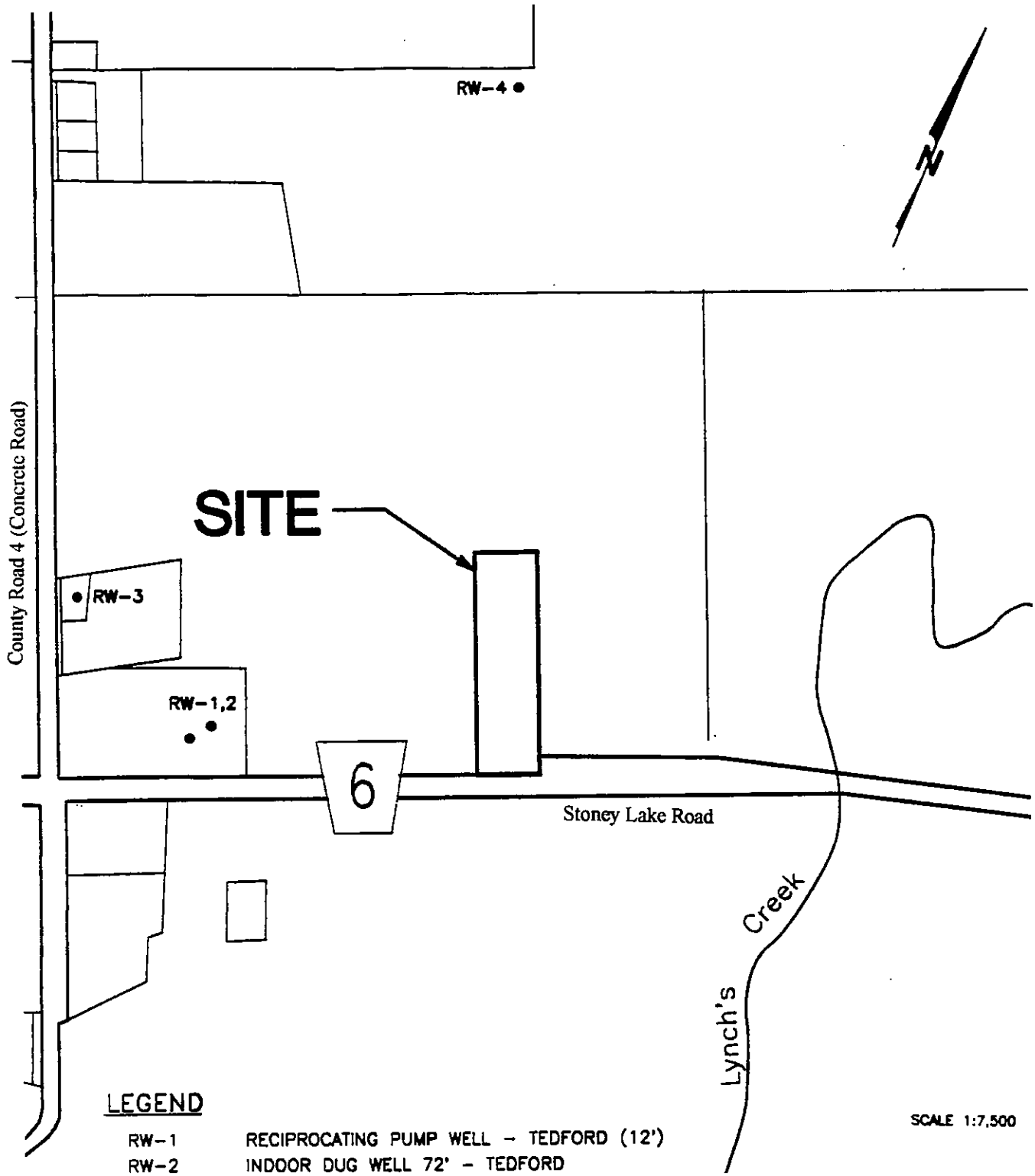

Figure No. 4

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Residential Well Locations

4.1 Hydrostratigraphy

The hydrostratigraphy of the area is simple, with dense, sandy, glacial till overlying limestone bedrock. The test wells were all discontinued after advancing into the upper bedrock aquifer.

Bedrock encountered during the drilling of the test wells was broken and fractured. The abundance of fractures would allow a hydraulic connection between the overburden aquifer and the surficial bedrock aquifer.

Borehole logs and as-built diagrams for all piezometer installations have been included in Appendix A.

4.2 Hydraulic Gradients and Ground Water Flow Direction

Hydraulic gradients were calculated using piezometric elevations measured on July 25, 1994. Vector addition was used to calculate the ground water flow direction on site. Calculations of hydraulic gradients and ground water flow directions were conducted under the assumption that the shallow bedrock aquifer and the overlying overburden deposits are hydraulically connected. The calculations have been included in Appendix C.

The hydraulic gradients are listed in Table 3.

Table 3. Hydraulic Gradients

Well	Gradient
TW2-1 to TW1-1	0.0042
TW3-1 to TW1-1	0.0042
TW5-1 to TW1-1	0.0024
TW1-1 to TW4-1	0.0043
TW2-1 to TW3-1	0.0030
TW3-1 to TW4-1	0.0051
TW5-1 to TW4-1	0.0043

The calculated gradients showed that the ground water flow direction was found to be from the north to the centre of the landfill and from the south to the centre of the landfill. The ground water flow direction for the northern portion of the landfill was determined to be 178° east of north. The ground water flow direction for the southern portion of the landfill was determined to be 14° west of north. The ground water flow directions converge near the centre of the landfill. This would suggest that the landfill is situated in a ground water discharge area. The ground water flow directions are shown on Figure 2.

4.3 Hydraulic Conductivity

In-situ hydraulic conductivity values were determined using piezometers TW2-2 and TW5-2. The tests were performed by causing an instantaneous drop in the water level in each piezometer through bailing. Water level recovery was then observed with time. Water level recovery was monitored manually, using a stopwatch and an electric water level indicator.

Interpretation of the water level versus time data was conducted using the Hvorslev method for point piezometers. As described in Freeze and Cherry (1979) the hydraulic conductivity (K) is determined using the following equation:

$$K=[r^2 \ln(L/R)]/[2LT_0]$$

where T_0 is the time lag, or time that would be required for the complete equalization of the head differences if the original rate of inflow were maintained; L is the length of the piezometer intake or screen; r is the radius of the piezometer pipe; and R is the radius of the screen or intake.

The hydraulic conductivity was determined to be:

4.60 x 10-7 m/s for piezometer TW2-2, and
5.71 x 10-6 m/s for piezometer TW5-2.

average - 3.1×10^{-6} m/s

The calculations are included in Appendix D.

5.0 WATER QUALITY ASSESSMENT

Both ground and surface water samples were collected during the 1994 program. Ground water quality was compared to the Ontario Drinking Water Objectives (ODWO) and Reasonable Use Policy. Surface water quality results were compared to Provincial Water Quality Objectives (PWQO).

5.1 Ground Water Quality

Ground water samples were collected on July 25 and 26, 1994. Ground water samples were collected from test wells and from residential wells in the area. Water samples were analyzed for Ontario Drinking Water Objective (ODWO) indicator parameters. Table 4 summarizes the concentrations of the parameters found in samples collected from the test wells. Table 5 summarizes the concentrations of the parameters found in samples collected from the four residential wells on the same dates.

Analytical results for the ground water samples collected show that the ODWO maximum acceptable concentration (MAC) for turbidity was exceeded at all the test wells. At test wells TW3-1, near the centre of the landfill, and TW2-2, north of the landfill, manganese, total dissolved solids, alkalinity, and colour exceeded ODWO MAC limits. The concentration of dissolved iron at test well TW2-2 also exceeded ODWO MAC limits. The phenol concentration at well TW5-2, south of the landfill, was 6 ug/L. The ODWO MAC for phenols is 2 ug/L. Phenols were not found above the ODWO MAC at any of the wells installed in the landfilled area (TW1, TW3, and TW4). The presence of these parameters at elevated concentrations is interpreted to be indicative of leachate contamination.

Results of the residential sampling show that total dissolved solids were above ODWO MAC limits for the Kelly (RW3) and Tedford (RW1) wells. Nitrate as nitrogen exceeded ODWO limits at the Tedford well (RW1). Turbidity was present at levels above the ODWO MAC limits for the dug well (RW2) at the Tedford residence. Phenols were detected at a concentration of 4 ug/L in the water sampled at the Medland well (RW4).

Table 4: Summary of Ground Water Quality Results, August, 1994
Stoney Lake Road Landfill - Douro Township Project # - 7777 - 096

Parameter	O.D.W.O	TW2-1	TW2-2	TW3-1	TW4-1
Alkalinity as CaCO3	(30-500)*	362	1221	593	274
Ammonia + Ammonium	N/L	<0.1	11.8	26.8	<0.1
Arsenic (diss)	0.05(0.025)*	<0.01	<0.01	<0.01	<0.01
Barium (diss)	1	0.03	0.31	0.38	0.03
Biological Oxygen demand	N/L	<4	780	13	<4
Boron (diss)	5	<0.02	0.13	0.22	<0.02
Cadmium (diss)	0.005	<0.005	<0.005	<0.005	<0.005
Calcium (diss)	N/L	97.7	465	148	111
Chemical Oxygen Demand	N/L	<8	780	78	<8
Chloride	250	3.7	153	75.1	9.42
Cyanide	0.2	<0.01	<0.01	<0.01	<0.01
Colour TCU	5	<5	21	12	<5
Conductivity (umhos/cm)	N/L	460	2820	1338	528
Chromium (diss)	0.05	<0.02	<0.02	<0.02	<0.02
Dissolved Oxygen	N/L	9	2.1	5.8	8.4
Flouride	1.5	0.07	0.05	0.08	0.05
Iron (diss)	0.3	0.02	45.7	0.07	<0.02
Lead (diss)	0.05(0.01)*	<0.005	<0.005	<0.005	<0.005
Magnesium (diss)	N/L	2.28	24.9	14.5	2.1
Manganese (diss)	0.05	<0.01	6.14	0.77	<0.01
Mercury Total	0.001	<0.0001	<0.0001	<0.0001	0.0001
Nitrate as Nitrogen	10	1.96	0.025	0.33	1.8
Nitrite as Nitrogen	1	<0.006	0.069	0.086	<0.006
pH units	6.5-8.5	7.63	6.53	6.9	7.5
Phenol ug/L	2	<2	<2	<2	<2
Potasium (diss)	N/L	0.85	8.79	24.9	1.33
Selenium (diss)	0.01	<0.01	<0.01	<0.01	<0.01
Sodium (diss)	200	1.65	94.6	70.8	4.13
Total Dissolved Solids	500	290	2484	756	354
Total Kjeldahl Nitrogen	N/L	0.2	14.1	26.9	<0.1
Turbidity NTU	1	82	156	18.9	38.4

ALL RESULTS ARE EXPRESSED IN mg/L UNLESS OTHERWISE STATED
SHADED AREAS INDICATE VALUES THAT EXCEED ODWO MAXIMUM ACCEPTABLE CONCENTRATIONS.
()* INDICATES LIMITS ARE OBTAINED FROM O.D.W.O. 1991 DRAFT GUIDELINES.
TW1-1, TW1-2, TW3-2, TW4-2 WERE DRY DURING THE SUMMER SAMPLING PROGRAMME
O.D.W.O. INDICATES ONTARIO DRINKING WATER OBJECTIVES
[ ] INDICATES EXCEEDANCE OF THE REASONABLE USE Cm VALUES (APPENDIX F)

Table 4 (Con't): Summary of Ground Water Quality Results, August, 1994
Stoney Lake Road Landfill - Douro Township Project # - 7777 - 096

Parameter	O.D.W.O	TW5-1	TW5-2	Dupl.TW2-1	Trav.Blank
Alkalinity as CaCO3	(30-500)*	169	154	265	<1
Ammonia + Ammonium	N/L	<0.1	0.15	<0.1	<0.1
Arsenic (diss)	0.05(0.025)*	<0.01	<0.01	<0.01	<0.01
Barium (diss)	1	0.07	0.04	0.03	<0.02
Biological Oxygen demand	N/L	<4	<4	<4	<4
Boron (diss)	5	<0.02	<0.02	<0.02	<0.02
Cadmium (diss)	0.005	<0.005	<0.005	<0.005	<0.005
Calcium (diss)	N/L	64.6	28.9	97.3	<0.1
Chemical Oxygen Demand	N/L	10	14	<8	
Chloride	250	26.3	24	3.46	<0.2
Cyanide	0.2	<0.01	<0.01	<0.01	<0.01
Colour TCU	5	<5	5	<5	<5
Conductivity (umhos/cm)	N/L	474	447	459	1
Chromium (diss)	0.05	<0.02	<0.02	<0.02	<0.02
Dissolved Oxygen	N/L	8	7.9	9.2	8.4
Flouride	1.5	0.13	0.19	0.08	0.01
Iron (diss)	0.3	0.04	0.04	<0.02	<0.02
Lead (diss)	0.05(0.01)*	<0.005	<0.005	<0.005	<0.005
Magnesium (diss)	N/L	5.73	3.01	2.23	<0.02
Manganese (diss)	0.05	0.04	<0.01	<0.01	<0.01
Mercury Total	0.001	<0.0001	<0.0001		<0.0001
Nitrate as Nitrogen	10	0.16	0.61	1.86	<0.005
Nitrite as Nitrogen	1	<0.006	<0.006	<0.006	<0.006
pH units	6.5-8.5	7.9	8.21	7.65	6.02
Phenol ug/L	2	2	6	<2	<2
Potasium (diss)	N/L	2.47	2.26	0.75	<0.2
Selenium (diss)	0.01	<0.01	<0.01	<0.01	<0.01
Sodium (diss)	200	29.6	66.3	1.52	<0.05
Total Dissolved Solids	500	316	362	270	4
Total Kjeldahl Nitrogen	N/L	0.28	0.15	0.24	<0.1
Turbidity NTU	1	12.9	32	76	<0.1

ALL RESULTS ARE EXPRESSED IN mg/L UNLESS OTHERWISE STATED
SHADED AREAS INDICATE VALUES THAT EXCEED ODWO MAXIMUM ACCEPTABLE CONCENTRATIONS
()* INDICATES LIMITS ARE OBTAINED FROM O.D.W.O. 1991 DRAFT GUIDELINES.
TW1-1, TW1-2, TW3-2, TW4-2 WERE DRY DURING THE SUMMER SAMPLING PROGRAMME
O.D.W.O. INDICATES ONTARIO DRINKING WATER OBJECTIVES
[ ] INDICATES EXCEEDANCE OF THE REASONABLE USE Cm VALUES (APPENDIX F)

Table 5: Summary of Residential Well Quality Results, August, 1994
Stoney Lake Road Landfill - Douro Township Project # 7777 - 096

Parameter	O.D.W.O.	RW1 Tedford	RW2 Tedford	RW3 Kelly	RW4 Medland	Dupl. RW3 Kelly	Trav. Blk.
Alkalinity	(30-500)*	355	246	265	260	35	<1
Ammonia+Ammonium	N/L	<0.1	0.18	<0.1	<0.1	<0.1	<0.1
Arsenic(diss)	0.05(0.025)*	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Barium(diss)	1	0.27	0.14	0.04	<0.02	0.4	<0.02
Biological Oxygen Demand	N/L	<4	<4	<4	<4	<4	<4
Boron(diss)	5	0.03	0.16	0.2	0.02	0.17	<0.02
Cadmium(diss)	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium(diss)	N/L	161	59.1	130	110	130	<0.10
Chemical Oxygen Demand	N/L	<8	<8	<8	<8	<8	<8
Chloride	250	27.8	27.8	127	19.8	125	<0.2
Chromium(diss)	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cyanide(Total)	0.2	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Colour TCU	5	<5	<5	<5	<5	<5	<5
Conductivity (umhos/cm)	N/L	1021	591	962	572	959	1.04
Dissolved Oxygen	N/L	7.9	6.3	6.4	8.3	6.2	7.5
Flouride	2.4(1.5)*	0.05	0.51	0.24	0.05	0.24	0.01
Iron(diss)	0.3	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead(diss)	0.05(0.01)*	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Magnesium(diss)	N/L	15.1	21	12.9	2.87	12.9	<0.05
Manganese(diss)	0.05	0.01	0.03	<0.01	0.04	0.04	<0.01
Mercury	0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
NO2 asN mg/L	1	<0.006	<0.006	0.18	<0.006	0.18	<0.006
NO3 as N mg/L	10	25.4	0.009	0.68	1.3	0.071	0.015
pH units	(6.5-8.5)*	7.5	7.84	7.27	7.56	7.27	6.1
Phenol ug/L	2	<2	3	<2	4	<2	<2
Potassium(diss)	N/L	1.26	3.36	3.01	5.17	2.98	<0.20
Selenium(diss)	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium(diss)	(200)*	41.6	40.3	54.3	5.92	55.2	<0.050
Total Dissolved Solid	500	650	315	600	370	610	<1
Total Kjeldahl Nitrogen	N/L	<0.1	0.29	<0.1	<0.1	<0.1	<0.1
Turbidity NTU	1	<0.1	7.1	<0.1	<0.1	0.2	<0.1

ALL RESULTS ARE EXPRESSED IN mg/L UNLESS OTHERWISE STATED.
SHADED AREAS INDICATE VALUES THAT EXCEED ODWO MAXIMUM ACCEPTABLE CONCENTRATIONS
( )* INDICATES LIMITS ARE OBTAINED FROM O.D.W.O. 1994 DRAFT GUIDELINES.
N/L INDICATES NO LIMIT
O.D.W.O. INDICATES ONTARIO DRINKING WATER OBJECTIVES

Ground water at RW4 is considered to represent background ground water quality in the area of the landfill site. The drilled well, RW4, is located approximately 400 meters north of the landfill. The elevated phenol concentration detected at the well (4 ug/L) could be the result of natural conditions. Phenols were also found in the dug well, RW2, at 3 ug/L. This concentration is below the background level at RW4. The phenol concentration of 6 ug/L, detected at test well TW5-2, is above the background concentration and is interpreted to be the result of natural causes.

5.1.1 Reasonable Use Assessment

Nine parameters were used to calculate the maximum allowed concentration (Cm), of these parameters at the property boundary. The calculations are contained in Appendix F.

Residential well, RW4, was used as the background well for determining reasonable use concentrations. The concentration of sodium at RW4 (5.92) is an order of magnitude lower than sodium concentrations at the three other residential wells monitored, which could also be used to establish background water quality. The Cm for sodium shown below, is therefore, considered to be conservative in value as natural variations in background sodium concentrations are apparent for the area.

Barium (Ba) - Health	Cm_{Ba}	=	0.265 mg/L
Alkalinity - Aesthetic	Cm_{Alk}	=	380 mg/L
Colour - Aesthetic	Cm_{Colour}	=	5.0 TCU
Turbidity - Aesthetic	Cm_{Turb}	=	0.55 NTU
Manganese (Mn) - Aesthetic	Cm_{Mn}	=	0.045 mg/L
Chloride (Cl) - Aesthetic	Cm_{Cl}	=	134.9 mg/L
Sodium (Na) - Health	Cm_{Na}	=	54.44 mg/L
TDS - Aesthetic	Cm_{TDS}	=	435 mg/L
Iron (Fe) - Aesthetic	Cm_{Fe}	=	0.16 mg/L

Examination of Table 4 shows that the concentrations of barium, sodium, manganese, total dissolved solids, colour, turbidity, and alkalinity at TW2-2 and TW3-1 are present in excess of the reasonable use values shown above. Water samples collected from piezometers TW2-1, TW4-1, TW5-1 and TW5-2 exhibit concentrations in excess of the maximum allowable concentrations for turbidity. Chloride and iron are also present above reasonable use values at TW2-2. Water collected from piezometer TW5-2 shows concentrations in excess of the reasonable use Cm value for sodium.

Test wells, TW2, TW3, and TW5, which exhibited exceedance of reasonable use values, are located very close to the site boundaries. TW1, located close to the western boundary,and TW4, located near the centre of the landfill, only exceeded reasonable use for turbidity. There are currently no monitoring wells located off site to verify off site impacts.

5.2 Surface Water Quality

Surface water samples were collected on July 26, 1994. The samples were analyzed for the Provincial Water Quality Objective (PWQO) indicator parameters. The sample collected from SW-1 was also analyzed for herbicides and pesticides. Location SW-1 was selected for herbicide and pesticide analysis because it was considered to be the surface water location with the greatest possibility for leachate contamination. The analytical results for the surface water samples collected are summarized in Table 6. Results of the herbicide and pesticide analysis are summarized in Table 7.

Sample location SW4 is approximately 300 meters west and upstream of the landfill site. SW4 is interpreted to represent background conditions for surface water for this program. Total lead was detected at 0.010 mg/L and pH was measured at 9.09, at SW4. Both parameters are present in concentrations above the PWQO MAC limit.

The sample collected from surface water location SW2 showed concentrations of total iron (1.07 mg/L) and total lead (0.012 mg/L) above PWQO MAC limits. The PWQO MAC limit for total iron is 0.3 mg/L and for total lead is 0.005 mg/L. SW2 is located over 150 meters east and downstream of the landfill site, in the neighbouring wetland.

Table 6: Summary of Surface Water Quality Results, August, 1994
Stoney Lake Road Landfill - Douro Township Project # 7777 - 096

Parameter	PWQO	SW1	SW2	SW4	Dupl. SW1	Trav. Blk.
Alkalinity as CaCO3	N/L	255	263	75	254	<1
Aluminium	0.1	0.12	<0.10	0.19	0.1	<0.10
Ammonia + Ammonium	N/L	<0.1	<0.1	<0.1	<0.1	<0.10
Biological Oxygen Demand	N/L	<4	<4	<4	<4	<4
Cadmium	0.0002	<0.0002	<0.0002	<0.0002	NA	<0.0002
Calcium	N/L	94	99	28	93	0.1
Chemical Oxygen Demand	N/L	22	28	56	16	<8
Chloride	N/L	9.74	7.78	38.2	9.62	<0.20
Colour TCU	N/L	57	60	17	50	<5
Conductivity (umhos/cm)	N/L	484	489	291	480	1.05
Copper	0.005	0.02	0.015	0.006	NA	0.015
Cromium	0.1	<0.02	<0.02	<0.02	<0.02	<0.02
Dissolved Oxygen	N/L	7.7	7.7	8.4	8.2	7.4
Fecal. Coli (MPN/100mL)	N/L	>1100	500	<3	1100	NA
Fecal. Strep (/mL)	N/L	<1	<1	<1	<1	NA
Iron	0.3	0.44	1.07	0.25	0.41	0.04
Lead	0.005	<0.005	0.012	0.01	<0.005	<0.005
Magnesium	N/L	2.6	2.57	5.33	<0.05	<0.05
Manganese	N/L	0.07	0.7	0.04	<0.01	<0.01
Mercury	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
NH3 Union	0.02	<0.004	<0.005	<0.09	<0.006	<0.00002
Nickel	0.025	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate as Nitrogen	N/L	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite as Nitrogen	N/L	<0.006	<0.006	<0.006	<0.006	<0.006
pH (units)	6.5 - 8.5	7.9	7.99	9.09	8.04	6.01
Phenol	1	<2	<2	<2	<2	<2
Phosphorous (Total)	0.03	<0.10	<0.10	<0.10	<0.10	<0.10
Potassium	N/L	0.54	0.61	1.51	0.48	<0.20
Selenium	0.1	<0.010	<0.010	<0.010	<0.010	<0.010
Silver	0.001	0.0002	0.0009	0.0002	NA	<0.001
Sodium	N/L	7.07	4.89	23	7.15	<0.05
Total Kjeldahl Nitrogen	N/L	0.45	0.67	0.79	0.36	<0.1
Total Organic Carbon	N/L	11.8	13.9	11.8	10.7	<1
Total Suspended Solids	N/L	5	8	14	3	<1
Turbidity (NTU)	N/L	0.3	2.8	0.4	0.3	<0.1
Zinc	0.03	0.03	0.01	0.01	0.03	<0.01

ALL RESULTS ARE REPRESENTED IN mg/L UNLESS OTHERWISE STATED
SHADED AREAS INDICATE VALUES THAT EXCEED PWQO MAXIMUM ACCEPTABLE CONCENTRATIONS
SW3 AND SW5 WERE DRY DURING THE SUMMER SAMPLING PROGRAMME
NA - INDICATES NOT AVAILABLE
N/L - INDICATES NO LIMIT
P.W.Q.O. INDICATES PROVINCIAL WATER QUALITY OBJECTIVES

Table 7: Herbicide & Pesticide Results, August, 1994
Stoney Lake Road Landfill - Douro Township Project # 7777 - 096
For Sample SW1

Parameter	Result (µg/L)	ODWO (µg/L)	Livestock Watering (µg/L)
Hexachlorobenzene	< 0.006	N/L	N/L
Heptachlor	< 0.006	3.0	0.1
Aldrin	< 0.005	0.7	1.0
p.p' -DDE	< 0.005	N/L	N/L
Mirex	0.001	N/L	0.001
alpha - BHC	< 0.004	N/L	N/L
beta - BHC	< 0.005	N/L	N/L
gamma - BHC (Lindane)	< 0.003	4.0	5.0
delta - BHC	< 0.011	N/L	N/L
alpha - Chlordane	< 0.003	7.0	3.0
gamma - Chlordane	< 0.004	7.0	3.0
Oxychlodane	< 0.006	7.0	3.0
p.p' -DDD	< 0.005	N/L	N/L
p.p' -DDT	< 0.005	30	50
Methoxychlor	< 0.008	100	1000
Heptachlor Epoxide	< 0.006	3.0	0.1
alpha-Endosulphan	< 0.004	N/L	N/L
Dieldrin	< 0.003	0.7	1.0
Endrin	< 0.005	0.2	0.5
beta-Endosulphan	< 0.004	N/L	N/L
Endosulphan Sulphate	< 0.013	N/L	N/L
Total PCB	< 0.02	3.0	N/L
Endrin Aldehyde	< 0.005	N/L	N/L
Toxaphene	< 1	5.0	5.0
2,4 - D	ND	100	N/L
Silvex (2,4,5 - TP)	ND	10	N/L
2,4,5 - T	ND	280	N/L
Diazinon	ND	14	N/L
Methyl Parathion	ND	7.0	N/L
Parathion	ND	35	N/L
Chlorpyrifos	ND	90	N/L
Dimethoate	ND	20	N/L
Ethion	ND	N/L	N/L
Malathion	ND	190	N/L
Phorate	ND	2	N/L
Terbufos	ND	1.0	N/L
Dichlorvos	ND	N/L	N/L
Fenchlorphos	ND	N/L	N/L

ND - INDICATES THE SUBSTANCE WAS NOT DETECTED
N/L - INDICATES NO LIMIT AVAILABLE
O.D.W.O. INDICATES ONTARIO DRINKING WATER OBJECTIVES

The sample collected from SW1, located just west of SW2, showed a concentration of total iron (0.44 mg/L) above the PWQO MAC limit. A comparison of the total lead concentrations measured at SW4 and SW2 indicates only a small increase at SW2 over background water quality.

There were no herbicides or pesticides detected above ODWO MAC limits for the surface water sample collected from location SW1, east of the landfill site. Concentrations of aluminium (0.12 mg/L), copper (0.02 mg/L), iron (0.44 mg/L) and total phosphorous (<0.10 mg/L) were above PWQO MAC limits. Aluminium, copper, and total phosphorous concentrations at SW1 were less than the background concentrations at SW4.

Landfill leachates generated on site contain elevated concentrations of iron, manganese, and TDS. The presence of elevated iron concentrations at SW2 and SW1 suggest both these locations could be displaying evidence of leachate contamination.

6.0 SUMMARY

The results of the summer monitoring program indicate that the landfill is situated in a ground water discharge area. Ground water flow converges from the north and south under the landfill. The convergence of the ground water at the site suggests that the landfill is located in a discharge area.

Considering the limited information available to date, ground water and surface water quality does not appear to have been impacted significantly by landfilling activities. Background concentrations of phenols in the ground water was above ODWO MAC limits. The concentration of total lead at the background surface water location, SW4, was above PWQO MAC limits. Concentrations of barium and sodium, both health related parameters, are present in excess of the reasonable use values calculated for water samples from piezometers TW2-2 and TW3-1. These piezometers are close to the site boundary.

7.0 RECOMMENDATIONS

It is recommended that the landfill continue to be monitored on a seasonal basis and that the sample suite should include all ODWO and PWQO objectives. The monitoring program should continue until sufficient data are available to confirm findings to date and permit a thorough impact assessment of the site.

Landfill gas is generally produced by the decomposition of domestic waste. Since domestic waste is a major contributor of landfill material at the landfill, gas production (specifically methane gas) may be significant at this site. Therefore, a gas monitoring program is recommended at the boundaries of the site. The program should be conducted in the winter months, when the ground is frozen.

Respectfully submitted,
LAKEFIELD RESEARCH

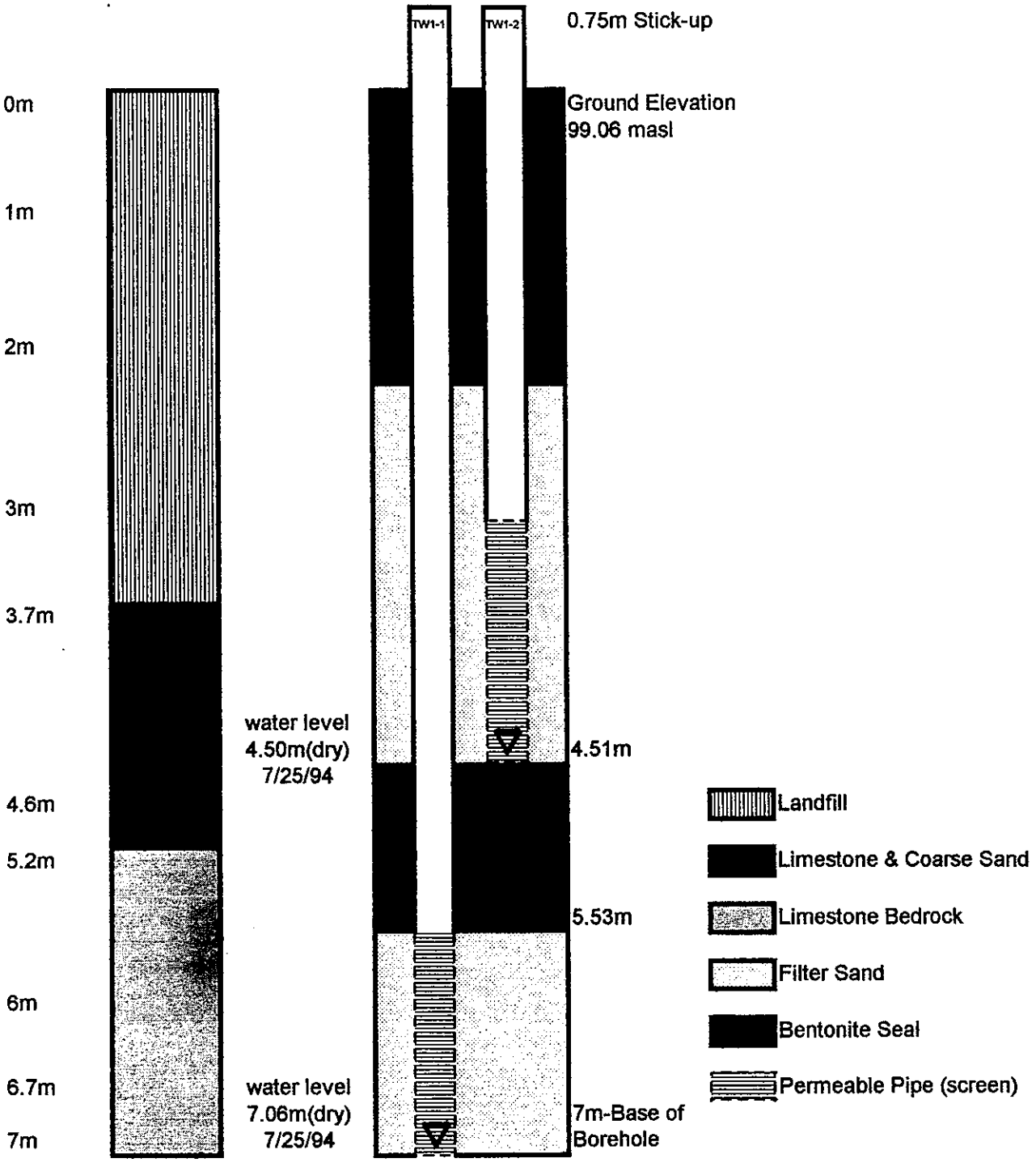
Steven R. Aiken, P.Eng.
Hydrogeological Engineer - Associate

Linda C.M. Elliott, M.Eng.
Project Manager

APPENDIX A

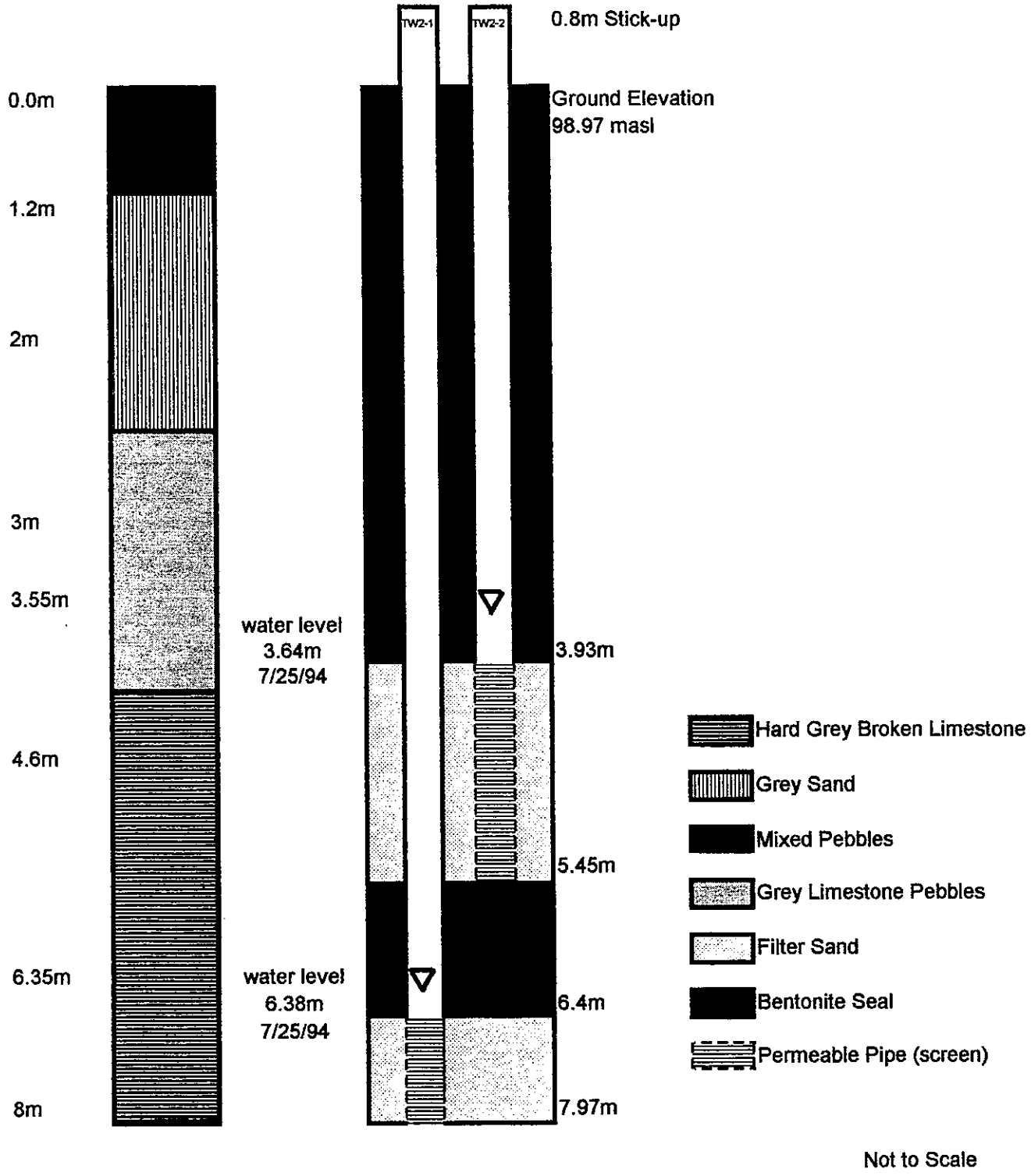
Well Logs and Piezometer As-Built Diagrams

Well Log and As-Built Diagrams for TW1 @Stoney Lake Road Landfill (Douro North)
7777-096
Date Drilled: July 21 1994



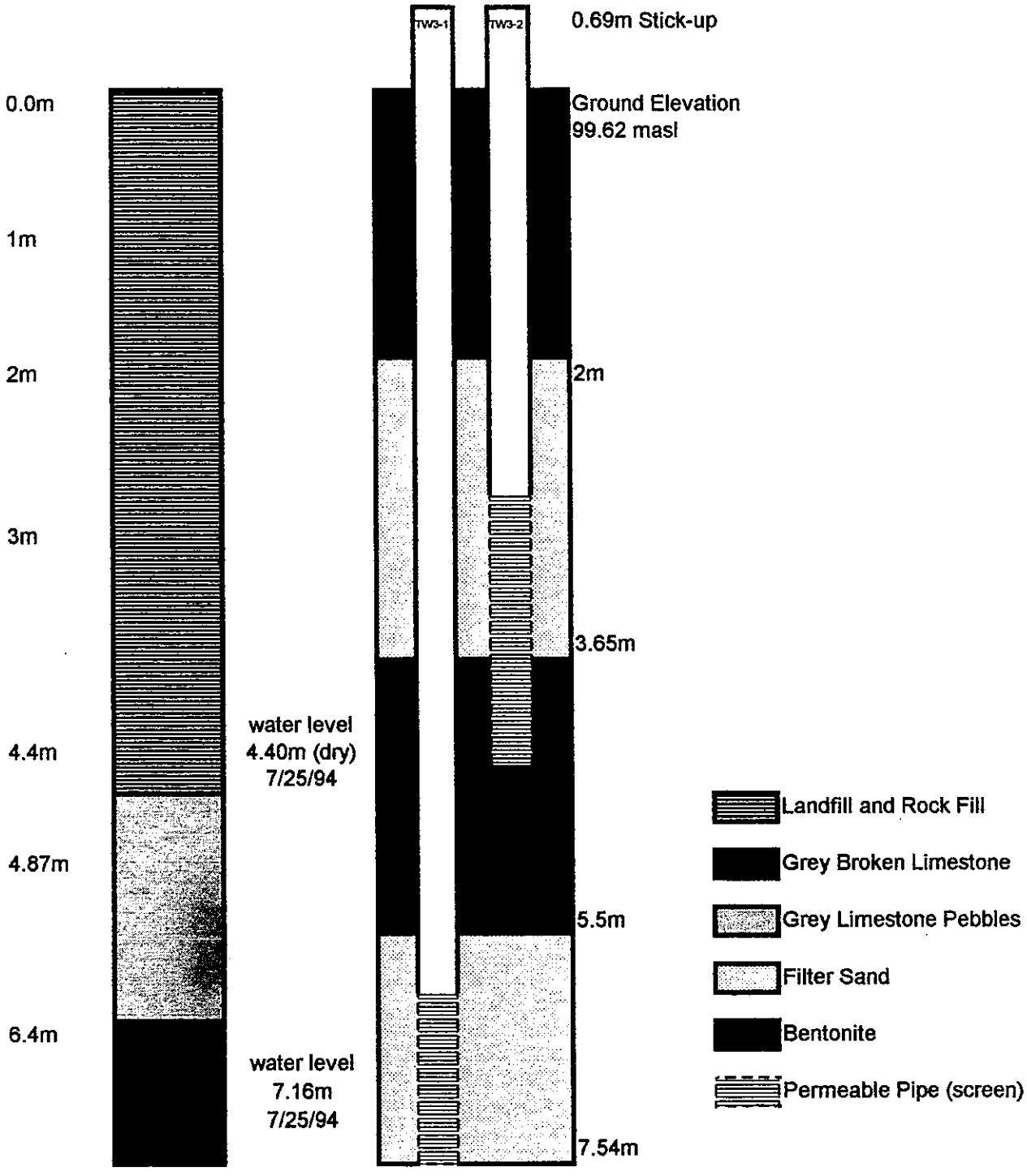
Not to Scale

Well Log and As-Built Diagrams for TW2 @Stoney Lake Road Landfill (Douro North)
7777-096
Date Drilled: July 21 1994

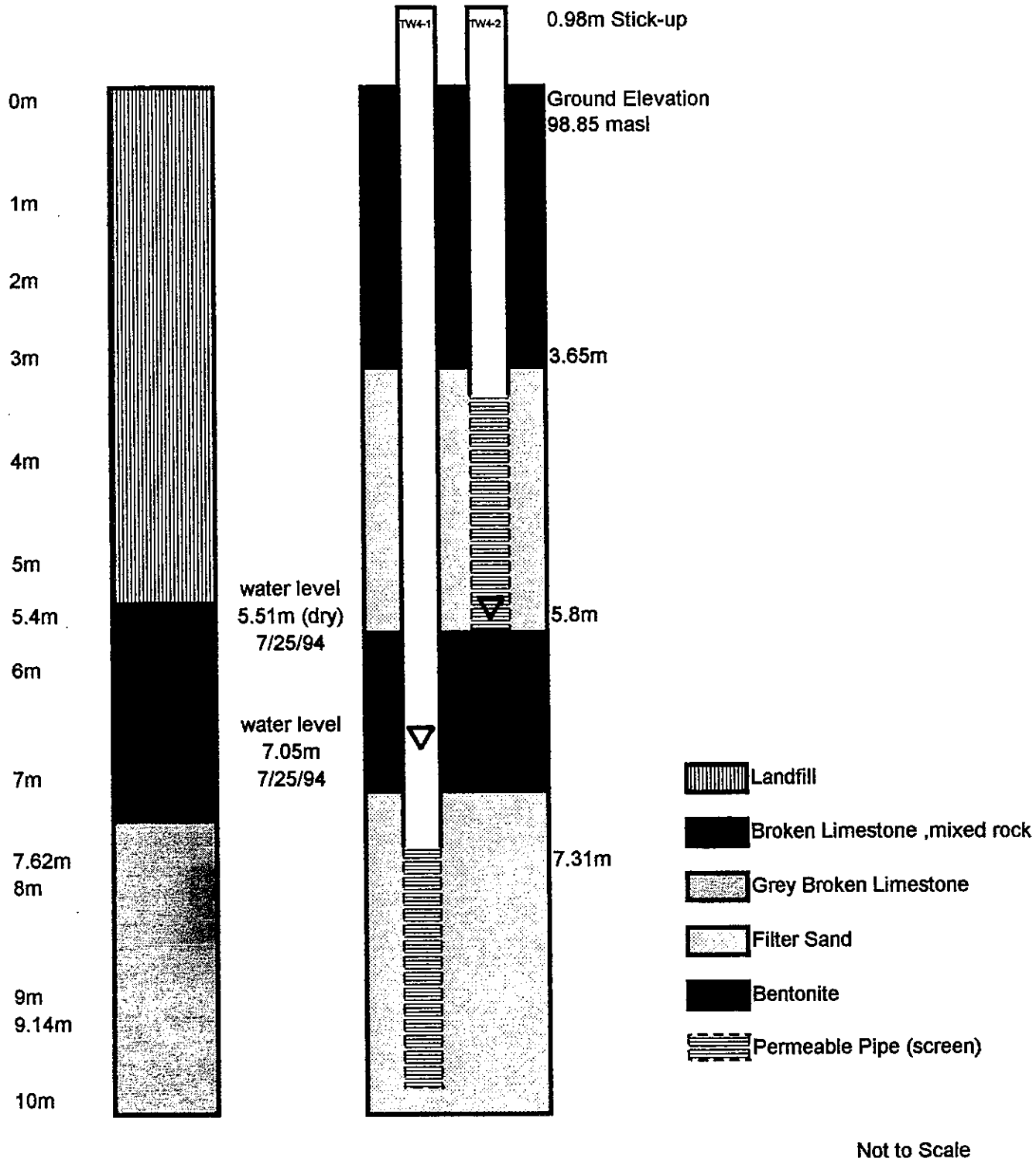


Not to Scale

Well Log and As-Built Diagrams for TW3 @Stoney Lake Road Landfill (Douro North)
7777-096
Date Drilled: July 21 1994

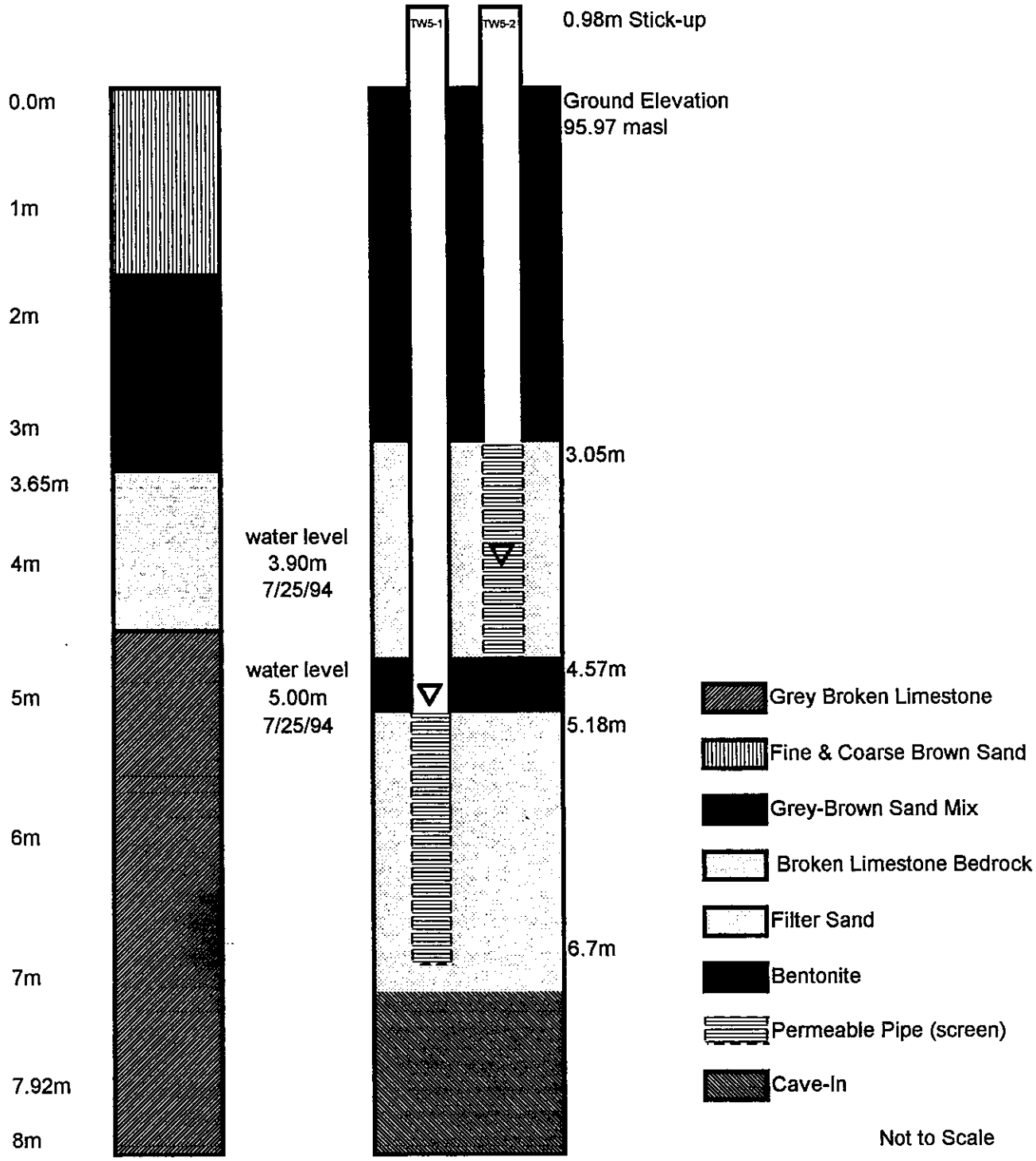


Well Log and As-Built Diagrams for TW4 @Stoney Lake Road Landfill (Douro North)
7777-096
Date Drilled: July 21 1994



Not to Scale

Well Log and As-Built Diagrams for TW5 @Stoney Lake Road Landfill (Douro North)
7777-096
Date Drilled: July 21 1994



APPENDIX B

Hydraulic Gradient and Ground Water Flow Direction Calculations

Stoney Lake Road "North" Landfill Site
Ground Water Flow Directions and Gradients: (August, 1994)

TW2-1 to TW1-1

93.39m - 92.88m = 0.51m = Δh, Δl = 120.51m

$i = \Delta h / \Delta l$
= 0.51m / 120.51m
= 0.0042m

TW2-1 to TW3-1

93.39m - 93.18m = 0.21m = Δh, Δl = 69.67m

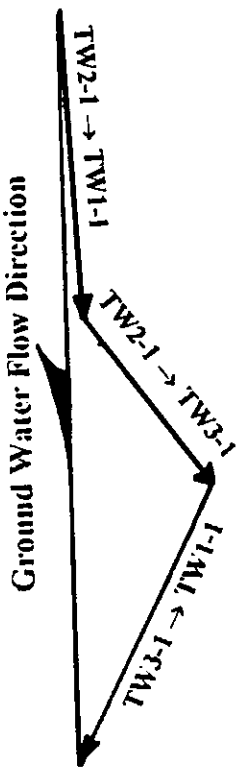
$i = \Delta h / \Delta l$
= 0.21m / 69.67m
= 0.0030m

TW3-1 to TW1-1

93.18m - 92.88m = 0.30m = Δh, Δl = 71.15m

$i = \Delta h / \Delta l$
= 0.30m / 71.15m
= 0.0042

178° East of North
(approximately due south)



scale 1:100

Stoney Lake Road "North" Landfill Site
Ground Water Flow Directions and Gradients: (August, 1994)

TW5-1 to TW1-1

93.20m - 92.88m = 0.32m = Δh, Δl = 135.50m

$i = \Delta h / \Delta l$
$= 0.32m / 135.50m$
$= 0.0024m$

TW1-1 to TW4-1

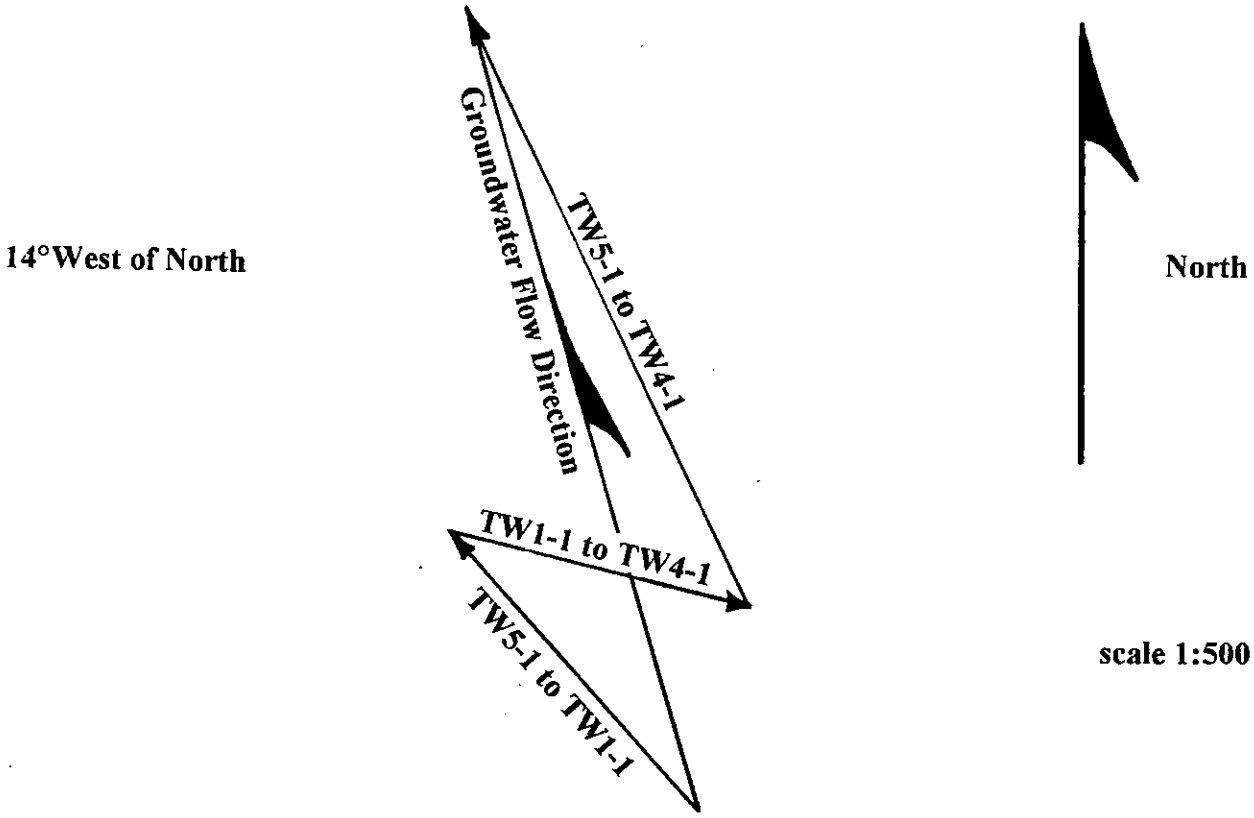
92.88m - 92.78m = 0.10m = Δh, Δl = 49.54m

$i = \Delta h / \Delta l$
$= 0.10m / 49.54m$
$= 0.0020m$

TW5-1 to TW4-1

93.20m - 92.78m = 0.42m = Δh, Δl = 97.33m

$i = \Delta h / \Delta l$
$= 0.42m / 97.33m$
$= 0.0043m$



APPENDIX C

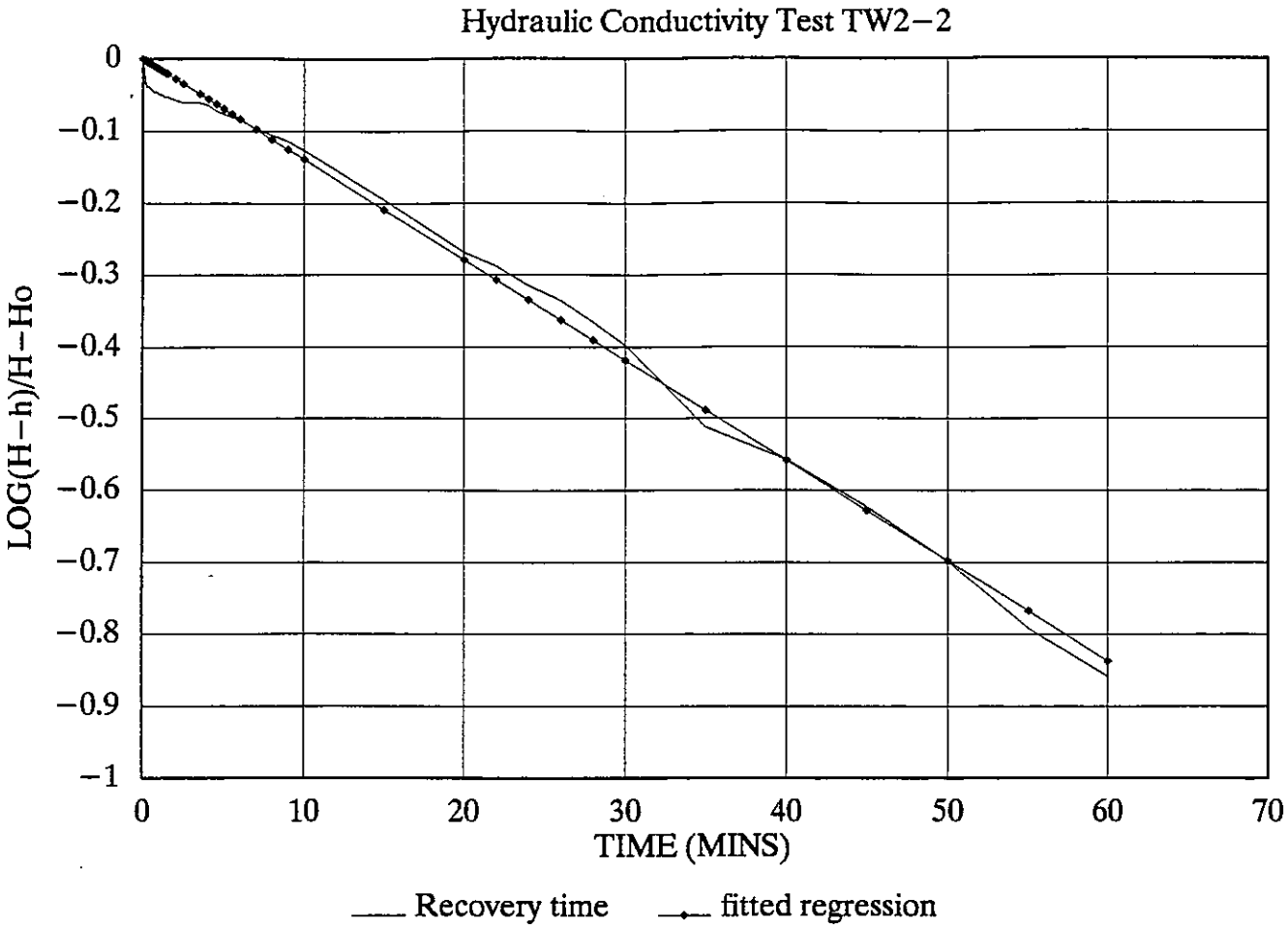
Hydraulic Conductivity Calculations

HYDRAULIC CONDUCTIVITY CALCULATION
HVORSLEV METHOD

Project: Stoney Lake Road "north" Landfill Site
Test #: TW2-2
Date: August 24, 1994

CONSTANTS:		RESULTS:	
L (m)	1.50	K (m/s):	4.60E-07
R (m)	0.025	R squared:	0.991061
r (m)	0.025		
ALPHA (m)	0.000853		
LOG (0.37)	-0.4318		
H(static), m	3.80		
H0(t=0), m	5.10		
H-H0 ,m	1.30		

Stoney Lake Road "North" Landfill



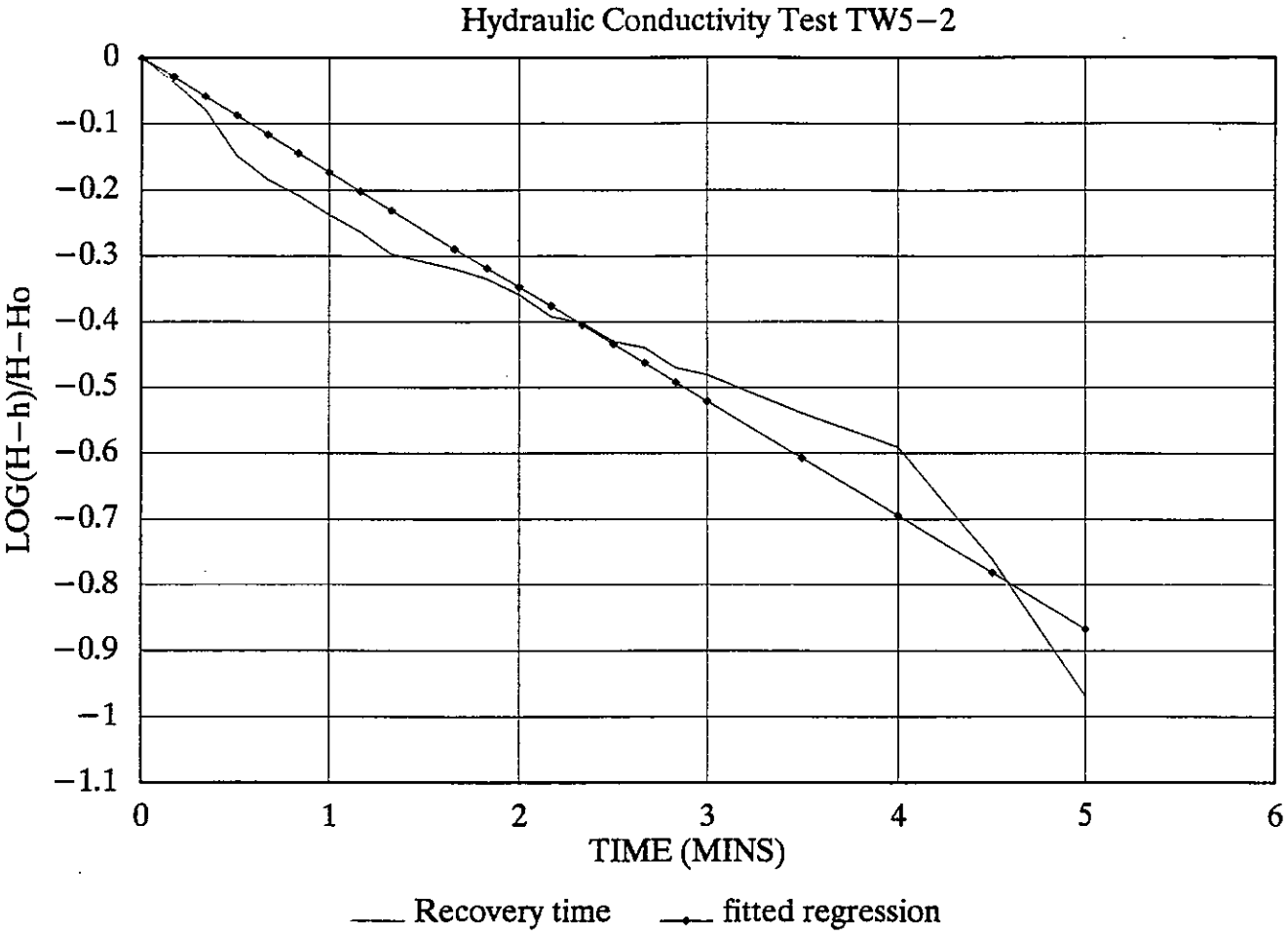
abs time (h)	(m)	(s)	rel time (min)	level h (m.)	diff H-h (m.)	norm	log(norm)	est.
		0	0	5.1	1.3	1	0	0
		10	0.166666667	4.99	1.19	0.915385	-0.0384	-0.00233
		20	0.333333333	4.99	1.19	0.915385	-0.0384	-0.00465
		30	0.5	4.98	1.18	0.907692	-0.04206	-0.00698
		40	0.666666667	4.97	1.17	0.9	-0.04576	-0.00931
		50	0.833333333	4.97	1.17	0.9	-0.04576	-0.01164
		60	1	4.96	1.16	0.892308	-0.04949	-0.01396
	1	10	1.166666667	4.96	1.16	0.892308	-0.04949	-0.01629
	1	20	1.333333333	4.95	1.15	0.884615	-0.05325	-0.01862
	1	30	1.5	4.95	1.15	0.884615	-0.05325	-0.02094
	2	0	2	4.94	1.14	0.876923	-0.05704	-0.02793
	2	30	2.5	4.93	1.13	0.869231	-0.06086	-0.03491
	3	30	3.5	4.93	1.13	0.869231	-0.06086	-0.04887
	4	0	4	4.92	1.12	0.861538	-0.06473	-0.05585
	4	30	4.5	4.9	1.1	0.846154	-0.07255	-0.06283
	5	0	5	4.89	1.09	0.838462	-0.07652	-0.06982
	5	30	5.5	4.88	1.08	0.830769	-0.08052	-0.0768
	6	0	6	4.87	1.07	0.823077	-0.08456	-0.08378
	7	0	7	4.84	1.04	0.8	-0.09691	-0.09774
	8	0	8	4.82	1.02	0.784615	-0.10534	-0.11171
	9	0	9	4.8	1	0.769231	-0.11394	-0.12567
	10	0	10	4.77	0.97	0.746154	-0.12717	-0.13963
	15	0	15	4.63	0.83	0.638462	-0.19487	-0.20945
	20	0	20	4.5	0.7	0.538462	-0.26885	-0.27926
	22	0	22	4.47	0.67	0.515385	-0.28787	-0.30719
	24	0	24	4.43	0.63	0.484615	-0.3146	-0.33512
	26	0	26	4.4	0.6	0.461538	-0.33579	-0.36304
	28	0	28	4.36	0.56	0.430769	-0.36576	-0.39097
	30	0	30	4.32	0.52	0.4	-0.39794	-0.4189
	35	0	35	4.2	0.4	0.307692	-0.51188	-0.48871
	40	0	40	4.16	0.36	0.276923	-0.55764	-0.55853
	45	0	45	4.11	0.31	0.238462	-0.62258	-0.62834
	50	0	50	4.06	0.26	0.2	-0.69897	-0.69816
	55	0	55	4.01	0.21	0.161538	-0.79172	-0.76798
	60	0	60	3.98	0.18	0.138462	-0.85867	-0.83779

HYDRAULIC CONDUCTIVITY CALCULATION
HVORSLEV METHOD

Project: Stoney Lake Road "north" Landfill Site
Test #: TW5-2
Date: August 24, 1994

CONSTANTS:		RESULTS:	
L (m)	1.50	K (m/s):	5.71E-06
R (m)	0.025	R squared:	0.949597
r (m)	0.025		
ALPHA (m)	0.000853		
LOG (0.37)	-0.4318		
H(static), m	3.99		
H0(t=0), m	5.20		
H-H0 ,m	1.21		

Stoney Lake Road "North" Landfill



abs time (h)	(m)	(s)	rel time (min)	level h (m.)	diff H-h (m.)	norm	log(norm)	est.
		0	0	5.2	1.21	1	0	0
		10	0.166666667	5.1	1.11	0.917355	-0.03746	-0.02892
		20	0.333333333	5	1.01	0.834711	-0.07846	-0.05785
		30	0.5	4.85	0.86	0.710744	-0.14829	-0.08677
		40	0.666666667	4.78	0.79	0.652893	-0.18516	-0.1157
		50	0.833333333	4.74	0.75	0.619835	-0.20772	-0.14462
		60	1	4.69	0.7	0.578512	-0.23769	-0.17355
	1	10	1.166666667	4.65	0.66	0.545455	-0.26324	-0.20247
	1	20	1.333333333	4.6	0.61	0.504132	-0.29746	-0.23139
	1	40	1.666666667	4.57	0.58	0.479339	-0.31936	-0.28924
	1	50	1.833333333	4.55	0.56	0.46281	-0.3346	-0.31817
	2	0	2	4.52	0.53	0.438017	-0.35851	-0.34709
	2	10	2.166666667	4.48	0.49	0.404959	-0.39259	-0.37602
	2	20	2.333333333	4.47	0.48	0.396694	-0.40154	-0.40494
	2	30	2.5	4.44	0.45	0.371901	-0.42957	-0.43386
	2	40	2.666666667	4.43	0.44	0.363636	-0.43933	-0.46279
	2	50	2.833333333	4.4	0.41	0.338843	-0.47	-0.49171
	3	0	3	4.39	0.4	0.330579	-0.48073	-0.52064
	3	30	3.5	4.34	0.35	0.289256	-0.53872	-0.60741
	4	0	4	4.3	0.31	0.256198	-0.59142	-0.69418
	4	30	4.5	4.2	0.21	0.173554	-0.76057	-0.78096
	5	0	5	4.12	0.13	0.107438	-0.96884	-0.86773
	5	30	5.5	4.05	0.06	0.049587	-1.30463	-0.9545
	6	0	6	4.03	0.04	0.033058	-1.48073	-1.04128
	6	30	6.5	4.01	0.02	0.016529	-1.78176	-1.12805
	7	0	7	4	0.01	0.008264	-2.08279	-1.21482
	7	30	7.5	3.99	0	0	ERR	-1.30159

APPENDIX D

Certificates of Analyses: July and August 1994

LAKEFIELD RESEARCH

A Division of Falconbridge Limited

P.O. Box 4300, 185 Concession St., Lakefield, Ontario, K0L 2H0

Phone : 705-652-2000 - FAX : 705-652-6365

Environmental Services

Attn : L. Elliott

Lakefield, August 22, 1994

Date Rec. : July 22, 1994
LR. Ref. : **JUL7363.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	Limits	TW1-1 (dry)	TW1-2 (dry)	TW2-1	TW2-2
As (Diss) [mg/L]	0.025	--	--	< 0.01	< 0.01
Ba (Diss) [mg/L]	1.0	--	--	0.03	0.31
B (Diss) [mg/L]	5.0	--	--	< 0.02	0.13
Cd (Diss) [mg/L]	0.005	--	--	< 0.005	< 0.005
Cr (Diss) [mg/L]	0.05	--	--	< 0.02	< 0.02
Pb (Diss) [mg/L]	0.01	--	--	< 0.005	< 0.005
Se (Diss) [mg/L]	0.01	--	--	< 0.01	< 0.01
Ca (Diss) [mg/L]	--	--	--	97.7	465
Mg (Diss) [mg/L]	--	--	--	2.28	24.9
Fe (Diss) [mg/L]	0.3	--	--	0.02	45.7
Mn (Diss) [mg/L]	0.05	--	--	< 0.01	6.14
Na (Diss) [mg/L]	200	--	--	1.65	94.6
K (Diss) [mg/L]	--	--	--	0.85	8.79
Hg (tot) [mg/L]	0.001	--	--	< 0.0001	< 0.0001
F [mg/L]	1.5	--	--	0.07	0.05
NO2 as N [mg/L]	1.0	--	--	< 0.006	0.069
NO3 as N [mg/L]	10.0	--	--	1.96	0.025
Cl- [mg/L]	250	--	--	3.70	153
CN- [mg/L]	0.2	--	--	< 0.01	< 0.01
TKN [mg/L]	--	--	--	0.20	14.1
NH3+NH4 [(N) mg/L]	--	--	--	< 0.1	11.8
Diss. O [mg/L]	--	--	--	9.0	2.1
pH [units]	6.5 -8.5	--	--	7.63	6.53
TDS [mg/L]	500	--	--	290	2484
Cond. [µmhos/cm]	--	--	--	460	2820
Alk.mg/L [as CaCO3]	30 -500	--	--	362	1221
Colour [TCU]	5.0	--	--	< 5	21
Turbidity [NTU]	1.0	--	--	82	156
BOD [mg/L]	--	--	--	< 4	780
COD [mg/L]	--	--	--	< 8	780
Phenol [µg/L]	2	--	--	< 2	< 2

Dave Hevenor

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LAKEFIELD RESEARCH

A Division of Falconbridge Limited

P.O. Box 4300, 185 Concession St., Lakefield, Ontario, KOL 2HO

Phone : 705-652-2000 - FAX : 705-652-6365

Environmental Services

Lakefield, August 22, 1994

Attn : L. Elliott

Date Rec. : July 22, 1994
LR. Ref. : **JUL7363.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	TW3-1	TW3-2 (dry)	TW4-1	TW4-2 (dry)	TW5-1
As (Diss) [mg/L]	< 0.01	--	< 0.01	--	< 0.01
Ba (Diss) [mg/L]	0.38	--	0.03	--	0.07
B (Diss) [mg/L]	0.22	--	< 0.02	--	< 0.02
Cd (Diss) [mg/L]	< 0.005	--	< 0.005	--	< 0.005
Cr (Diss) [mg/L]	< 0.02	--	< 0.02	--	< 0.02
Pb (Diss) [mg/L]	< 0.005	--	< 0.005	--	< 0.005
Se (Diss) [mg/L]	< 0.01	--	< 0.01	--	< 0.01
Ca (Diss) [mg/L]	148	--	111	--	64.6
Mg (Diss) [mg/L]	14.5	--	2.10	--	5.73
Fe (Diss) [mg/L]	0.07	--	< 0.02	--	0.04
Mn (Diss) [mg/L]	0.77	--	< 0.01	--	0.04
Na (Diss) [mg/L]	70.8	--	4.13	--	29.6
K (Diss) [mg/L]	24.9	--	1.33	--	2.47
Hg (tot) [mg/L]	< 0.0001	--	0.0001	--	< 0.0001
F [mg/L]	0.08	--	0.05	--	0.13
NO2 as N [mg/L]	0.086	--	< 0.006	--	< 0.006
NO3 as N [mg/L]	0.33	--	1.80	--	0.16
Cl- [mg/L]	75.1	--	9.42	--	26.3
CN- [mg/L]	< 0.01	--	< 0.01	--	< 0.01
TKN [mg/L]	26.9	--	< 0.1	--	0.28
NH3+NH4 [(N) mg/L]	26.8	--	< 0.1	--	< 0.1
Diss. O [mg/L]	5.8	--	8.4	--	8.0
pH [units]	6.90	--	7.50	--	7.90
TDS [mg/L]	756	--	354	--	316
Cond. [µmhos/cm]	1338	--	528	--	474
Alk.mg/L [as CaCO3]	593	--	274	--	169
Colour [TCU]	12	--	< 5	--	< 5
Turbidity [NTU]	18.9	--	38.4	--	12.9
BOD [mg/L]	13	--	< 4	--	< 4
COD [mg/L]	78	--	< 8	--	10
Phenol [µg/L]	< 2	--	< 2	--	2

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A Division of Falconbridge Limited

P.O. Box 4300, 185 Concession St., Lakefield, Ontario, KOL 2HO

Phone : 705-652-2000 - FAX : 705-652-6365

Environmental Services

Lakefield, August 22, 1994

Attn : L. Elliott

Date Rec. : July 22, 1994
LR. Ref. : **JUL7363.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	TW5-2	Duplicate TW2-1	Travelling Blank
As (Diss) [mg/L]	< 0.01	< 0.01	< 0.01
Ba (Diss) [mg/L]	0.04	0.03	< 0.02
B (Diss) [mg/L]	< 0.02	< 0.02	< 0.02
Cd (Diss) [mg/L]	< 0.005	< 0.005	< 0.005
Cr (Diss) [mg/L]	< 0.02	< 0.02	< 0.02
Pb (Diss) [mg/L]	< 0.005	< 0.005	< 0.005
Se (Diss) [mg/L]	< 0.01	< 0.01	< 0.01
Ca (Diss) [mg/L]	28.9	97.3	< 0.1
Mg (Diss) [mg/L]	3.01	2.23	< 0.02
Fe (Diss) [mg/L]	0.04	< 0.02	< 0.02
Mn (Diss) [mg/L]	< 0.01	< 0.01	< 0.01
Na (Diss) [mg/L]	66.3	1.52	< 0.05
K (Diss) [mg/L]	2.26	0.75	< 0.20
Hg (tot) [mg/L]	< 0.0001	--	< 0.0001
F [mg/L]	0.19	0.08	0.01
NO2 as N [mg/L]	< 0.006	< 0.006	< 0.006
NO3 as N [mg/L]	0.61	1.86	< 0.005
Cl- [mg/L]	24.0	3.46	< 0.2
CN- [mg/L]	< 0.01	< 0.01	< 0.01
TKN [mg/L]	0.15	0.24	< 0.1
NH3+NH4 [(N) mg/L]	0.15	< 0.1	< 0.1
Diss. O [mg/L]	7.9	9.2	8.4
pH [units]	8.21	7.65	6.02
TDS [mg/L]	362	270	4
Cond. [µmhos/cm]	447	459	1.0
Alk.mg/L [as CaCO3]	154	265	< 1
Colour [TCU]	5	< 5	< 5
Turbidity [NTU]	32	76	< 0.1
BOD [mg/L]	< 4	< 4	< 4
COD [mg/L]	14	< 8	..
Phenol [µg/L]	6	< 2	< 2

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Environmental Services

Attn : L. Elliott

Lakefield, August 22, 1994

Date Rec. : July 22, 1994
LR. Ref. : **JUL7364.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	Limits	SW1	SW2	SW3 (Dry)	SW4
Hg [mg/L]	0.0002	< 0.0001	< 0.0001	--	< 0.0001
Al (tot) [mg/L]	--	0.12	< 0.10	--	0.19
Cu (tot) [mg/L]	0.005	0.020	0.015	--	0.006
Cd (tot) [mg/L]	0.0002	< 0.0002	< 0.0002	--	< 0.0002
Cr (tot) [mg/L]	0.10	< 0.02	< 0.02	--	< 0.02
P total [mg/L]	0.02	< 0.10	< 0.10	--	< 0.10
Ni (tot) [mg/L]	0.025	< 0.02	< 0.02	--	< 0.02
Pb (tot) [mg/L]	0.005	< 0.005	0.012	--	0.010
Ag (tot) [mg/L]	0.0001	0.0002	0.0009	--	0.0002
Se (tot) [mg/L]	0.10	< 0.01	< 0.01	--	< 0.01
Zn (tot) [mg/L]	0.03	0.03	0.01	--	0.01
Ca (tot) [mg/L]	--	94	99	--	28
Mg (tot) [mg/L]	--	2.60	2.57	--	5.33
Mn (tot) [mg/L]	--	0.07	0.70	--	0.04
Fe (tot) [mg/L]	0.3	0.44	1.07	--	0.25
Na (tot) [mg/L]	--	7.07	4.89	--	23
K (tot) [mg/L]	--	0.54	0.61	--	1.51

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Environmental Services

Attn : L. Elliott

Lakefield, August 22, 1994

Date Rec. : July 22, 1994
LR. Ref. : **JUL7364.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	SW10 (Dry)	SW1 Duplicate	Travelling Blank
Hg [mg/L]	--	< 0.0001	< 0.0001
Al (tot) [mg/L]	--	0.10	< 0.10
Cu (tot) [mg/L]	--	--	0.015
Cd (tot) [mg/L]	--	--	< 0.0002
Cr (tot) [mg/L]	--	< 0.02	< 0.02
P total [mg/L]	--	< 0.10	< 0.10
Ni (tot) [mg/L]	--	< 0.02	< 0.02
Pb (tot) [mg/L]	--	--	< 0.005
Ag (tot) [mg/L]	--	--	< 0.0001
Se (tot) [mg/L]	--	< 0.01	< 0.01
Zn (tot) [mg/L]	--	0.03	< 0.01
Ca (tot) [mg/L]	--	93	0.1
Mg (tot) [mg/L]	--	2.60	< 0.05
Mn (tot) [mg/L]	--	0.06	< 0.01
Fe (tot) [mg/L]	--	0.41	0.04
Na (tot) [mg/L]	--	7.15	< 0.05
K (tot) [mg/L]	--	0.48	< 0.20

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Environmental Services

Attn : L. Elliott

Lakefield, August 22, 1994

Date Rec. : July 22, 1994
LR. Ref. : **JUL7365.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	Limits	SW1	SW2	SW3 (dry)	SW4
NH3+NH4 [(N) mg/L]	--	< 0.1	< 0.1	--	< 0.1
TKN [mg/L]	--	0.45	0.67	--	0.79
TOC [mg/L]	--	11.8	13.9	--	11.8
NO2 as N [mg/L]	--	< 0.006	< 0.006	--	< 0.006
NO3 as N [mg/L]	--	< 0.005	< 0.005	--	< 0.005
Cl- [mg/L]	--	9.74	7.78	--	38.2
Turbidity [NTU]	--	0.3	2.8	--	0.4
TSS [mg/L]	--	5	8	--	14
Cond. [µmhos/cm]	--	484	489	--	291
pH [units]	6.5 -8.5	7.90	7.99	--	9.09
Alk.mg/L [as CaCO3]	--	255	263	--	75
Dis. O [mg/L]	--	7.7	7.7	--	8.4
Phenol [µg/L]	1	< 2	< 2	--	< 2
BOD [mg/L]	--	< 4	< 4	--	< 4
COD [mg/L]	--	22	28	--	56
Colour [TCU]	--	57	60	--	17
NH3 mg/L [unionized]	0.02	< 0.004	< 0.005	--	< 0.09
Coli Fec. [MPN/100ml	--	> 1100	500	--	< 3
Fecal Str [/ml]	--	< 1	< 1	--	< 1
Pesticide [---]	--	--	--	--	--

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Project : 9446651

CERTIFICATE OF ANALYSIS

Element	SW10(dry)	SW1 Duplicate	Travelling Blank
NH3+NH4 [(N) mg/L]	--	< 0.1	< 0.1
TKN [mg/L]	--	0.36	< 0.1
TOC [mg/L]	--	10.7	< 1
NO2 as N [mg/L]	--	< 0.006	< 0.006
NO3 as N [mg/L]	--	< 0.005	< 0.005
Cl- [mg/L]	--	9.62	< 0.2
Turbidity [NTU]	--	0.3	< 0.1
TSS [mg/L]	--	3	< 1
Cond. [µmhos/cm]	--	480	1.05
pH [units]	--	8.04	6.01
Alk.mg/L [as CaCO3]	--	254	< 1
Dis. O [mg/L]	--	8.2	7.4
Phenol [µg/L]	--	< 2	< 2
BOD [mg/L]	--	< 4	< 4
COD [mg/L]	--	16	< 8
Colour [TCU]	--	50	< 5
NH3 mg/L [unionized]	--	< 0.006	< 0.00002
Coli Fec. [MPN/100ml	--	1100	--
Fecal Str [/ml]	--	< 1	--
Pesticide [---]	--	--	--

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Attn : L. Elliott

Date Rec. : July 22, 1994
LR. Ref. : **JUL7366.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	Limits	RW1	RW2	RW3
As (Diss) [mg/L]	0.025	< 0.025	< 0.025	< 0.025
Ba (Diss) [mg/L]	1.0	0.27	0.14	0.04
B (Diss) [mg/L]	5.0	0.03	0.16	0.20
Cd (Diss) [mg/L]	0.005	< 0.005	< 0.005	< 0.005
Cr (Diss) [mg/L]	0.05	< 0.02	< 0.02	< 0.02
Pb (Diss) [mg/L]	0.01	< 0.01	< 0.01	< 0.01
Se (Diss) [mg/L]	0.01	< 0.01	< 0.01	< 0.01
Ca (Diss) [mg/L]	--	161	59.1	130
Mg (Diss) [mg/L]	--	15.1	21.0	12.9
Fe (Diss) [mg/L]	0.3	< 0.02	< 0.02	< 0.02
Mn (Diss) [mg/L]	0.05	< 0.01	0.03	< 0.01
Na (Diss) [mg/L]	200	41.6	40.3	54.3
K (Diss) [mg/L]	--	1.26	3.36	3.01
Hg (tot) [mg/L]	0.001	< 0.0001	< 0.0001	< 0.0001
F [mg/L]	1.5	0.05	0.51	0.24
NO2 as N [mg/L]	1.0	< 0.006	< 0.006	0.18
NO3 as N [mg/L]	10.0	25.4	0.009	0.068
Cl- [mg/L]	250	27.8	27.8	127
CN- [mg/L]	0.2	< 0.01	< 0.01	< 0.01
TKN [mg/L]	--	< 0.1	0.29	< 0.1
NH3+NH4 [(N) mg/L]	--	< 0.1	0.18	< 0.1
Diss. O [mg/L]	--	7.9	6.3	6.4
pH [units]	6.5 -8.5	7.50	7.84	7.27
TDS [mg/L]	500	650	315	600
Cond. [µmhos/cm]	--	1021	591	962
Alk.mg/L [as CaCO3]	30 -500	355	246	265
Colour [TCU]	5	< 5	< 5	< 5
Turbidity [NTU]	1.0	< 0.1	7.1	< 0.1
BOD [mg/L]	--	< 4	< 4	< 4
COD [mg/L]	--	≤ 8	< 8	< 8
Phenol [µg/L]	2	< 2	3	< 2

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Environmental Services

Lakefield, August 22, 1994

Attn : L. Elliott

Date Rec. : July 22, 1994
LR. Ref. : **JUL7366.C94**
Reference : 7777-096
Project : 9446651

CERTIFICATE OF ANALYSIS

Element	RW2	RW3	RW4	RW3 Duplicate	Travelling Blank
As (Diss) [mg/L]	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025
Ba (Diss) [mg/L]	0.14	0.04	< 0.02	0.04	< 0.02
B (Diss) [mg/L]	0.16	0.20	0.02	0.17	< 0.02
Cd (Diss) [mg/L]	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Cr (Diss) [mg/L]	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Pb (Diss) [mg/L]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Se (Diss) [mg/L]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ca (Diss) [mg/L]	59.1	130	110	130	< 0.10
Mg (Diss) [mg/L]	21.0	12.9	2.87	12.9	< 0.05
Fe (Diss) [mg/L]	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Mn (Diss) [mg/L]	0.03	< 0.01	< 0.01	< 0.01	< 0.01
Na (Diss) [mg/L]	40.3	54.3	5.92	55.2	< 0.050
K (Diss) [mg/L]	3.36	3.01	5.17	2.98	< 0.20
Hg (tot) [mg/L]	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
F [mg/L]	0.51	0.24	0.05	0.24	0.01
NO2 as N [mg/L]	< 0.006	0.18	< 0.006	0.18	< 0.006
NO3 as N [mg/L]	0.009	0.068	1.30	0.071	0.015
Cl- [mg/L]	27.8	127	19.8	125	< 0.2
CN- [mg/L]	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
TKN [mg/L]	0.29	< 0.1	< 0.1	< 0.1	< 0.1
NH3+NH4 [(N) mg/L]	0.18	< 0.1	< 0.1	< 0.1	< 0.1
Diss. O [mg/L]	6.3	6.4	8.3	6.2	7.5
pH [units]	7.84	7.27	7.56	7.27	6.10
TDS [mg/L]	315	600	370	610	< 1
Cond. [µmhos/cm]	591	962	572	959	1.04
Alk.mg/L [as CaCO3]	246	265	260	35	< 1
Colour [TCU]	< 5	< 5	< 5	< 5	< 5
Turbidity [NTU]	7.1	< 0.1	< 0.1	0.2	< 0.1
BOD [mg/L]	< 4	< 4	< 4	< 4	< 4
COD [mg/L]	< 8	< 8	< 8	< 8	< 8
Phenol [µg/L]	3	< 2	4	< 2	< 2

Dave Hevenor

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MDS
Environmental Services Limited

Certificate of Analysis

Client: (1542) Lakefield Research, Lakefield
Reported: 8-Aug-94

Project Number:
Purchase Order:
Attention: Mr. D. Hevenor
Date Received: 28-Jul-94
Work Order: 19765
Client Ref. #:
Sample Type: Liquid

Sample #	Test	Result	Units	MDL	Comment
94-A010745	Sample Description: LR 9446651 SW1			Date & Time Sampled:	
	2,4-D	ND	ug/L	0.1	
	Silvex (2,4,5-TP)	ND	ug/L	0.1	
	2,4,5-T	ND	ug/L	0.1	
	Diazinon	ND	ug/L	0.05	
	Methyl Parathion	ND	ug/L	0.05	
	Parathion	ND	ug/L	0.05	
	Chlorpyrifos	ND	ug/L	0.05	
	Dimethoate	ND	ug/L	0.05	
	Ethion	ND	ug/L	0.02	
	Malathion	ND	ug/L	0.05	
	Phorate	ND	ug/L	0.05	
	Terbufos	ND	ug/L	0.05	
	Dichlorvos	ND	ug/L	0.05	
	Fenchlorphos	ND	ug/L	0.05	

EXPLANATION OF CODES:
ND Not Detected **MDL** Method Detection Limit

W.M. Neaves M. Sc., C.Chem

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MDS
Environmental Services Limited

Certificate of Analysis ORGANOCHLORINE INSECTICIDES, GC-ECD

Client: (1542) Lakefield Research, Lakefield — Reported: 8-Aug-94 — Page: 2

Project Number: — Purchase Order:

Attention: Mr. D. Hevenor — Date Received: 28-Jul-94

Work Order: 9765 — Client Ref. #: — Sample Type: Liquid

Sample #	Compound	Result	Units	Comment
94-A010745	Sample Description: LR 9446651 SW1		Date & Time Sampled:	
	Hexachlorobenzene	< 0.006	ug/L	
	Heptachlor	< 0.006	ug/L	
	Aldrin	< 0.005	ug/L	
	p,p'-DDE	< 0.005	ug/L	
	Mirex	0.001	ug/L	
	alpha-BHC	< 0.004	ug/L	
	beta-BHC	< 0.005	ug/L	
	gamma-BHC (Lindane)	< 0.003	ug/L	
	delta-BHC	< 0.011	ug/L	
	alpha-Chlordane	< 0.003	ug/L	
	gamma-Chlordane	< 0.004	ug/L	
	Oxychlordane	< 0.006	ug/L	
	p,p'-DDD	< 0.005	ug/L	
	p,p'-DDT	< 0.005	ug/L	
	Methoxychlor	< 0.008	ug/L	
	Heptachlor Epoxide	< 0.006	ug/L	
	alpha-Endosulphan	< 0.004	ug/L	
	Dieldrin	< 0.003	ug/L	
	Endrin	< 0.005	ug/L	
	beta-Endosulphan	< 0.004	ug/L	
	Endosulphan Sulphate	< 0.013	ug/L	
	Total PCB	< 0.02	ug/L	
	Endrin Aldehyde	< 0.005	ug/L	
	Toxaphene	< 1	ug/L	

EXPLANATION OF CODES:

ND Not Detected — **MDL** Method Detection Limit

for W.M. Neages M. Sc., C.Chem

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APPENDIX E

FIELD SHEETS

FIELD SHEET - GROUND WATER DEVELOPMENT

Site Location	Water Level (m) Before	Water Level (m) After	B.H. Dpth (m)	B.H. Diameter	Stick - Up (m)	Purge Volumes (L) Needed	Purge Volumes (L) Actual	Temp (C)	pH	Conductivity Before	Conductivity After	Observations
TW1-1	6.93	6.93	7.06	2"	0.75	1	-	-	-	-	-	Insufficient sample
TW1-2	Dry	Dry	4.50	2"	0.75	0	-	-	-	-	-	Insufficient sample
TW2-1	6.38	6.38	7.88	2"	0.80	10	30	10	-	300	280	Cloudy grey No odour
TW2-2	3.62	3.64	5.38	2"	0.80	11	15	15	-	1275	1710	rusty brown colour strong leachate odour
TW3-1	7.13	7.16	7.54	2"	0.69	2.5	5	14	-	1000	800	Bright rusty orange colour Strong leachate odour
TW3-2	Dry	Dry	4.40	2"	0.69	0	-	-	-	-	-	Insufficient sample
TW4-1	7.05	7.05	10.15	2"	0.98	20	30	12	-	410	350	Cloudy grey No odour
TW4-2	Dry	Dry	5.51	2"	0.98	0	-	-	-	-	-	Insufficient sample
TW5-1	3.65	5.00	7..87	2"	0.88	25	25	12	-	240	270	Milky grey, sandy No odour
TW5-2	3.65	3.90	5..71	2"	0.88	13	20	11	-	270	310	Milky grey, sandy No odour

LOCATION: Douro Landfill - Stoney Lake Road (7777-096) DATE: July 25, 1994 SAMPLED BY: D.Bucholtz

WEATHER TODAY: Cloudy periods, windy. 25C. YESTERDAY: Sunny and rain. Humid, 29C.

FIELD SHEET - GROUND WATER SAMPLING

Site Location	F.S. #	Water Level (m)	Temp (C)	pH	Conductivity	Odour	Observations
TW1-1	-	7.06	-	-	-	-	Insufficient sample
TW1-2	-	4.50	-	-	-	-	Insufficient sample
TW2-1	1	6.38	10	7.63	280	None	Cloudy grey. No sheen.
TW2-1 Dup	2	6.38	10	7.65	280	None	Cloudy grey. No sheen.
TW2-2	3	3.64	15	6.53	1720	Strong leachate	rusty brown colour. No sheen.
TW3-1	4	7.16	14	6.90	850	Strong leachate	Bright rusty orange colour Strong leachate odour
TW3-2	-	4.40	-	-	-	-	Insufficient sample
TW4-1	5	7.05	12	7.50	350	None	cloudy grey. No sheen.
TW4-2	-	5.51	-	-	-	-	Insufficient sample
TW5-1	6	5.00	12	7.90	270	None	Milky grey, sandy No odour
TW5-2	7	3.90	11	8.21	510	None	Milky grey, sandy No odour

LOCATION: Douro Landfill - Stoney Lake Road (7777-096) DATE: July 25, 1994 SAMPLED BY: D.Bucholtz

WEATHER TODAY: Cloudy periods, windy. 25C. YESTERDAY: Sunny and rain. Humid, 29C.

FIELD SHEET - SURFACE WATER SAMPLING

Site Location	F.S. #	Flow Est. (L/sec)	Temp (C)	pH	Cond	Sheen	Odour	Colour	Observations
SW1	9	minimal	24	7.90	480	oily, blue	None	yellow / brown	clear. Heavy plant life (mixture) Varied aquatic life and plants.
SW1 Dup	10	minimal	24	7.85	480	oily, blue	None	yellow / brown	clear. Heavy plant life (mixture) Varied aquatic life and plants.
SW2	11	5	22	8.00	490	oily, blue	None	yellow / brown	clear. Heavy plant life (mixture) Varied aquatic life and plants. (blood suckers)
SW3	-	Dry	-	-	-	-	-	-	Insufficient sample
SW4	15	Pond	24	9.10	290	None	None	Slight yellow	Plant growth around and in pond Heavy algae. Cow feces along bank.
SW5	-	Dry	-	-	-	-	-	-	Insufficient sample

LOCATION: Douro Landfill - Stoney Lake Road (7777-096) DATE: July 26, 1994 SAMPLED BY: D.Bucholtz & M.Rowsell

WEATHER TODAY: Sunny and rain. Humid, 29C YESTERDAY: Cloudy periods, windy. 24C.

FIELD SHEET - RESIDENTIAL WELL WATER SAMPLING

Site Location	F.S. #	Temp (C)	pH	Conductivity	Odour	Observations
RW1 B.Tedford	12	10	7.50	730	None	Sample from 12' dug well in front. clear no odour.
RW2 B. Tedford	13	13	7.80	450	Strong sulfide	Sample from basement, pre softener (72' well) clear.
RW3 B.Kelly	14	10	7.30	690	None	Sample taken by resident following morning. clear.
RW3 Duplicate B.Kelly	15	10	7.30	690	None	Sample taken by resident following morning. clear.
RW4 Medland	17	9	7.50	400	None	Sample taken from tap at front, outside. Clear. No softener at all.

LOCATION: Douro Landfill - Stoney Lake Road (7777-096) DATE: July 26, 1994 SAMPLED BY: D.Bucholtz & M.Rowsell

WEATHER TODAY: Sunny and rain. Humid, 29C YESTERDAY: Cloudy periods, windy. 24C.

APPENDIX F

Reasonable Use Calculations

Stoney Lake Road "North" Landfill Site
Reasonable Use Calculations

Cm = Cb + (X) x (Cr-Cb) X = 0.25 for health related
= Reasonable Use Value = 0.50 for aesthetic related

Health Related:

Barium (Ba)
Cm = 0.02 + 0.25 x (1.0-0.02)
= 0.265 mg/L

Sodium (Na)
Cm = 5.92 + 0.25 x (200-5.92)
= 54.44 mg/L

Aesthetic Related:

Alkalinity
Cm = 260 + 0.50 x (500-260)
= 380 mg/L

Turbidity
Cm = 0.1 + 0.50 x (1-0.1)
= 0.55 NTU

Manganese (Mn)
Cm = 0.04 + 0.50 x (0.05-0.04)
= 0.045 mg/L

Chloride (Cl)
Cm = 19.8 + 0.50 x (250-19.8)
= 134.9 mg/L

Total Dissolved Solids
Cm = 370 + 0.50 x (500-370)
= 435

Iron (Fe)
Cm = 0.02 + 0.50 x (0.3-0.02)
= 0.16

Colour
Cm = 5 + 0.50 x (5-5)
= 5 TCU