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REPORT ON

2001 HYDROGEOLOGICAL INVESTIGATION AND MONITORING PROGRAM AND LANDFILL OPERATIONS REVIEW WARD 3 LANDFILL SITE TOWNSHIP OF ALFRED AND PLANTAGENET ONTARIO

Submitted to:

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EXECUTIVE SUMMARY

This report presents the results of the 2001 hydrogeological investigation and groundwater monitoring program conducted by Golder Associates Ltd. (Golder) and the results of the landfill operations review conducted by Stantec Consulting Ltd. (Stantec) at the Ward 3 landfill site in the Township of Alfred and Plantagenet (Township). The objective of the 2001 hydrogeological investigation and monitoring program was to complete the supplemental hydrogeological investigation recommended in Golder (2001). An assessment of site compliance under the MOE Reasonable Use Guideline B-7 is presented along with a review of site operational issues and a summary of proposed future site activities is also provided in this report.

The field investigation activities during 2001 included the drilling of three boreholes, installation of 5 groundwater monitoring wells, in-situ hydraulic conductivity testing of newly installed monitoring wells, and sampling of all on-site monitoring wells.

Based on the groundwater elevation data, the direction of horizontal groundwater flow at the site is interpreted to be in a southeasterly to southerly direction at a rate of less than 1 to 4 metres per year.

Exceedances of the Reasonable Use Performance Objectives (RUPO) as per MOE Guideline B-7 were reported during fall 2001 at monitoring locations BH00-5 and BH00-6, located approximately 450 metres upgradient from the southern property boundary. However, based on the estimated groundwater flow velocity and distance of the monitors from the south property boundary, it is concluded that the site is currently in compliance with MOE Guideline B-7 with respect to the south property boundary.

Monitoring wells at borehole locations BH01-8, BH01-9 and BH01-10 were installed in spring 2001 and only two groundwater sampling events have occurred at these locations. Groundwater quality at these locations is variable between the two sampling sessions. As such, an interpretation as to the presence or absence of landfill leachate impact at these locations requires additional groundwater quality data. Discussion of site compliance along the east and west landfill boundaries is deferred until additional groundwater quality data are collected at the monitoring wells in boreholes BH01-8, BH01-9 and BH01-10.

The area of the waste footprint is currently estimated to be about 2.62 hectares which is approximately 4 percent greater than the licensed waste footprint area of 2.51 hectares.

An average calculated waste volume of 40,032 m^3 is presently disposed of on the Ward 3 landfill site. The approved capacity of the site is 45,682 m^3. Therefore, the site has an estimated 5,650 m^3 of capacity available as of January 2001. It is the Township's intention to continue to use the Ware 3 site until it reaches its approved capacity and then to close the site in an environmentally sound fashion.

The proposed 2002 work program for the Ward 3 landfill site consists of activities required to address the outstanding issues with regards to Action Items 1, 2, and 3 as identified by the MOE in Section 4.1 of their Inspection Report dated January 21, 2000. The activities to be completed at the Ward 3 landfill site during 2002 are as follows:

- Completion of the 2002 hydrogeological monitoring program during the spring and fall of 2002 as summarized in Table 6. The objectives of the 2002 groundwater monitoring program are to continue monitoring of background groundwater quality; groundwater along the west and east property boundaries; groundwater quality within the area impacted or potentially impacted by landfill leachate (i.e., downgradient from the waste footprint); and to monitor groundwater levels and the groundwater flow direction at the site.

- preparation of a landfill closure report which defines the site operational and development issues associated with the shaping of the waste mound for final closure in an environmentally sound fashion once the site reaches it's approved capacity; and,

- submission of an application to the MOE for an amendment to the Certificate of Approval for the site to incorporate the currently used area method of fill as opposed to the approved trench method and to recognize the landfill closure report.

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1.0 INTRODUCTION

This report presents the results of the 2001 hydrogeological investigation and groundwater monitoring program conducted by Golder Associates Ltd. (Golder) and the results of the landfill operations review conducted by Stantec Consulting Ltd. (Stantec) at the Ward 3 landfill site in the Township of Alfred and Plantagenet (Township). This project was carried out as per the proposed work plan and cost estimate originally submitted to the Township on January 18, 2001 and revised on March 12, 2001. Authorization to proceed with the project was received via facsimile correspondence on March 30, 2001.

The Ward 3 landfill site (formerly known as the Carriere landfill site) is located on Part of west ½ of Lot 35, Concession 3 in the Township of Alfred and Plantagenet, Ontario. The landfill site is located southwest of Carriere Road about four kilometres northwest of the Village of Alfred, 70 kilometres east of Ottawa (Figure 1). The original Certificate of Approval (C of A) for the site was issued in 1977 and was later re-issued in 1981. A copy of the 1981 C of A is provided in Appendix A. The 1981 C of A permits a landfill area of 2.5 hectares within a total property area of 37.4 hectares.

The Township purchased the landfill site in 1999. However, the Township only purchased 21.2 hectares of the original 37.4 hectares. The current boundary of the landfill site and the limits of the waste fill are shown on Figure 2.

The Ontario Ministry of Environment (MOE) conducted a site inspection on October 20, 1999 and issued a Compliance Inspection Report to the Township on January 21, 2000. Golder was retained by the Township to address Action Items 1, 2 and 3 as identified by the MOE in Section 4 of their Compliance Inspection Report which is attached as Appendix B. Action Items 1, 2 and 3 are summarized below:

1. Municipality is to amend the existing Certificate of Approval to incorporate the currently used area method of fill as opposed to the approved trench method;

2. The municipality is to retain the services of a competent consultant to conduct a complete hydrogeological assessment of the site; and

3. The municipality is to retain the services of a competent consultant to complete the required Operation and Development Plan for the site.

In 2000, Golder completed an initial hydrogeological investigation and groundwater monitoring program in order to satisfy the requirements of Action Item 2 listed above (Golder, 2001). The investigation included an assessment of site compliance under the MOE Reasonable Use Guideline B-7 (MOE, 1994). Groundwater quality data collected during the investigation indicated that

certain monitoring locations in the immediate vicinity of the waste and downgradient of the waste disposal area had been impacted by landfill leachate. Concentrations of select parameters in groundwater at some monitoring locations were greater than the Reasonable Use Performance Objectives (RUPO) as per MOE Guideline B-7. It was concluded that the site was in compliance with MOE Guideline B-7 with respect to the south property boundary. However, based on the available hydrogeological data, it was not possible to determine whether the site was in compliance along the west and east property boundaries. Golder (2001) recommended that a supplemental hydrogeological investigation be completed at the site to evaluate groundwater quality along the east and west property boundaries through the installation of additional groundwater monitoring wells in order to conclusively establish the state of compliance with respect to MOE Guideline B-7. Additional recommendations contained in Golder (2001) included activities required to address Action Items 1 and 3 of the MOE Compliance Inspection Report.

The objective of the 2001 hydrogeological investigation and monitoring program was to complete the supplemental hydrogeological investigation recommended in Golder (2001). This report discusses the results of the 2001 hydrogeological investigation and monitoring program, including the installation of additional groundwater monitoring wells and an assessment of site compliance under the MOE Guideline B-7. A review of site operational issues and a summary of proposed future site activities is also provided.

2.0 PROCEDURES

2.1 Borehole Drilling and Monitoring Well Installation

The objectives of the borehole drilling and monitoring well installation program were to install additional groundwater monitors along the landfill's east and west property boundaries to allow for an evaluation of groundwater quality to conclusively establish the state of compliance with respect to MOE Guideline B-7.

The borehole drilling and monitoring well installation program was conducted on May 23 and 24, 2001, during which time a total of three boreholes (identified as BH01-8, BH01-9 and BH01-10) were drilled using a CME-55 track mounted hollow stem auger/rotary drill rig supplied and operated by Marathon Drilling Co. Ltd. of Gloucester, Ontario.

Two boreholes were located along the east boundary and one borehole was located along the west boundary, as shown on Figure 2. In a MOE Memorandum (from B. Putzlocher to G. Murphy dated July 18, 2001) which provided MOE comments on Golder (2001), the MOE recommended that three boreholes/monitoring wells be installed along the eastern boundary of the site instead of the two proposed in the report. However, the 2001 field drilling program was completed prior to receipt of the MOE review. As such, the 2001 field drilling program was completed as proposed in Golder (2001) (i.e. two monitoring wells along the east boundary and one monitoring well along the west boundary). The need for additional boreholes at the site would be evaluated based on the review of the 2001 data.

All boreholes were drilled using 200 millimetre diameter hollow stem augers. The boreholes were advanced to depths ranging from 4.4 metres to 6.7 metres below ground surface and all boreholes were terminated within the overburden. Soil samples were collected at regular intervals using a 50 millimetre diameter split spoon sampler in conjunction with performing the standard penetration test. The soil samples recovered from the boreholes were visually described in the field and returned to the Golder laboratory in Ottawa for further examination. A member of Golder's technical staff monitored the borehole drilling and monitoring well installation activities.

Boreholes BH01-8 and BH01-9 were completed with two monitoring well installations and BH01-10 was completed with one well installation. The monitoring wells were installed to allow subsequent measurement of groundwater levels and to permit groundwater sampling and in-situ hydraulic testing. In terms of monitoring well designations, the suffixes 'A' and 'B' respectively refer to the 'deeper' and 'shallower' installation at a given borehole location.

The deeper monitoring wells consist of a 1.5 metre length of 50 millimetre diameter, schedule 40, #10 slot, PVC screen which extends to above ground surface by means of a 50-millimetre diameter, schedule 40, flush threaded, PVC casing. The shallower monitoring wells consist of a 1.5 metre length of 38 millimetre diameter, schedule 40, #10 slot, PVC screen which extends to above ground surface by means of a 38 millimetre diameter, schedule 40, flush threaded, PVC casing. Bentonite seals were placed at specific locations within the boreholes to isolate the screen intake intervals (and thus prevent the vertical migration of groundwater along the length of the boring) and to provide seals near ground surface. Silica sand or native backfill was placed around and above the screened intervals. Each monitoring well location was completed with an aboveground protective casing. Detailed information on each installation is provided on the borehole logs in Appendix C.

Upon completion of the borehole drilling and monitoring well installation program, Stantec Consulting Group Ltd. (Stantec) field engineering staff surveyed the location (northing, easting) and ground surface elevation at each borehole and the top of casing elevation at each monitoring well location. All elevations were surveyed relative to a temporary benchmark (TBM No. 1) established northwest of the fill area near the BH00-1 (see Figure 2).

2.2 Monitoring Procedures

Monitoring sessions at the Ward 3 landfill site were conducted on June 11 and 12, 2001 (spring monitoring session) and September 18, 2001 (fall monitoring session) by a member of Golder's technical staff.

The monitoring program was scheduled to include a groundwater and surface water component, however, surface water bodies of significance (i.e., ponds, streams, creeks, ditches) were not evident at the time of the monitoring sessions. Therefore, surface water samples were not collected as part of the 2001 monitoring program.

The scheduled groundwater monitoring locations included all 18 monitoring wells (BH00-1A, BH00-1B, BH00-2A, BH00-2B, BH00-3A, BH00-3B, BH00-4A, BH00-4B, BH00-5A, BH00-5B, BH00-6A, BH00-6B, BH00-7, BH01-8A, BH01-8B, BH01-9A, BH01-9B and BH01-10). However, monitoring wells BH00-1B, BH00-2B and BH00-4B were not sampled during the fall sampling session due to insufficient water for sampling.

The groundwater level at each monitoring location was measured prior to development of the monitors by removing at least three standing well volumes of groundwater using dedicated sampling equipment. Sampling of the groundwater was conducted immediately after monitor development.

Groundwater samples from each monitoring location were collected using dedicated sampling equipment consisting of a length of flexible low density polyethylene (LDPE) tubing and a Model D-25 foot valve manufactured by Waterra Pumps Ltd. of Toronto, Ontario.

Groundwater samples were collected in pre-cleaned, laboratory-supplied containers containing preservatives (where appropriate). Groundwater samples destined for laboratory metals analysis were filtered in the field. The temperature, pH and electrical conductivity of the groundwater samples were measured in the field at the time of sample collection. The field conductivity measurements were obtained using a conductivity meter that was calibrated in the field prior to use. All samples were placed in coolers with ice packs and hand delivered to a private analytical laboratory.

The groundwater samples collected for the specific analyses were collected, prepared and preserved in the field using the following protocols:

Analytical Parameters	Preparation and Preservation Protocols
Hardness (calcium and magnesium) sodium, potassium, aluminium, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, silicon, silver, strontium, thallium, tin, titanium, vanadium and zinc	plastic bottle, field filtered to 0.45 microns and preserved to pH<2 with nitric acid
Total dissolved solids (TDS), alkalinity, sulphate, nitrate, nitrite and chloride	plastic bottle, unfiltered and unpreserved
Phenols, chemical oxygen demand (COD) and dissolved organic carbon (DOC)	amber glass bottle with foil lined cap, unfiltered and preserved to pH<4 with sulphuric acid
Ammonia, total kjeldahl nitrogen (TKN) and total phosphorus	plastic bottle, unfiltered and preserved to pH<2 with sulphuric acid

All laboratory chemical and physical analyses of groundwater samples were performed by Accutest Laboratories Ltd. (Accutest) of Nepean, Ontario. The Reports of Analyses from Accutest are provided in Appendix D.

3.0 GEOLOGICAL CONDITIONS

A log of the geological conditions encountered in each borehole drilled during the 2001 hydrogeological investigation together with details of the monitoring well installations are given on the Record of Borehole Sheets in Appendix C. Record of Borehole Sheets for boreholes drilled during the 2000 hydrogeological investigation are also provided in Appendix C. It is noted that the boundaries between strata on the Record of Borehole Sheets have been inferred from observations during drilling and non-continuous sampling and, as such, their positions should be considered as transitional in nature rather than an exact plane of geologic change. Natural variations other than those encountered in the boreholes should also be expected to exist.

The geological conditions encountered in boreholes BH01-8 through BH01-10 were similar in that they all encountered a layer of fine sand with trace to some silt above silty fine sand which was underlain by silty clay. The sand thickness varied from 2.4 metres (at BH01-10) to 3.8 metres (at BH01-8). Water table conditions were encountered within the sand unit at all borehole locations. The top of the silty clay was encountered at depths ranging from 2.9 to 5.0 metres below ground surface. Bedrock was not encountered in any of the boreholes. A surficial layer of topsoil was encountered at all three boreholes and varied from 0.09 to 0.24 metres in thickness. The surficial topsoil layer was overlain by a 0.52 metre thick surficial layer of sand fill mixed with a trace amount of municipal waste at BH01-8. The geological conditions encountered during the 2001 investigation were consistent with that reported during the 2000 investigation.

4.0 PHYSICAL HYDROGEOLOGY

4.1 Water Table Elevations and Hydraulic Gradients

The groundwater level data obtained during the spring and fall monitoring sessions, as well as historical groundwater elevation data are presented in Table 1.

The vertical hydraulic gradients between the spring and fall sessions are variable. However, the more active zone of groundwater flow at site is through the granular layer overlying the silty clay.

The groundwater elevation data from all monitoring wells from the spring and fall monitoring sessions were used to create piezometric surface elevation contours, which are presented on Figure 3 and Figure 4, respectively. The contours indicate that horizontal groundwater flow in the sand unit is in a southeasterly to southerly direction. During the spring monitoring session, horizontal hydraulic gradients varied from 0.003 in the south to 0.002 beneath the northern part of the site. During the fall monitoring session, horizontal hydraulic gradients varied from 0.001 (south) to 0.005 (north).

4.2 Horizontal Hydraulic Conductivity

Estimates of the horizontal hydraulic conductivity of the surficial geological units in the vicinity of the monitoring well intake screens were calculated from rising head tests conducted on the five monitoring wells installed during the 2001 hydrogeological investigation, namely BH01-8A, BH01-8B, BH01-9A, BH01-9B and BH01-10) . All of these monitors were screened in the silty sand unit, with the exception of BH01-9A which was screened in both the silty sand and the silty clay unit. The calculated horizontal hydraulic conductivity in these monitoring wells ranged from 1.9×10^{-6} metres per second (m/s) to 3.5×10^{-6} m/s (Appendix E). Based on data presented in Golder Associates (2001), the overall range of hydraulic conductivity for the granular layer is indicated to range from 1.9×10^{-6} m/s to 8.1×10^{-6} m/s.

4.3 Groundwater Flow Velocity

The average linear groundwater velocity, $\bar{v}$, is calculated using the equation:

$$\bar{v} = \frac{Ki}{n}$$

where: $\bar{v}$ = average linear groundwater velocity in units of length per time
n = dimensionless formation porosity
K = horizontal hydraulic conductivity in units of length per time
i = dimensionless horizontal hydraulic gradient in direction of $\bar{v}$

For unconsolidated deposits such as sand, typical porosity values can range from 25 to 50 percent (Freeze and Cherry, 1979). An average porosity of 30 percent for the granular overburden deposits is assumed for the determination of average linear groundwater velocities in the vicinity of the landfill site.

Using the overall range in hydraulic conductivity values for the sand unit (1.9×10^{-6} m/s to 8.1×10^{-6} m/s) and the range of horizontal gradients presented above (0.001 to 0.005), the average linear horizontal groundwater velocity within the sand unit below the landfill is less than 1 to 4 metres per year towards the south/southeast.

5.0 GROUNDWATER CHEMISTRY

5.1 General Physical and Inorganic Chemical Analyses

The groundwater quality in the vicinity of the site was assessed by collecting a groundwater sample from each monitoring well with subsequent physical and chemical analyses. The chemical and physical analyses data obtained as a result of the 2001 groundwater monitoring programs along with the relevant Ontario Drinking Water Standards (MOE, 2001) are provided in Appendix F.

Discussions relating to compliance with the Ontario Drinking Water Standards (ODWS) relate specifically to non-health related objectives (i.e., aesthetic parameters) and health related standards for which a Maximum Acceptable Concentration (MAC) or Interim Maximum Acceptable Concentration (IMAC) have been established.

5.2 Background Groundwater Quality

Based on the physical hydrogeology, monitoring wells BH00-1A and BH00-1B are hydraulically upgradient from the landfill site and thus should not be impacted by landfill leachate. The shallow monitor (BH00-1B) is screened in the sand unit whereas the deeper monitor (BH00-1A) is screened in the underlying silty clay. Table 2 is provided to show the maximum reported parameter concentrations for background groundwater quality in the sand and clay at the Ward 1 landfill site between August 2000 and September 2001.

Dissolved organic carbon (DOC) and iron exceed the ODWS in background monitoring well BH00-1A during at least one of the sampling sessions in 2001. DOC exceed the ODWS in background monitoring well BH00-1B during the June 2001 monitoring session. In addition, manganese exceeded ODWS in these wells during 2000. As such, concentrations of DOC, iron and manganese above the ODWS downgradient of the landfill site do not necessarily indicate leachate impact; comparison of *Leachate Indicator Parameter* concentrations with background concentrations are more meaningful with respect to assessing the degree of leachate impact on groundwater quality at the site.

5.3 Leachate Indicator Parameters

Leachate Indicator Parameters are parameters which are useful in determining the presence/absence of landfill leachate impact on water resources; assessing the degree of leachate impact on water resources; and, are useful in determining the extent of leachate impact near a landfill site.

Based on a review of the groundwater chemistry data available to date, monitor BH00-3B appears to exhibit the greatest leachate effects as exhibited by elevated concentrations of chloride, hardness, sulphate, TDS, iron and strontium. As such, *Leachate Indicator Parameters* for the Ward 3 landfill have been selected using the groundwater monitoring results from monitoring well BH00-3B. The six parameters considered to be the most relevant groundwater *Leachate Indicator Parameters* at the site are: chloride, hardness, sulphate, TDS, iron and strontium.

5.4 Groundwater Quality

The parameters with reported levels exceeding their respective ODWS; a comparison of groundwater quality to background conditions; and, an interpretation of the geochemical data with respect to the degree of landfill leachate impact from the existing landfill site are summarized in Table 3 for each of the monitoring wells sampled in 2001.

The interpretation of the 2001 groundwater quality data presented in Table 3 are summarized as follows:

- Monitoring wells BH00-1A and BH00-1B are located upgradient of the waste footprint and are considered representative of background groundwater quality;
- Monitoring well BH00-7 is located northeast of the waste footprint and is not impacted by landfill leachate;
- Groundwater may be slightly impacted by landfill leachate at BH00-2A and BH00-2B located at the west edge of the waste footprint and at BH00-3A located at the south edge of the waste footprint;
- Landfill leachate impacts are noted at BH00-3B located at the south edge of the waste footprint, BH00-4A and at BH00-4B located at the east edge of the waste footprint;
- Downgradient (south) monitoring well BH00-5B is impacted by leachate whereas BH00-5A is not impacted based on the low chloride concentrations (refer to Figure 5);
- Monitoring well BH00-6B is located downgradient (south) of the waste footprint and is interpreted to be impacted by leachate whereas BH00-6A may be slightly impacted based on the chloride concentrations (refer to Figure 5); and
- Only two groundwater sampling events have occurred for the monitoring wells at boreholes BH01-8, BH01-9 and BH01-10 and the available groundwater quality data is quite variable between the two sampling sessions. As such, interpretation as to the presence or absence of landfill leachate impact at these location requires additional groundwater quality data as noted in Table 3.

The interpretation of the 2001 groundwater quality data is similar to that presented in Golder (2001) with the exception that the groundwater derived from monitoring well BH00-5B is interpreted to have become impacted by landfill leachate during 2001.

Figure 5 illustrates the chloride concentrations at the monitoring wells during 2001. With respect to Figure 5, the most noteworthy trends are as follows:

- variable chloride concentrations between the spring and fall sampling sessions at monitoring wells BH01-8A, BH01-8B, BH01-9A, BH01-9B and BH01-10.

- the significant increase in chloride concentration between the spring and fall sampling sessions at shallow monitoring wells monitoring wells BH00-3B, BH00-5B and BH00-6B.

6.0 GROUNDWATER COMPLIANCE ASSESSMENT

MOE Guideline B-7 (MOE, 1994), *Incorporation of the Reasonable Use Concept into MOE Groundwater Management*, addresses the levels of off-site leachate impact on groundwater considered acceptable by the MOE and defines the level of impact on groundwater beyond which some form of mitigation measure(s) would be warranted.

Under MOE Guideline B-7, a change in the quality of groundwater on adjacent properties will only be acceptable if the quality is not degraded in excess of fifty percent of the difference between background concentrations and established water quality criteria for aesthetic related parameters, and twenty-five percent of the difference between background conditions and established water quality criteria for health related parameters. If the background concentration of a particular parameter exceeds a given water quality criteria, the quality of the groundwater should not be degraded further.

For the purpose of this site evaluation, the groundwater quality reported for monitor BH00-1B is assumed to represent background groundwater quality within the sand unit in the vicinity of the Ward 3 landfill site. As well, the standards described in the ODWS are used to represent the established water quality criteria. The parameters selected for the compliance assessment include those within the schedule of analysis for the site that relate specifically to non-health related objectives (i.e., aesthetic parameters) and health related parameters for which a MAC or IMAC have been established as specified within the OWDS. The relative mobility of parameters was also considered in the selection of appropriate parameters. As such, the parameters that are significant to this discussion are barium, boron, chloride, DOC, iron, sodium, sulphate and TDS. Each of these eight parameters together with their respective ODWS concentrations, the maximum background concentrations from monitoring well BH00-1B, and the calculated Reasonable Use Performance Objectives (RUPO) are provided below.

Parameter	ODWS (mg/L)	Maximum Background Concentration (mg/L)	Reasonable Use Performance Objectives (mg/L)
Barium	1 (MAC)	0.05	0.29
Boron	5 (IMAC)	0.01	1.26
Chloride	250 (AO)	2	126
DOC	5 (AO)	20.1	20.1
Iron	0.3 (AO)	0.92	0.92
Sodium	200 (AO)	31	116
Sulphate	500 (AO)	39	270
TDS	500 (AO)	300	400

Notes:
AO = Aesthetic Objective
MAC = Maximum Acceptable Concentration (Health Related Objective)
IMAC = Interim Maximum Acceptable Concentration (Health Related Objective)

With respect to the south property boundary, landfill leachate-impacted monitoring wells BH00-6A, BH00-6B and BH00-5B were use in the assessment of compliance under MOE Guideline B-7. A summary of parameters exceeding the RUPO at groundwater monitors BH00-6A, BH00-6B and BH00-5B is presented in Table 4. Although the degree of landfill leachate impact at these monitoring well locations exceeds that permissible under MOE Guideline B-7, the monitoring wells only recently began exhibiting a significant degree of landfill leachate impact and the monitors are located more than 400 metres upgradient (based on the interpreted direction of groundwater flow on Figures 3 and 4) of the south property line. For these reasons, and based on the estimated groundwater flow velocity of less than 1 to 4 metres per year, it is concluded that the site is in compliance with MOE Guideline B-7 with respect to the south property boundary.

Monitoring wells at borehole locations BH01-8, BH01-9 and BH01-10 were installed in spring 2001 and only two groundwater sampling events have occurred at these locations. Groundwater quality at these locations is variable between the two sampling sessions (particularly at borehole BH01-8). As such, an interpretation as to the presence or absence of landfill leachate impact at these locations requires additional groundwater quality data. Therefore, these monitors were not assessed with respect to compliance under MOE Guideline B-7. Discussion of site compliance along the east and west landfill boundaries is thus deferred until additional groundwater quality data are collected at the monitoring wells in boreholes BH01-8, BH01-9 and BH01-10.

7.0 LANDFILL OPERATIONS REVIEW

7.1 Certificate of Approval Conditions

With reference to minimum operating standards for the Ward 3 landfill site, the following conditions on the C of A are pertinent:

Condition 2. Wastes are to be deposited in an orderly manner in the fill area, compacted and adequately covered by 15 cm (6") of cover material once a month between April 15th and November 15th or as directed by the Director of the Southeastern Region of the Ministry of the Environment.

Condition 3. Burning of domestic waste is prohibited at the site.

7.2 Service Area and Waste Generation

The Ward 3 landfill services the former Village of Alfred, which encompasses 500 homes with a population of 1,212 (source - 1995 Municipal Directory). The Village of Alfred became Ward 3 when it amalgamated with the Township of Alfred and Plantagenet in January 1997.

Given that burning of waste was a common practice in the 1970's, the measurement of the actual volume of buried waste does not accurately reflect historical waste generation rates and will not be used to forecast future per capita rates. Instead, future rates will be projected using published Recycling Council of Ontario data for 1996 that shows the average Ontario resident produced 349 kg of waste annually. This translates to a disposal volume of 1.09 m^3/year (assuming a waste density of 400 kg/m^3 and an allowance of 25% for daily cover). Given that the Township started a blue box recycling program in 1999, these rates should closely represent current rates for the Township.

7.3 Existing Waste Volumes and Contours

A preliminary landfill operations review was presented in the 2000 hydrogeological investigation (Golder, 2001). The area of the waste footprint was preliminary estimated at approximately 2.7 hectares (ha) with an estimated volume of on-site buried waste plus cover material of 25,100 to 37,700 cubic metres (m^3). A preliminary estimate of the volume of above grade waste placed using the area method was 9,600 m^3, indicating up to 11,000 m^3 of capacity remaining at the site.

In January 2001, Stantec Consulting Ltd. completed a survey of the existing waste at the Ward 3 landfill site. The approximate limit of the waste footprint, based on the survey, is shown on Figure 6 (existing conditions). The area of the waste footprint is currently estimated to be about 2.62 ha which is approximately 4 percent greater than the licensed waste footprint area of 2.51 ha (refer to page 2 of the MOE Compliance Inspection Report in Appendix B).

The existing volume of waste and trench fill was determined using computer surface modelling software. Surfaces were generated for the top of waste and for the bottom of waste, utilizing information collected from test pitting activities during the 2000 hydrogeological investigation. Calculated on-site waste volumes ranged from 39,978 m^3 to 40,059 m^3. An average volume of 40,032 m^3 is used to represent the amount of waste disposed on the Ward 3 landfill site.

7.4 Site Capacity and Remaining Life

The existing volume of waste at the Ward 3 landfill site, as of January 2001, is approximately 40,032 m^3. The MOE/Compliance Inspection Report dated January 21, 2000 stated that the Ward 3 landfill has a total approved capacity of 45,682 m^3. Stantec Consulting Ltd. has reviewed the MOE's protocol for calculation of site capacity and concurs that 45,682 m^3 represents the site's total capacity. This leaves the landfill with approximately 5,650 m^3 of available capacity, as of January 2001.

The 1999 Official Plan of the United Counties of Prescott and Russell provides population estimates for the Township of Alfred and Plantagenet for the next 18 years. Population and waste quantity projections for the next 20 years, using an average growth rate of 1.15% to represent the annual growth rate for the Ward 3 service area, are shown in Table 5. Assuming that the site is used on a year round basis, it is predicted that the Ward 3 landfill site will reach its capacity by the fall of 2004. However, it is understood that the Township does not use the landfill site during the winter months and, as such, the site could reach final waste grades (capacity) later than 2004.

7.5 General Overview on Future Use of Site

Based on discussions with the Township, it is understood that the Township is planning to continue to use the Ward 3 site until it reaches its approved capacity of 45,682 cubic metres. The Township will continue to operate the site (using the area method as opposed to the trench method that is presently approved for this site) for an unspecified period of time until the remaining capacity is used, with the focus being to shape the waste mound as per the final waste contours on Figure 6 (Final Waste Contours). Once the final waste contours are achieved, the site will be closed in a manner consistent with the degree of groundwater impact in the area of the site (i.e., if site is in compliance with MOE Guideline B-7, a minimum final cover design would be proposed).

The following operational procedures will be adhered to during the placement of the remaining waste (and daily cover material) at the Ward 3 landfill site:

- Condition 2 of the existing C of A is specifies a minimum monthly covering of the waste with soil. This minimum requirement will be adhered to;

- Condition 3 of the existing C of A is still relevant and waste will not be burnt;
- A buffer zone of a minimum of 30 metres in width would be maintained between all future waste placement and the existing property limits;
- The site is authorized to operate by the trench method. Given the presence of a thick clay layer beneath the surficial sand deposit and the correspondingly high groundwater table, an area method of waste placement will be utilized to develop the remaining capacity at the site; and,
- The landfill has an approved footprint size of 2.51 ha. The existing waste covers an area of 2.62 ha. The 2.51 ha footprint for placement of the remaining waste will be positioned over the existing buried waste to minimize leachate production.

8.0 SUMMARY

The following points provide a summary of the results of the 2001 hydrogeological investigation and monitoring program and the results of the landfill operations review at the Ward 3 landfill site.

- The objective of the 2001 hydrogeological monitoring program was to complete the supplemental hydrogeological investigation recommended in Golder (2001) and provide an updated assessment of site compliance under the MOE Guideline B-7.

- The 2001 hydrogeological investigation included borehole drilling, monitoring well installation and two groundwater quality monitoring events.

- The geological conditions encountered in all boreholes were similar in that they all encountered a layer of fine sand above silty fine sand which was underlain by silty clay. Water table conditions were encountered within the sand unit at all borehole locations.

- Based on the groundwater elevation data, the direction of horizontal groundwater flow at the site is interpreted to be in a southeasterly to southerly direction at a rate of less than 1 to 4 metres per year.

- Monitoring wells BH00-1A and BH00-1B are located upgradient of the waste footprint and are considered representative of background groundwater quality.

- Monitoring well BH00-7 is located northeast of the waste footprint and is not impacted by landfill leachate.

- Groundwater may be slightly impacted by landfill leachate at BH00-2A and BH00-2B located at the west edge of the waste footprint and BH00-3A located at the south edge of the waste footprint.

- Landfill leachate impacts are noted at BH00-3B located at the south edge of the waste footprint, BH00-4A and BH00-4B located at the east edge of the waste footprint.

- Downgradient (south) monitoring well BH00-5B is impacted by leachate whereas BH00-5A is not impacted based on the low chloride concentrations.

- Monitoring well BH00-6B is located downgradient (south) of the waste footprint and is interpreted to be impacted by leachate whereas BH00-6A may be slightly impacted.

- Only two groundwater sampling events have occurred for the monitoring wells at locations BH01-8, BH01-9 and BH01-10 and the available groundwater quality data is quite variable between the two sampling sessions. As such, interpretation as to the presence or absence of landfill leachate impact at these location requires additional groundwater quality data.

- Based on the available hydrogeological data, it is concluded that the site is in compliance with MOE Guideline B-7 along the south property line. Additional data is required at monitoring locations along the west and east property lines before an assessment under MOE Guidelines B-7 can be undertaken.

- The area of the waste footprint is currently estimated to be about 2.62 hectares which is approximately 4 percent greater than the licensed waste footprint area of 2.51 hectares.

- An average calculated waste volume of 40,032 m^3 is presently disposed of on the Ward 3 landfill site. The approved capacity of the site is 45,682 m^3. Therefore, the site has an estimated 5,650 m^3 of capacity available as of January 2001. It is the Township's intention to continue to use the Ware 3 site until it reaches its approved capacity and then to close the site in an environmentally sound fashion.

9.0 PROPOSED 2002 SITE ACTIVITIES

The proposed 2002 work program for the Ward 3 landfill site consists of activities required to address the outstanding issues with regards to Action Items 1, 2, and 3 as identified by the MOE in Section 4.1 of their Inspection Report dated January 21, 2000 (Appendix B). The activities to be completed at the Ward 3 landfill site during 2002 are as follows:

- Completion of the 2002 hydrogeological monitoring program during the spring and fall of 2002 as summarized in Table 6. The objectives of the 2002 groundwater monitoring program are to continue monitoring of background groundwater quality; groundwater along the west and east property boundaries; groundwater quality within the area impacted or potentially impacted by landfill leachate (i.e., downgradient from the waste footprint); and to monitor groundwater levels and the groundwater flow direction at the site.

- preparation of a landfill closure report which defines the site operational and development issues associated with the shaping of the waste mound for final closure in an environmentally sound fashion once the site reaches it's approved capacity; and,

- submission of an application to the MOE for an amendment to the Certificate of Approval for the site to incorporate the currently used area method of fill as opposed to the approved trench method and to recognize the landfill closure report.

10.0 LIMITATIONS AND USE OF REPORT

This report was prepared for the exclusive use of the Township of Alfred and Plantagenet. The report, which specifically includes all tables, figures and appendices, is based on data and information collected by Golder and is based solely on the conditions of the properties at the time of the work, supplemented by historical information and data obtained by Golder as described in this report.

The assessment of environmental conditions and possible hazards at this site has been made using the results of physical measurements and chemical analyses of liquids from a number of locations. The site conditions between sampling locations have been inferred based on conditions observed at borehole and monitoring well locations. Subsurface conditions may vary from these sampled locations.

The services performed, as described in this report, were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The findings of this report are valid only as of the date of this report. If new information is discovered in future work, including excavations, borings, or other studies, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required. The groundwater monitors installed during the course of this investigation by Golder have been left in place. These groundwater monitors are the property of the Township and not Golder.

GOLDER ASSOCIATES LTD.
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MAV:KAM:dc
RPT-001 Ward 3 2001 Monitoring Report.doc

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Golder Associates, 2001. 2000 Hydrogeological Investigation and Groundwater Monitoring Program, Ward 3 Landfill Site, Township of Alfred and Plantagenet, Ontario, Report No. 001-2749, February 2001.

Ministry of the Environment, 1994. Guideline B-7: Incorporation of the Reasonable Use Concept into MOE Groundwater Management,: MOE Program Development Branch: Ontario Ministry of the Environment, April 1994, 8 p.

Ministry of the Environment, 2001. Ontario Drinking Water Standards, Ontario Ministry of the Environment.

TABLE 1

CURRENT AND HISTORICAL GROUNDWATER ELEVATIONS

Monitoring Location	Ground Surface Elevation (metres)	Top of Casing Elevation (metres)	Groundwater Elevation (metres)			
			Aug. 17, 2000	Nov. 27, 2000	Jun. 11, 2001	Sept. 18, 2001
BH00-1A	99.18	99.97	98.04	98.32	98.52	97.53
BH00-1B	99.18	100.00	98.76	99.17	98.70	97.41
BH00-2A	99.54	100.33	98.66	98.84	98.62	97.97
BH00-2B	99.54	100.38	98.66	98.84	98.62	97.71
BH00-3A	98.54	99.26	97.68	97.82	97.72	96.76
BH00-3B	98.54	99.31	97.97	98.07	97.97	96.72
BH00-4A	99.84	100.77	98.35	98.42	98.36	97.29
BH00-4B	99.84	100.79	98.36	98.42	98.35	97.32
BH00-5A	97.73	98.67	-	97.84	97.75	96.44
BH00-5B	97.73	98.73	-	97.82	97.74	96.66
BH00-6A	97.97	98.78	-	97.92	97.85	96.61
BH00-6B	97.97	98.71	-	97.95	97.88	96.55
BH00-7	98.80	99.76	-	98.64	98.48	97.47
BH01-8A	98.92	99.82	-	-	98.45	97.10
BH01-8B	98.92	99.83	-	-	98.47	97.20
BH01-9A	98.13	98.92	-	-	97.85	96.50
BH01-9B	98.13	98.95	-	-	97.93	96.85
BH01-10	98.36	99.17	-	-	98.17	96.77

Notes: All elevations are referred to a local datum (TBM No. 1 as shown on Figure 2)

TABLE 2
BACKGROUND GROUNDWATER QUALITY
WARD 3 LANDFILL SITE, TOWNSHIP OF ALFRED AND PLANTAGENET

Parameter	OWDS (mg/L)	Maximum Background Concentration in Sand [1] (mg/L)	Maximum Background Concentration in Clay [2] (mg/L)
Alkalinity		166	156
Aluminum		1.91	3.78
Ammonia (as N)		0.49	1.40
Barium	1	0.05	0.04
Beryllium		<0.002	<0.002
Boron	5	0.01	0.10
Cadmium	0.005	<0.005	<0.005
Calcium		34	32
Chloride	250	2.0	5.0
Chromium	0.05	<0.01	<0.01
Cobalt		<0.01	<0.01
COD		58	68
Electrical Conductivity		420	420
Copper	1	<0.01	0.01
DOC	5	**20.1**	**13.1**
Hardness (as $CaCO_3$)		118	121
Iron	0.3	**0.92**	**3.46**
Lead	0.01	<0.001	<0.001
Magnesium		8	10
Manganese	0.05	**0.11**	**0.14**
Molybdenum		<0.01	<0.01
Nickel		<0.01	<0.01
Nitrate (as N)	10	<0.10	<0.10
Nitrite	1	<0.10	<0.10
pH		7.3	8.0
Phenols		0.001	0.003
Phosphorus (total)		6.27	8.35
Potassium		19	7
Silicon		4.22	7.79
Silver		<0.01	<0.01
Sodium	200	31	60
Strontium		0.144	0.171
Sulphate	500	39	99
Total Dissolved Solids	500	300	380
Thallium		<0.2	<0.2
Tin		<0.01	<0.01
Titanium		0.06	0.17
TKN		0.69	1.40
Unionized Ammonia			0.67
Vanadium		<0.01	<0.01
Zinc	5	<0.01	0.01

NOTES:

(1) Reported concentrations from monitor BH00-1B.
(2) Reported concentrations from monitor BH00-1A.

TABLE 3
SUMMARY OF 2001 GROUNDWATER QUALITY
WARD 3 LANDFILL SITE, TOWNSHIP OF ALFRED AND PLANTAGENET

Monitoring Well	Parameters Exceeding ODWS in 2001	Leachate Indicator Parameters (1) Exceeding Background Levels in 2001	Trends	Hydrogeological Interpretation
BH00-1A Silty Clay	DOC, Iron	N/A	• Variable iron concentrations over time.	• Upgradient of waste and screened in silty clay • Background groundwater quality monitor
BH00-1B Sand	DOC	N/A	• Only one round of groundwater sampling completed in 2001 at this location.	• Upgradient of waste and screened in sand • Background groundwater quality monitor
BH00-2A Sand	DOC, Iron, Manganese	Chloride, Hardness, Iron, Strontium, TDS	• No obvious increasing or decreasing trends in parameter concentrations.	• Located within the limits of waste disposal on west side of the site and screened in silty clay. • Groundwater may be slightly impacted by landfill leachate
BH00-2B Sand	DOC, Iron, Manganese	Chloride, Hardness, Iron, TDS	• Only one round of groundwater sampling completed in 2001 at this location.	• Located within the limits of waste disposal on west side of the site and screened in sand. • Groundwater may be slightly impacted by landfill leachate
BH00-3A Silty Clay	TDS	Hardness, Strontium, Sulphate, TDS	• Lower concentrations of COD, iron, nitrate, TKN and TDS in 2001.	• Located within the limits of waste disposal on south side of the site and screened in silty clay. • Groundwater may be slightly impacted by landfill leachate
BH00-3B Sand	DOC, Iron, Manganese, Sulphate, TDS	Chloride, Hardness, Iron, Strontium, Sulphate, TDS	• Higher concentrations of chloride, DOC, hardness, iron, strontium, sulphate, and TDS in fall 2001 sampling session.	• Located within the limits of waste disposal on south side of the site and screened in sand. • Groundwater impacted by landfill leachate
BH00-4A Sand	DOC, Iron, Manganese	Chloride, Hardness, Iron, Strontium, TDS	• Higher concentration of iron in fall 2001 sampling session.	• Located within the limits of waste disposal on east side of the site and screened in sand. • Groundwater may impacted by landfill leachate
BH00-4B Sand	Barium, DOC, Iron, Manganese, TDS	Hardness, Iron, Strontium, TDS	• Only one round of groundwater sampling completed in 2001 at this location.	• Located within the limits of waste disposal on east side of the site and screened in sand. • Groundwater impacted by landfill leachate
BH00-5A Sand	[None]	Hardness, Strontium, Sulphate, TDS	• Increased concentrations of hardness, sodium, strontium, sulphate and TDS in fall 2001 sampling session.	• Located downgradient of waste to the south and screened in sand • Groundwater not impacted by landfill leachate based on low chloride concentrations (refer to Figure 5); additional groundwater quality data required to address changes in groundwater quality during fall 2001 monitoring session
BH00-5B Sand	DOC, Iron, Manganese, Sulphate, TDS	Chloride, Hardness, Iron, Strontium, Sulphate, TDS	• Increased concentrations of alkalinity, ammonia, chloride, COD, DOC, hardness, iron, manganese, sodium, strontium, sulphate, TDS and TKN in fall 2001 sampling session.	• Located downgradient of waste to the south and screened in sand • Groundwater impacted by landfill leachate based on significantly elevated concentrations of leachate indicator parameters in September 2001 (refer to Figure 5)

TABLE 3 (continued)
SUMMARY OF 2001 GROUNDWATER QUALITY
WARD 3 LANDFILL SITE, TOWNSHIP OF ALFRED AND PLANTAGENET

Monitoring Well	Parameters Exceeding ODWS in 2001	Leachate Indicator Parameters [1] Exceeding Background Levels in 2001	Trends	Hydrogeological Interpretation
BH00-6A Sand	DOC, Iron, Manganese	Chloride, Hardness, Iron, Strontium, Sulphate, TDS	• Decreased concentrations of chloride, DOC, and hardness with increased concentrations of sulphate in fall 2001 sampling session. • Variable iron, manganese and total phosphorus levels over time. • Highest sulphate and TDS concentrations to date measured in September 2001.	• Located downgradient of waste to the south and screened in sand • Groundwater may be slightly impacted by landfill leachate • Elevated iron, manganese and DOC may be related to presence of peat in area of the borehole
BH00-6B Sand	DOC, Iron, Manganese, Sulphate, TDS	Chloride, Hardness, Iron, Strontium, Sulphate, TDS	• Increased concentrations of alkalinity, ammonia, chloride, hardness, iron, manganese, strontium, sulphate, TDS and TKN in fall 2001 sampling session.	• Located downgradient of waste to the south and screened in sand • Groundwater impacted by landfill leachate based on elevated concentrations of leachate indicator parameters in September 2001 (refer to Figure 5)
BH00-7 Sand	DOC	[None]	• Highest sodium, sulphate and TDS concentrations to date measured in September 2001.	• Located northwest of waste and screened in sand • Groundwater not impacted by landfill leachate based on low chloride concentrations (refer to Figure 5)
BH01-8A Sand	DOC, Iron, Manganese, TDS (Fall 2001 only)	Chloride, Hardness, Iron, Strontium, Sulphate (Fall 2001 only), TDS	• Only 2 sets of data available at this location • Groundwater quality during 2 sampling sessions in 2001 was highly variable	• Located along western property boundary and screened in sand • Interpretation as to presence/of landfill leachate impact at this location requires additional groundwater quality data
BH01-8B Sand	DOC, Iron, Manganese	Hardness, Iron, Strontium, Sulphate (Fall 2001 only), TDS	• Only 2 sets of data available at this location • Groundwater quality during 2 sampling sessions in 2001 was highly variable	• Located along western property boundary and screened in sand • Interpretation as to presence/of landfill leachate impact at this location requires additional groundwater quality data

TABLE 3 (continued)
SUMMARY OF 2001 GROUNDWATER QUALITY
WARD 3 LANDFILL SITE, TOWNSHIP OF ALFRED AND PLANTAGENET

Monitoring Well	Parameters Exceeding ODWS in 2001	Leachate Indicator Parameters [1] Exceeding Background Levels in 2001	Trends	Hydrogeological Interpretation
BH01-9A Sand/Silty Clay	DOC, Iron, Manganese	Chloride, Hardness, Iron, Strontium, TDS	• Only 2 sets of data available at this location • Groundwater quality during 2 sampling sessions in 2001 was somewhat variable	• Located along the eastern property boundary and screened in sand and clay • Groundwater may be slightly impacted by landfill leachate based on higher chloride concentrations in fall 2001 • Elevated iron, manganese and DOC may be related to presence of peat in area of the borehole • Additional groundwater quality data required at this location to provide a more definitive interpretation on the potential presence/absence of landfill leachate impacts
BH01-9B Sand	Iron, Manganese	Chloride, Hardness, Iron, Strontium, TDS	• Only 2 sets of data available at this location • Groundwater quality during 2 sampling sessions in 2001 was somewhat variable	• Located along the eastern property boundary and screened in sand • Groundwater may be slightly impacted by landfill leachate based on higher chloride concentrations in fall 2001 • Elevated iron, manganese and DOC may be related to presence of peat in area of the borehole • Additional groundwater quality data required at this location to provide a more definitive interpretation on the potential presence/absence of landfill leachate impacts
BH01-10 Sand	DOC, Iron, Manganese	Chloride, Hardness, Iron, Strontium, Sulphate, TDS	• Only 2 sets of data available at this location • Groundwater quality during 2 sampling sessions in 2001 was somewhat variable	• Located along the eastern property boundary and screened in sand • Groundwater may be slightly impacted by landfill leachate due to elevated concentrations of leachate indicator parameters primarily in spring 2001 sampling session • Elevated iron, manganese and DOC may be related to presence of peat in area of the borehole • Additional groundwater quality data required at this location to provide a more definitive interpretation on the potential presence/absence of landfill leachate impacts

Notes:
1. Leachate indicator parameters are selected from a list of parameters which are characterized by elevated concentrations in monitor BH00-3B in comparison to background conditions at BH00-1A and BH00-1B. The leachate indicator parameters are: Chloride, Hardness, Iron, Strontium, Sulphate and TDS.

N/A Not applicable as these are the background monitoring wells.

TABLE 4
SUMMARY OF PARAMETERS EXCEEDING REASONABLE USE PERFORMANCE OBJECTIVES AT GROUNDWATER MONITORS SCREENED IN THE SAND UNIT WARD 3 LANDFILL SITE, TOWNSHIP OF ALFRED AND PLANTAGENET

Monitoring Location	Monitoring Session			
	Summer		Fall	
	Parameter	Concentration (mg/L)	Parameter	Concentration (mg/L)
BH00-5B	---	---	DOC Iron Sulphate TDS	21.1 24.90 1180 2740
BH00-6A	DOC	4.58	TDS	456
BH00-6B	DOC Iron	53.7 6.34	DOC Iron Sulphate TDS	20.2 21.90 1180 2710

Note – RUPO concentrations for DOC, iron, sulphate and TDS are 20.1 mg/L, 0.92 mg/L, 270 mg/L and 400 mg/L, respectively.

Table 5
Population and Waste Quantity Projections

Calendar Year	Village Alfred Population (#)	Vol/Yr (m^3)	Total Waste/Yr (m^3)	Cumulative Vol. Waste (m^3)	Ward 3 Volume (m^3)	Available Capacity (m^3)
% increase	1.0115	1.09				
2001	1,374	1,498	1,498	8,737	40,032	5,650
2002	1,390	1,515	1,515	10,252	41,547	4,135
2003	1,406	1,532	1,532	11,784	43,079	2,603
2004	1,422	1,550	1,550	13,334	44,629	1,053
2005	1,438	1,568	1,568	14,902	46,197	-515
2006	1,455	1,586	1,586	16,488	47,783	-2,101
2007	1,472	1,604	1,604	18,092	49,387	-3,705
2008	1,488	1,622	1,622	19,714	51,009	-5,327
2009	1,506	1,641	1,641	21,355	52,650	-6,968
2010	1,523	1,660	1,660	23,015	54,310	-8,628
2011	1,540	1,679	1,679	24,694	55,989	-10,307
2012	1,558	1,698	1,698	26,393	57,688	-12,006
2013	1,576	1,718	1,718	28,111	59,406	-13,724
2014	1,594	1,738	1,738	29,848	61,143	-15,461
2015	1,613	1,758	1,758	31,606	62,901	-17,219
2016	1,631	1,778	1,778	33,384	64,679	-18,997
2017	1,650	1,798	1,798	35,182	66,477	-20,795
2018	1,669	1,819	1,819	37,001	68,296	-22,614
2019	1,688	1,840	1,840	38,841	70,136	-24,454
2020	1,707	1,861	1,861	40,702	71,997	-26,315
2021	1,727	1,882	1,882	42,585	73,880	-28,198

Note: All volumes are shown from the start of the calendar year
Capacity has been estimated from the January survey of the Ward 3 Landfill

TABLE 6
PROPOSED 2002 MONITORING PROGRAM
WARD 3 LANDFILL SITE, TOWNSHIP OF ALFRED AND PLANTAGENET

1.0 MONITORING SESSIONS

1.1 Water Level and Quality Monitoring

Spring (May/June)
Fall (September/October)

2.0 SAMPLING LOCATIONS

BH00-1B*, BH00-2A, BH00-2B, BH00-3A, BH00-3B*, BH00-4A, BH00-4B, BH00-5A, BH00-5B*, BH00-6A, BH00-6B*, BH00-7, BH01-8A, BH01-8B, BH01-9A, BH01-9B and BH01-10.

3.0 FIELD MEASURED PARAMETERS

Groundwater levels in all monitors

temperature, electrical conductivity, and pH

4.0 LABORATORY MEASURED PARAMETERS

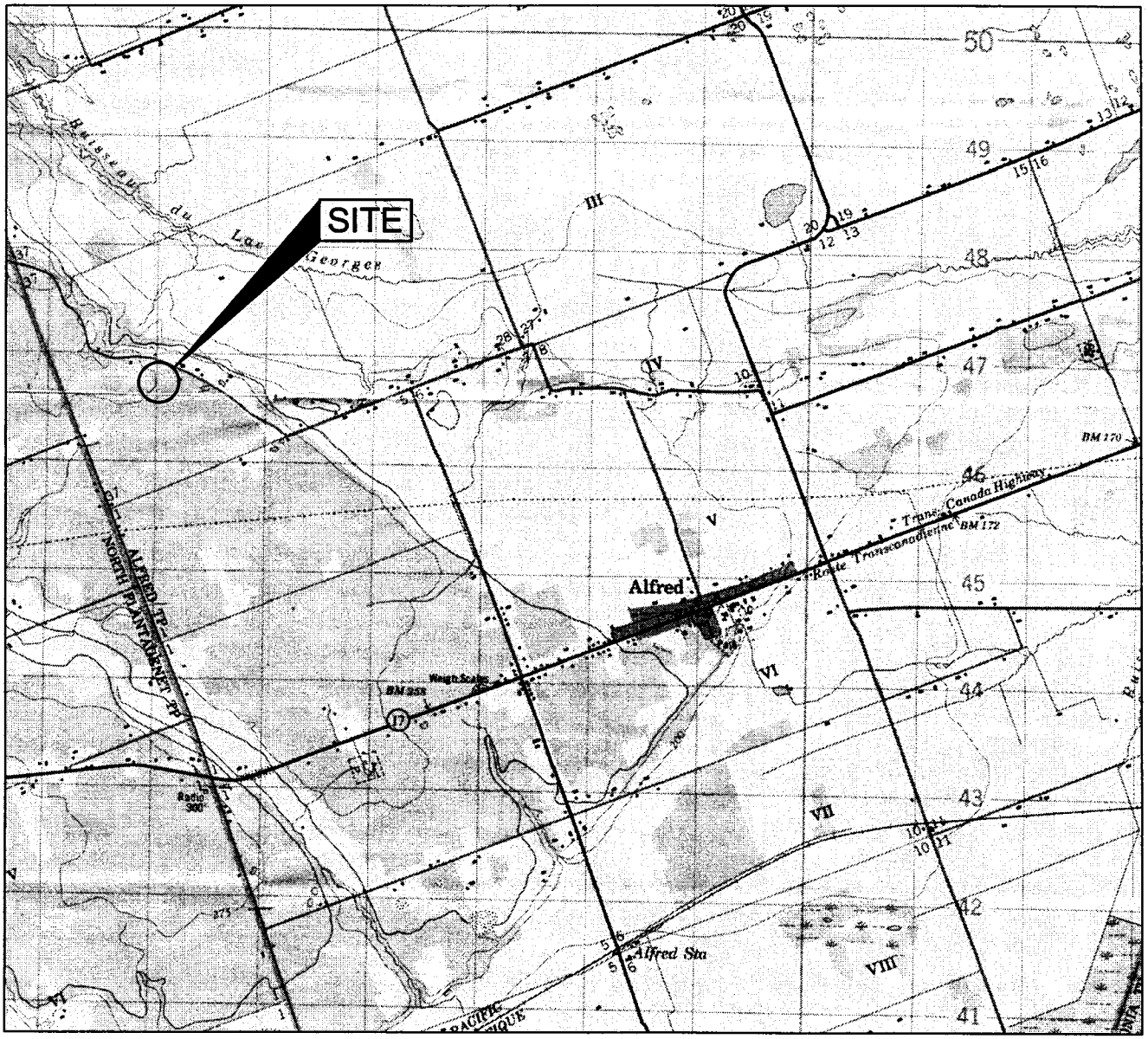
Surveillance Groundwater Parameters (for locations marked with * in Section 2.1 above) includes alkalinity, aluminum, ammonia, barium, beryllium, boron, cadmium, calcium, chloride, chromium, cobalt, COD, copper, DOC, hardness (calculated from laboratory calcium and magnesium analyses), iron, lead, magnesium, manganese, molybdenum, nickel, nitrate, nitrite, phenols, phosphorus, potassium, silicon, silver, sodium, strontium, sulphate, sulphur, TDS, thallium, tin, titanium, TKN, unionized ammonia (calculated from laboratory ammonia concentrations and field temperature and pH measurements), vanadium, zinc.

Routine Groundwater Parameters includes alkalinity, boron, chloride, hardness (calculated from laboratory calcium and magnesium analyses), iron, manganese, strontium, sulphate, TDS and TKN.

NOTE: All laboratory analyses on water samples should be performed by a private analytical laboratory and the method detection limits (MDLs) for the specific analyses should be commensurate with the standards established in the MOE Ontario Drinking Water Standards (groundwater) or Provincial Water Quality Objectives (surface water).

KEY PLAN

FIGURE 1



SCALE 1 : 50,000

SPECIAL NOTE
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Date: MARCH 2002

Project: 011-2825

Golder Associates

Drawn: K.T.

Chkd: MV

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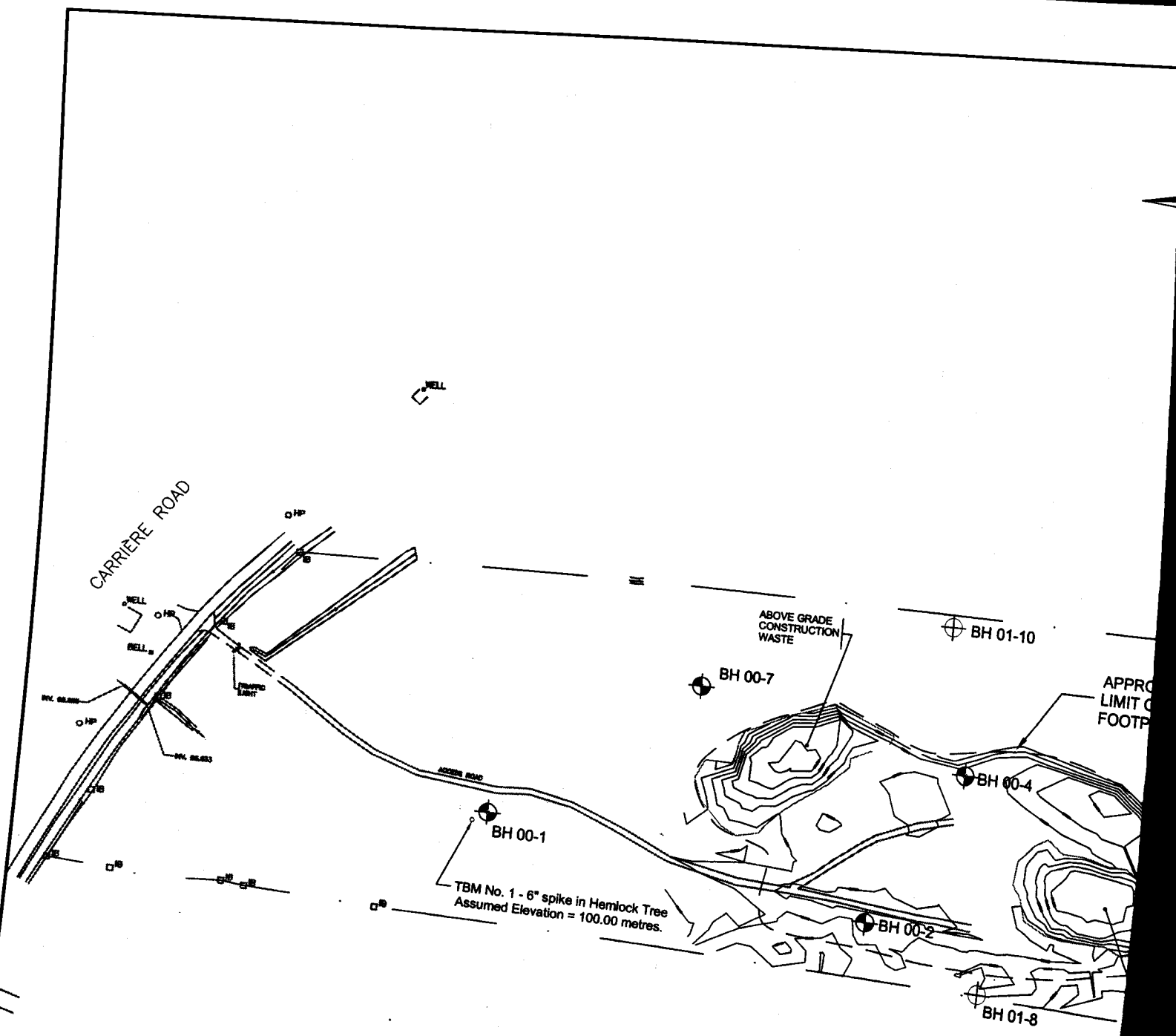
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WELL
HP
ABOVE GRADE CONSTRUCTION WASTE
BH 01-10
BH 00-7
BH 00-4
BH 00-1
BH 00-2
BH 01-8
TBM No. 1 - 6" spike in Hemlock Tree
Assumed Elevation = 100.00 metres.

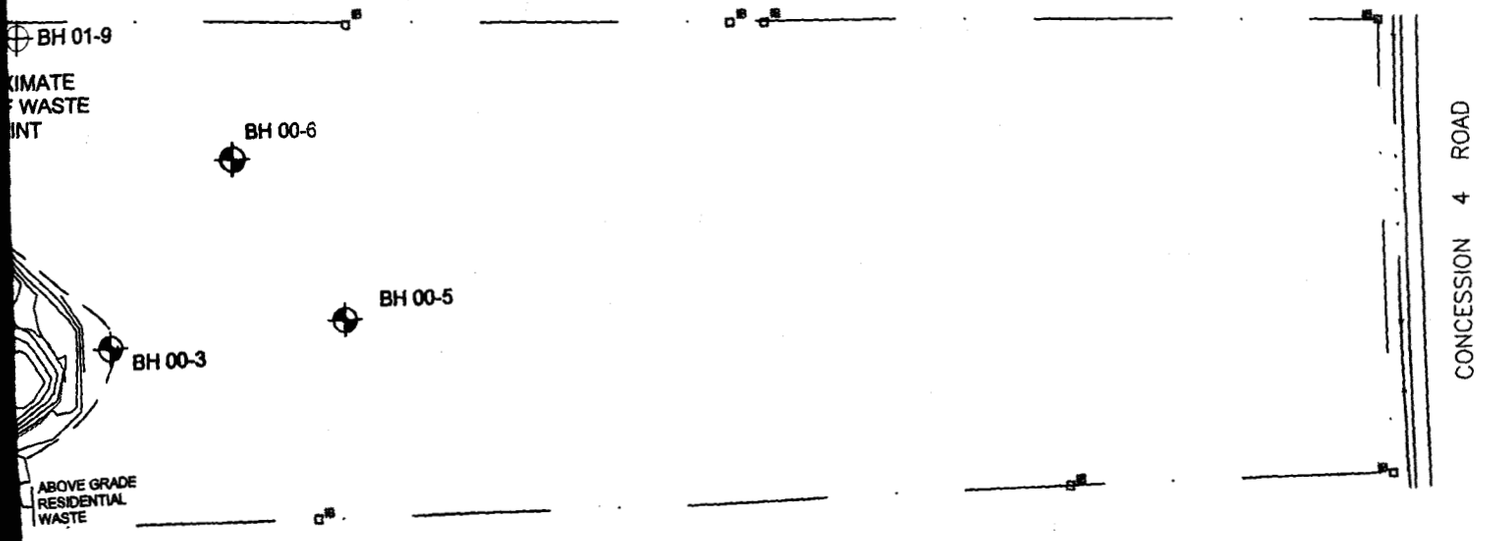
SITE PLAN

FIGURE 2

LEGEND

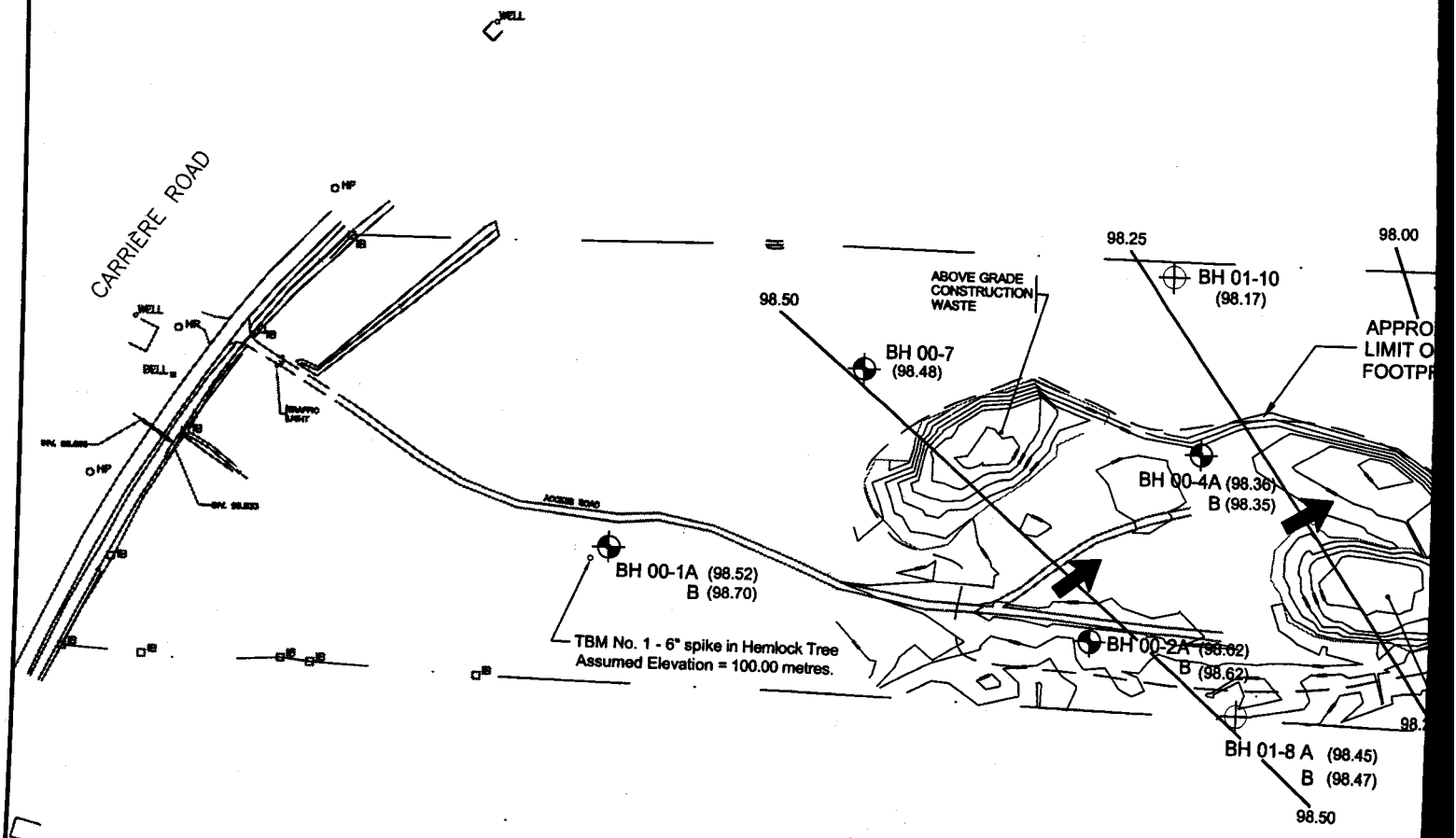
BOREHOLE LOCATION IN PLAN (GOLDER, 2000)

BOREHOLE LOCATION IN PLAN (GOLDER, 2001)



REFERENCE:

BASE PLAN SUPPLIED BY : STANTEC CONSULTING LTD.



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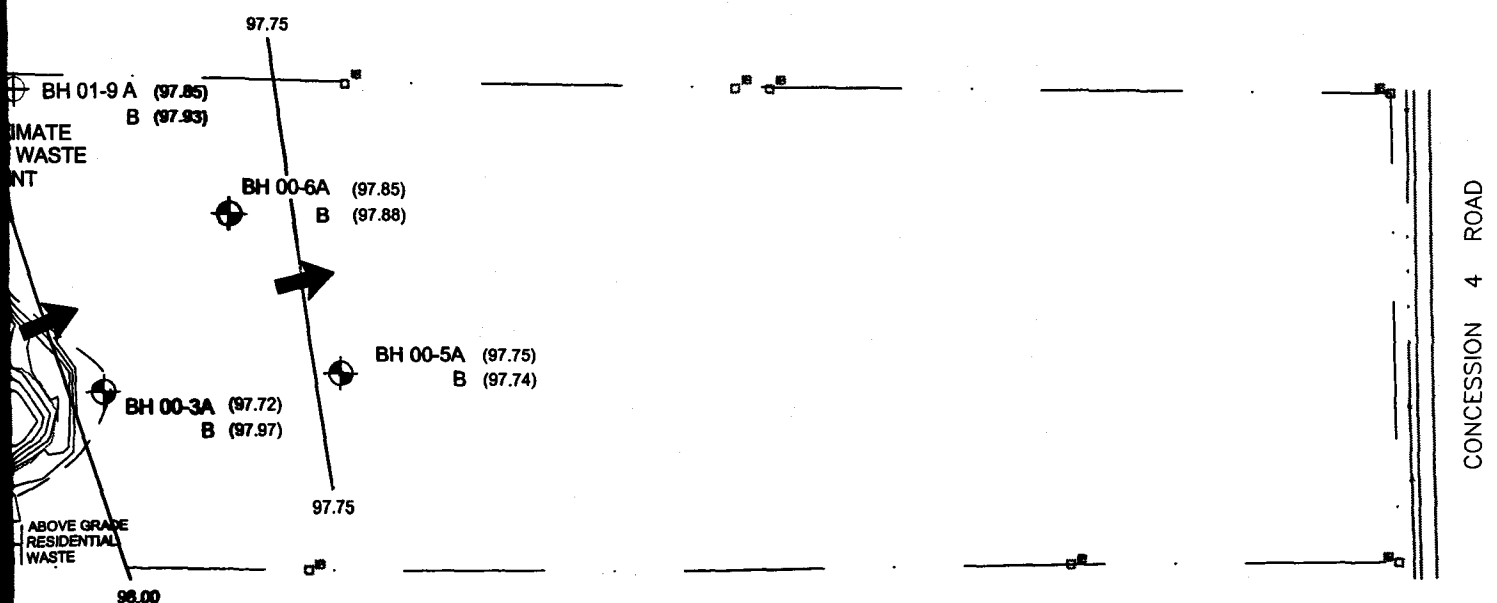
GROUNDWATER ELEVATIONS AND FLOW DIRECTION (SPRING 2001)

FIGURE 3

LEGEND

- BOREHOLE LOCATION IN PLAN (GOLDER, 2000)
- BOREHOLE LOCATION IN PLAN (GOLDER, 2001)
- (97.92) GROUNDWATER ELEVATION, metres (MEASURED ON JUNE 11, 2001)
- —98— INFERRED GROUNDWATER ELEVATION CONTOUR, metres
- INTERPRETED DIRECTION OF GROUNDWATER FLOW IN SAND UNIT



REFERENCE:

BASE PLAN SUPPLIED BY : STANTEC CONSULTING LTD.

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SCALE 1 : 3000

SPECIAL NOTE
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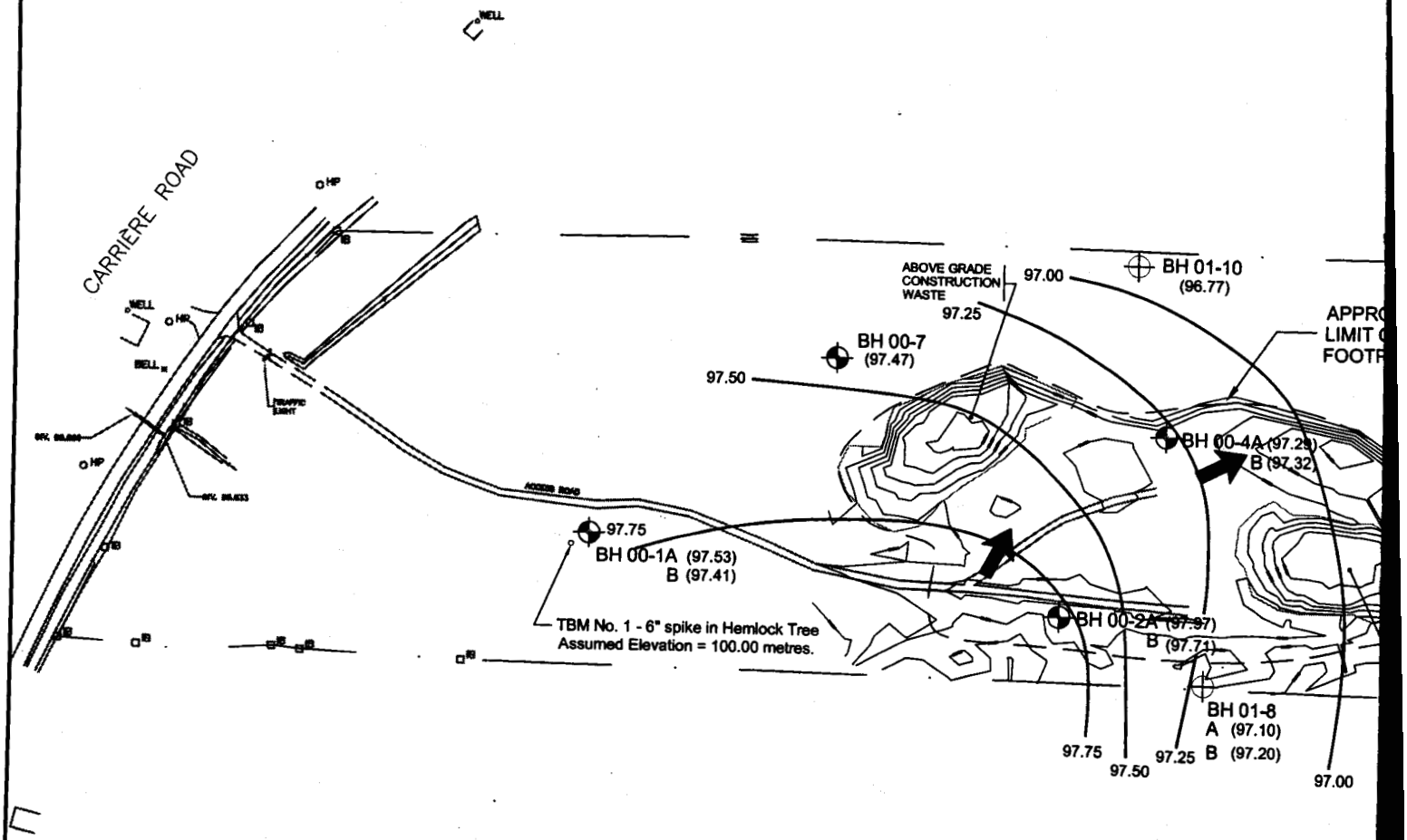
Golder Associates

Date: MARCH 2002

Drawn: K.T.

Chkd: MW

011-2825



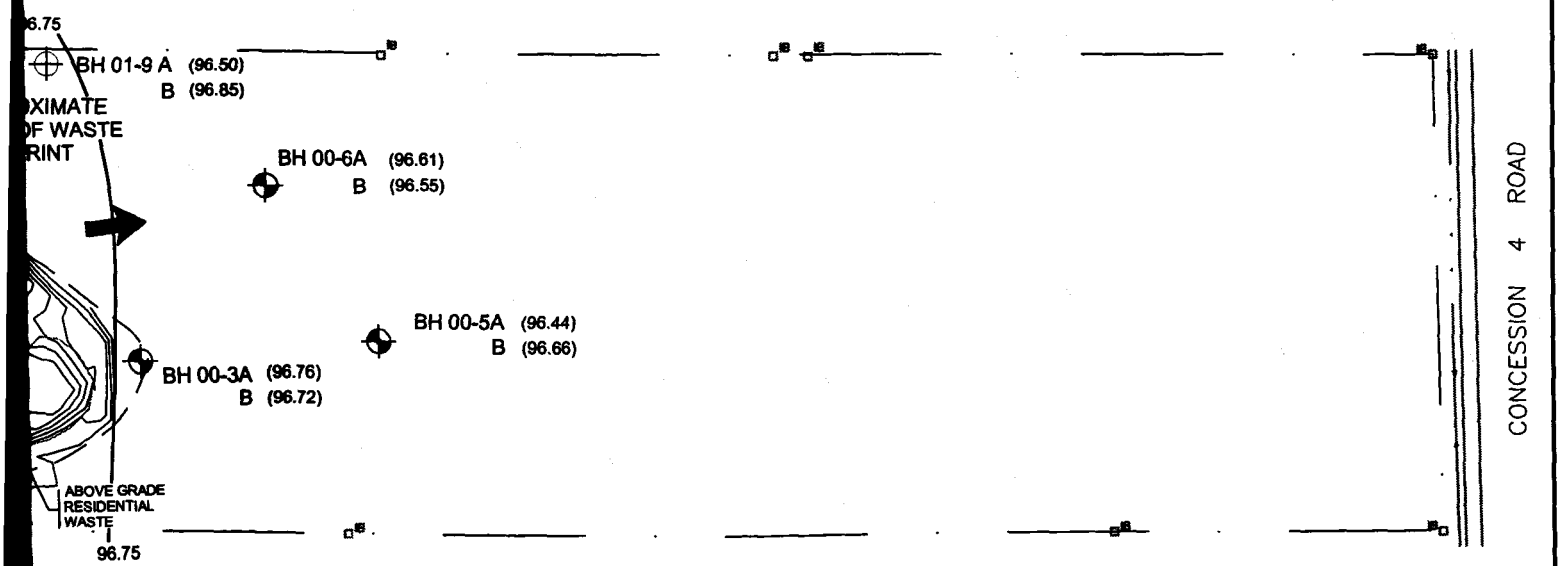
N/ACTIVE/2800/011-2825/ACAD/0112825-1000-04.DWG

GROUNDWATER ELEVATIONS AND FLOW DIRECTION (FALL 2001)

FIGURE 4

LEGEND

- BOREHOLE LOCATION IN PLAN (GOLDER, 2000)
- BOREHOLE LOCATION IN PLAN (GOLDER, 2001)
- (97.92) GROUNDWATER ELEVATION, metres (MEASURED ON SEPT 18, 2001)
- 96.75 INFERRED GROUNDWATER ELEVATION CONTOUR, metres
- INTERPRETED DIRECTION OF GROUNDWATER FLOW IN SAND UNIT



REFERENCE:

BASE PLAN SUPPLIED BY : STANTEC CONSULTING LTD.

SCALE in metres

20 0 20 40 60 80

SCALE 1 : 3000

SPECIAL NOTE
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

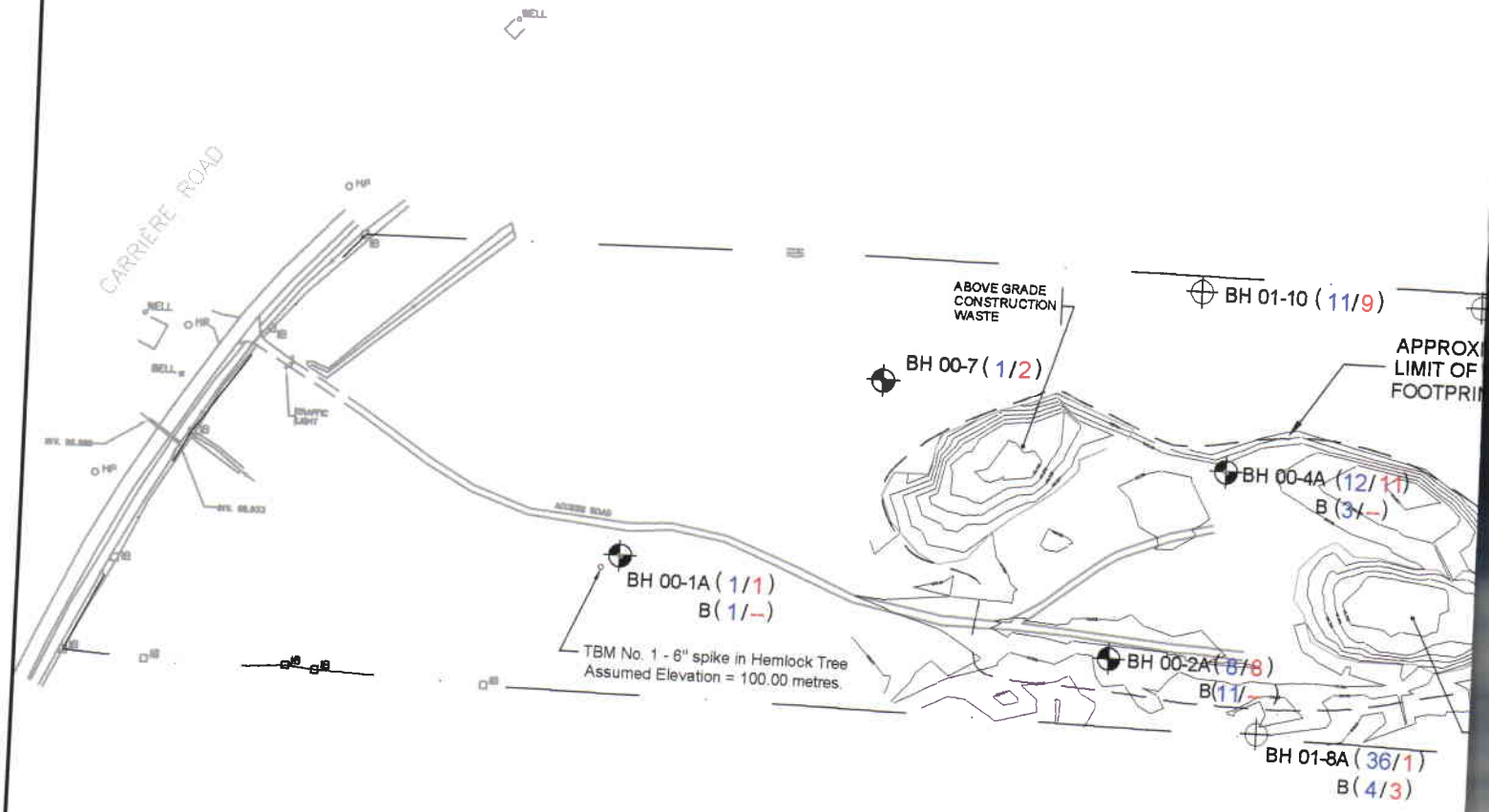
Date: MARCH 2002

Project: 011-2825

Golder Associates

Drawn: K.T.

Chkd: MW



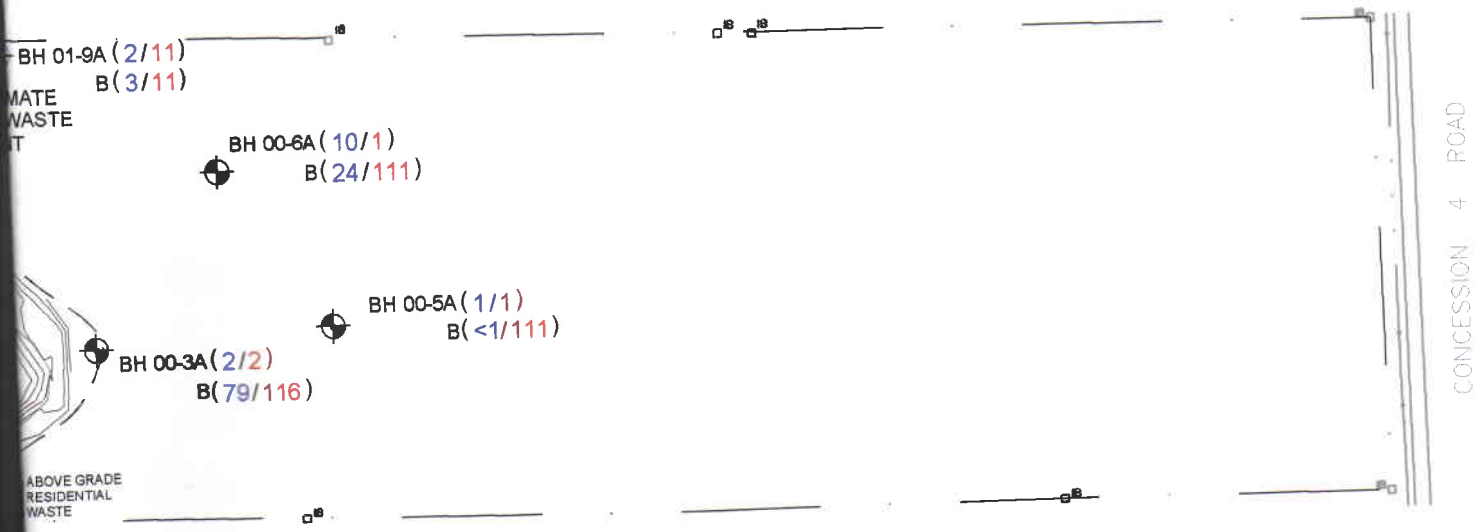
N/ACTIVE/2800/011-2825/ACAD/0112825-1000-05.DWG

CHLORIDE CONCENTRATIONS DURING 2001

FIGURE 5

LEGEND

- BOREHOLE LOCATION IN PLAN (GOLDER, 2000)
- BOREHOLE LOCATION IN PLAN (GOLDER, 2001)
- (2/5) CHLORIDE CONCENTRATIONS (SPRING / FALL) (mg/L)



REFERENCE:

BASE PLAN SUPPLIED BY : STANTEC CONSULTING LTD.

SCALE in metres

20 0 20 40 60 80

SCALE 1 : 3000

SPECIAL NOTE
THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING REPORT

Date: MARCH 2002

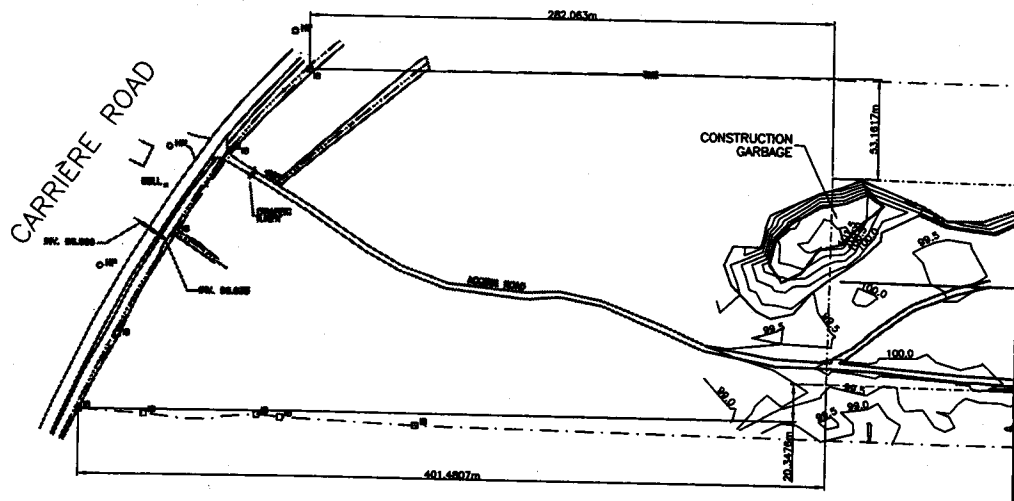
Project: 011-2825

Golder Associates

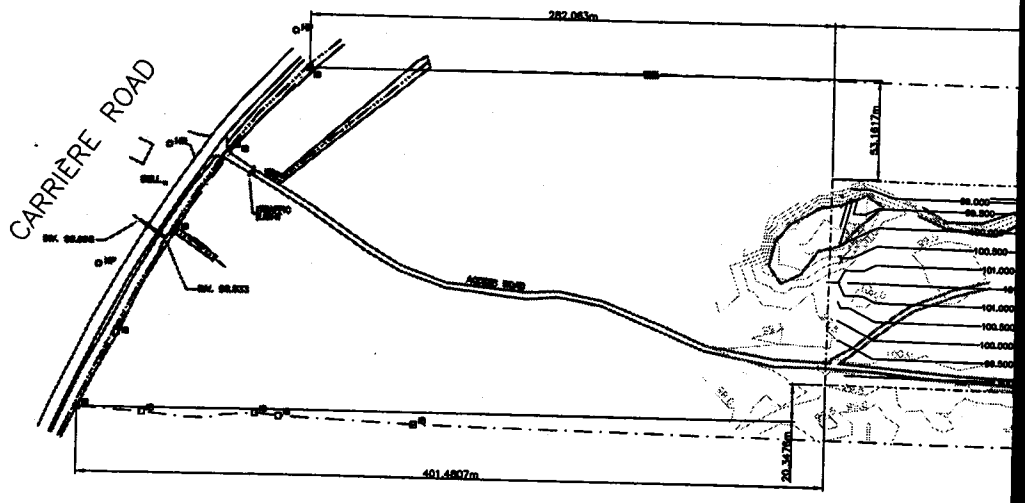
Drawn: K.T.

Chkd: MW

BM ELEV. 99.156, NAIL IN SOUTH SIDE OF HYDRO POLE #2724 NORTH OF ENTRANCE TO SITE



EXISTING CONDITI



FINAL WAST

N/ACTIVE/2800/011-2825/ACAD/0112825-1000-06.DWG

No.	Date	Revision

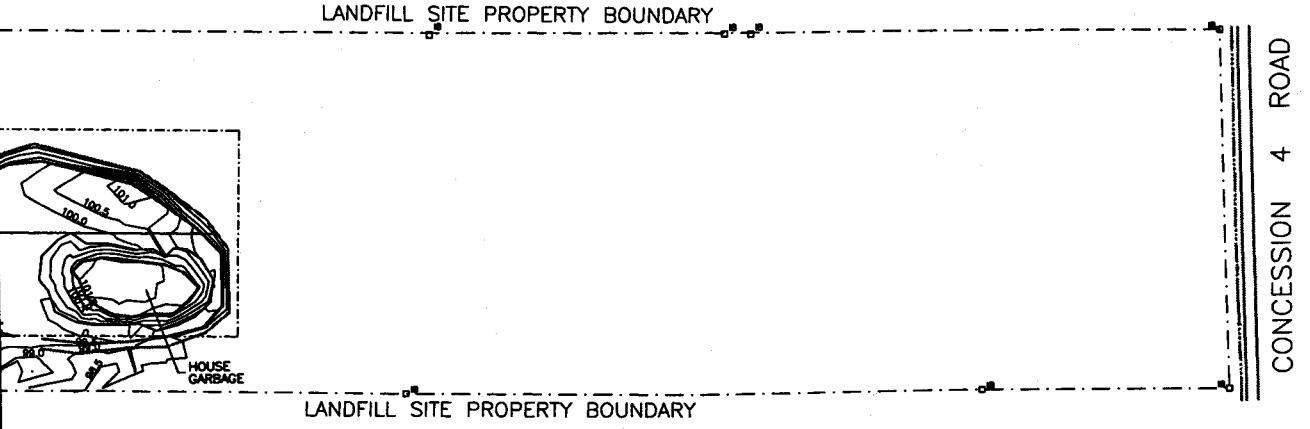
Stantec

Owner	TOWNSHIP OF ALFRED PLANTAGENET
Project	WARD 3 LANDFILL
Title	EXISTING AND FINAL WASTE CONTOURS

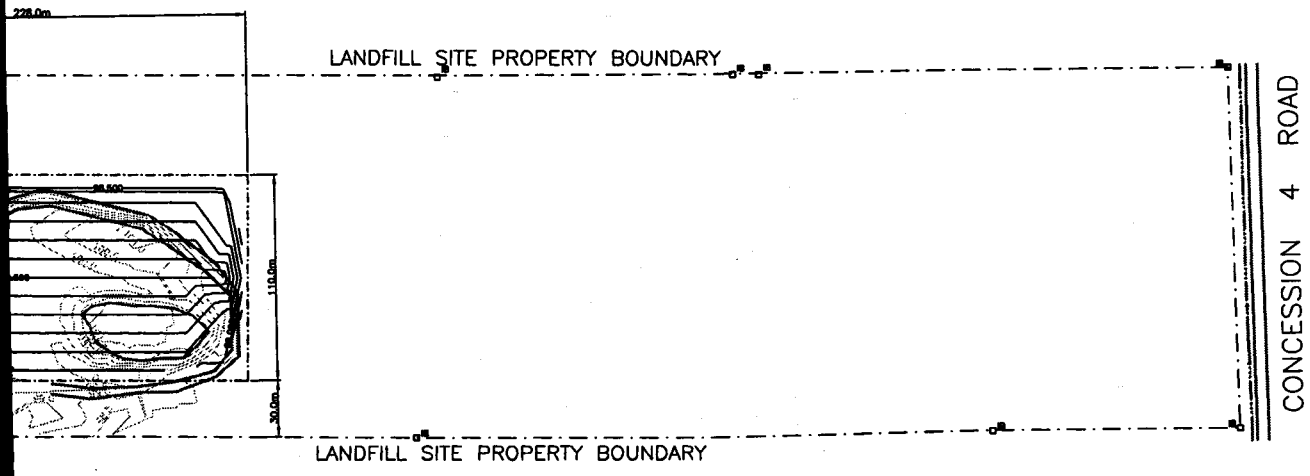
Design	G.L.	Scale	AS SHOWN	Proj. No.	634-00212	Dwg No.	FIG-6
Drawn	Y.L.	Check	S.B.	Date	JAN/2001		

SURVEY EXECUTED NOVEMBER 2000

30 0 15 30 60 90 120



ONS



E CONTOURS

APPENDIX A

MOE CERTIFICATE OF APPROVAL (1981)

of the Environment
Ontario

470904

PROVISIONAL CERTIFICATE OF APPROVAL
WASTE DISPOSAL SITE

Under The Environmental Protection Act, 1971 and the regulations and subject to the limitations thereof, this Provisional Certificate of Approval is issued to:

Arthur N. Carriere,
R.R. #1,
Alfred, Ontario.

for the use and operation of a 2.51 hectare landfilling site within a total site area of 37.4 hectares.

all in accordance with the following plans and specifications:
as per Schedule "A" (see attached)

Located:
Part of West 1/2 of Lot 35, Concession 3,
Township of Alfred,
County of Prescott

which includes the use of the site only for the disposal of the following categories of waste (NOTE: Use of the site for additional categories of wastes requires a new application and amendments to the Provisional Certificate of Approval) 65% commercial, 30% domestic and 5% non-hazardous solid industrial waste.

and subject to the following conditions:

Registered ON TITLE as Instrument 48131

1. No waste shall be disposed of at the site until this Certificate including the reasons for this condition has been registered by the applicant as an instrument in the appropriate Land Registry Office against title to the site and a duplicate registered copy thereof has been returned by the applicant to the Director.

2. Wastes are to be deposited in an orderly manner in the fill area, compacted and adequately covered by 15 cm (6") of cover material once a month between April 15 and November 15, or as directed by the Director of the Southeastern Region of the Ministry of the Environment.

3. Burning of domestic waste is prohibited at the site.

THIS IS A TRUE COPY OF THE ORIGINAL CERTIFICATE MAILED ON 23.7.81

Dated this 14th day of July, 19 81

(Signed)

Director, Section 39,
The Environmental Protection Act, 1971

Jan 6, 1977.

Mr G.J. McKenna, P.Eng.,
District Officer,
Municipal and Private Abatement,
4 Montréal Road,
Second Floor,
Cornwall, Ontario.

MINISTRY OF THE ENVIRONMENT

JAN 1 1977

Cornwall

Subject: Operational Plan of Mr Arthur N. Carrière's Proposed Dump Site in the Township of Alfred.

Dear Sir:

Mr Arthur N. Carrière, if his dump site is approved intends to operate in the following manner:

according to Mr. Carriere stopped using the trench used in approx 1980 next one method of landfill

1. The trenches will be dug to a maximum depth of 6 = 1.82m feet, starting at the northeast end of the dump site, excavating the trench parallel to the east property line and progressing gradually with the other trenches toward the west side of the dump with all trenches being parallel to one another.

2. Compaction of the garbage and coverage with 6 inches of fill material will be done at least once a month and more frequently if required.

3. The access gate to the dump will be locked when the dump is not being used and signs will be erected near the gate. The signs erected will indicate the following:
   a) No trespassing.
   b) Hours for dump opening (as per Village requirements)
   c) Materials accepted in the dump site.

4. A buffer zone of 150 feet will be observed from all neighboring properties. This 150 feet buffer zone will include 50 feet of screening from adjacent properties.

5. The garbage will be compacted and covered using a D-6 dozer. The gravel road to the dump site is private and will be maintained by Mr Carrière.

Yours truly,

André Desjardins

André E. Desjardins, P.ENG.

c.c. Mr Carrière.

614 THERIAULT STREET, HAWKESBURY, ONTARIO, K6A 1Z3 – TEL.: (613) 632-4271

SCHEDULE "A"

Provisional Certificate of Approval No. A 470904

1. Application and Supporting Information forms for the Waste Disposal Site dated November 24, 1976.

2. Document entitled "Description of Proposed Waste Disposal Site".

3. Aerial photography showing the proposed site and surrounding area.

4. Plan dated November 26, 1976 showing the proposed waste disposal site and adjacent property owners.

5. "Operative Plan of Mr. Arthur Carrier's Proposed Dump Site in the Township of Alfred" dated January 6, 1977 prepared by Andre F. Desjardins, P. Eng., Consulting Engineer.

Ontario

MINISTRY OF THE ENVIRONMENT

NOTICE

TO: Arthur N. Carriere,
R.R. #1,
Alfred, Ontario.

You are hereby notified that Provisional Certificate of Approval No. A 470904 has been issued to you subject to the conditions outlined therein.

The reasons for the imposition of these conditions are as follows:

1. A reason for the condition requiring registration of the Certificate is that Section 46 of The Environmental Protection Act, 1971 prohibits any use being made of the lands after they cease to be used for waste disposal purposes within a period of twenty-five years from the year in which such land ceased to be used unless the approval of the Minister for the proposed use has been given. The purpose of this prohibition is to protect future occupants of the site and the environment from any hazards which might occur as a result of waste being disposed of on the site. This prohibition and potential hazard should be drawn to the attention of future owners and occupants by the Certificate being registered on title.

2. The reason for the imposition of condition 2 is to ensure that the development of this landfilling site will be in an orderly and systematic manner and the landfilling operations will be in accordance with the provisions of The Environmental Protection Act, 1971 and Regulation 824 pursuant to that Act and the use and operation of the site without such a conditon may create a nuisance.

3. A reason for condition 3 is to ensure the health and safety of any person and the operations of the site without such a condition may create a nuisance.

You may by written notice served upon me and the Environmental Appeal Board within 15 days after receipt of this Notice, require a hearing by the Board.

This Notice should be served upon:

The Secretary
Environmental Appeal Board
1 St. Clair Avenue West
5th Floor
Toronto, Ontario
M4V 1K7

AND

The Director
Section 39, E.P.A.
Ministry of the Environment
133 Dalton Street, Box 820,
Kingston, Ontario
K7L 4X6

Dated at Toronto this 14th day of July, 1981.

Ministry of the Environment — Waste Management Branch

Ontario

SUPPORTING INFORMATION TO AN APPLICATION FOR APPROVAL OF A LANDFILL DISPOSAL SITE

FOR MINISTRY USE ONLY

File A —

APPLICANT TO COMPLETE ITEMS 1-4 INCLUSIVE

1. Site Details

APPLICANT: Arthur N. Carrière

SITE LOCATION: Pt W½ Lot 35 Concession 3

Alfred Township - Prescott County

TOTAL AREA OF SITE 92.5 65 ACRES	TOTAL AREA TO BE UTILIZED FOR WASTE DISPOSAL 6.2 ACRES
ANTICIPATED LIFETIME ____ YEARS	DISTANCE TO NEAREST WATERCOURSE N/A FT.
DISTANCE TO NEAREST POTABLE WELL WATER SUPPLY 900 FT.	DEPTH OF WELL NOTED AT LEFT 16 FT.
DISTANCE TO DWELLING 900 FT.	DISTANCE TO PUBLIC ROAD MEASURED FROM WORKING AREA 1,200 FT.
DISTANCE TO CEMETERY 14,000 FT.	DEPTH FROM ORIGINAL SURFACE TO BOTTOM OF WASTE 6 FT.
DEPTH FROM ORIGINAL SURFACE TO TOP OF FILL - FT.	

GROUND CONDITIONS ENCOUNTERED MEASURED FROM ORIGINAL SURFACE

Fine Sand FROM 0' TO 9'

FROM ____ TO ____

FROM ____ TO ____

FROM ____ TO ____

DEPTH TO WATERTABLE BELOW SURFACE None at 9 FT.	ON(DATE) August 23 1976

GENERAL DESCRIPTION OF SITE (LOCATION, TOPOGRAPHY, ETC.)

1200 feet south of Forced Road across W½ Lot 35 Concession 3 on topographically high area.

PROPOSED USE OF LAND AFTER SITE FULLY UTILIZED

FOR REGIONAL OFFICE USE

Authorities consulted:	OBJECTION	RECOMMENDED
HEALTH UNIT	☐	☐
A.M.B.	☐	☐
MUNICIPALITY	☐	☐
CONSERVATION AUTHORITY	☐	☐
SANITARY ENGINEERING	☐	☐
INDUSTRIAL WASTES	☐	☐
WATER QUANTITY	☐	☐
OTHER ____	☐	☐
____	☐	☐

Inspection Record Forms attached Yes ☐ No ☐

Number of Forms ____

Regional Engineer's Report attached ☐

	REQUIRED	AVAILABLE
Ground Water monitoring	Yes ☐ No ☐	Yes ☐ No ☐
Surface Water monitoring	Yes ☐ No ☐	Yes ☐ No ☐

3. Quantities

TOTAL TONS PER DAY	TOTAL GALLONS PER DAY
1	Nil

ESTIMATED ☒ OR MEASURED ☐

SITE OPENED 5 DAYS FROM 9 AM TO 4 PM

POPULATION SERVED ~~1,000~~ 1350

NAMES OF MUNICIPALITIES SERVED

Village of Alfred

OFFICIAL PLAN ☐ N/A ZONING BY-LAW ☐ N/A

SITE LAND ZONED	ADJACENT LAND ZONED
Agricultural	Agricultural

EQUIPMENT OWNED ☑ RENTED ☑

2. Wastes to be disposed of

DOMESTIC 95

COMMERCIAL

INDUSTRIAL WASTE

HAULED LIQUID INDUSTRIAL WASTE

*DESCRIBE

ORIGIN (OTHER)

Ontario Environment Management Branch

FOR MINISTRY USE ONLY

File A —

APPLICATION FOR A CERTIFICATE OF APPROVAL FOR A WASTE DISPOSAL SITE

IMPORTANT NOTE: This form must be submitted through the office of the Regional Waste Management Engineer **See back of form for instructions for completing this form.**

1. Owner (Applicant) — Under the Environmental Protection Act and the Regulations, this application is made by:—

Arthur N. Carrière (Name)
RR 1
Alfred, Ontario. (Address)
Box 38

2. Type of disposal site — For the ~~Renewal~~ / Issue of a Certificate of Approval for a

Landfilling Dump

3. Site location — Located

Pt W½ Lot 35 Concession 2
Alfred Township
Prescott County.

IF APPLICATION IS FOR REISSUE, COMPLETE SECTIONS 4 AND 5 (A OR B)

4. Previous Certificate details — Certificate / Provisional Certificate of Approval:— for this site was issued on:—

No. N/A
..... 197

5. Changes. (A) The following changes in use, operation or ownership (have occurred since the date of the original application) OR (are proposed)

N/A

(B)

6. Operator

APPENDIX B

MOE COMPLIANCE INSPECTION REPORT
(January 21, 2000)

Ministry of the Environment

113 Amelia Street
Cornwall ON K6H 3P1
Telephone: (613) 933-7402
Fax: (613) 933-6402

Ministère de l'Environnement

113 rue Amelia
Cornwall ON K6H 3P1
Téléphone: (613)933-7402
Télécopieur: (613)933-6402

Ontario

January 21, 2000

Diane Thauvette, Clerk-Treasurer
Corporation of the Township of
Alfred and Plantagenet
205 Old Highway 17
P.O. Box 350
Plantagenet, ON K0B 1L0

Dear Madam:

Re: Compliance Inspection Report - Carrière Waste Disposal Site

The above-noted facility was inspected on October 20, 1999, by Gerry Murphy, Senior Environmental Officer, for this office.

Enclosed is a copy of the inspection report. Your attention is directed to the sections of the report titled "Action(s) Required" .

I ask that you provide this office with a detailed abatement schedule for addressing the operational concerns outlined in the inspection report. Please send me this schedule by February 25, 2000.

If you have any questions or comments, please contact Gerry Murphy at this office at extension 232.

Yours truly,

R.J. Robertson

R.J. Robertson
Area Supervisor

GM:sp
Enclosure

S:\GROUPS\WORDPRO\2000\Inspections\WASTE\CARRIERE

COMPLIANCE INSPECTION REPORT

CARRIÈRE
Waste Disposal Site

SOLID NON-HAZARDOUS WASTE DISPOSAL SITE

REPORT PREPARED BY THE CORNWALL OFFICE OF THE MINISTRY OF THE ENVIRONMENT, EASTERN REGION

Inspected by: Gerry Murphy
Inspection: October 20, 1999

TABLE OF CONTENTS

APPENDICES

Ontario

MINISTRY OF THE ENVIRONMENT

SOLID NON-HAZARDOUS WASTE DISPOSAL SITE INSPECTION REPORT

COMPANY/MUNICIPALITY: Old Township of Alfred, presently the amalgamated Township of Alfred & Plantagenet. Note: This site serves the Village of Alfred only.

SITE ADDRESS: Part of West ½ of Lot 35, Concession 3

CONTACT NAME: Sylvio Simard **TITLE:** Deputy Clerk

CONTACT TELEPHONE: 613-673-4797 **FAX:** 613-673-4812

SITE LOCATION: The site is located approximately 4.5 km northwest of the Village of Alfred and on the south side of Carrière Road.

SITE NAME: The site is still referred to as the Carrière site, but as of September 29,1999, the site is now owned and operated by the municipality and registered on title as Instrument No. 102864.

INSPECTION DATE: October 20, 1999

DATE OF LAST INSPECTION: December 15, 1994

1.0 CERTIFICATES OF APPROVAL

- CofA #A470904 - issued August 11,1977, expiry date August 15, 1982 (Appendix "A")
  Condition: For the use, operation and establishment of a landfilling site all in accordance with Schedule "A" attached.

- CofA #A470904 - dated July 14, 1981, with no expiry date (Appendix "B"), for the use and operation of a 2.51 Ha landfilling site within a total site area of 37.4 Ha, all in accordance with the following plans and specifications as per Schedule "A" attached.

  Conditions:

  1) No waste shall be disposed of at the site until this Certificate, including the reasons for this condition, has been registered by the applicant as an instrument in the appropriate Land Registry Office against title to the site and a duplicate registered copy thereof has been returned by the applicant to the Director.
  NOTE: The Certificate has been registered on title as Instrument No. 48131.

2) Wastes are to be deposited in an orderly manner in the fill area, compacted and adequately covered by 15 cm (6") of cover material once a month between April 15th and November 15th or as directed by the Director MOE.
3) Burning of domestic waste is prohibited at the site.

Is there a record of financial assurance on the MOE file?

- No record of financial assurance on the MOE files, with no requirement documented on the CofA.

What is the approved total area of the site ?

- The present approved total area of the site is 37.4 hectares.
  Note: When the site was purchased by the municipality (September 1999), they acquired 21.2 Ha of the approved 37.4 Ha from the original owner, Mr. Arthur Carrière. A copy of the assessment map (Appendix "C") is enclosed, which shows the presently approved 37.4 Ha area and the newly purchased area.

What is the approved landfilling area (footprint) of the site ?

- The approved footprint of the site is 2.51 Ha.

Does the site have an approved capacity ?

- The site does not have a documented approved capacity, but based on presently approved trench method of fill, the total site capacity is 45,682 m^3 of waste.
  Capacity calculation: Area of footprint, multiplied by approved depth of waste in trench
  (2.51 Ha =25,100 m^2) X (6 feet = 1.82 metres) = 45,682 m^3

  Note: Since this approval was issued in 1977 for trench method of fill, Mr. A. Carrière converted over to the area method of fill in approximately 1980.

2.0 INSPECTION OBSERVATIONS

Has the footprint been flagged and/or is clearly identifiable ?

- During the current compliance inspection, the footprint was not flagged, or clearly identifiable. Municipal representatives mentioned that this would be done within the new year.

Are wastes being deposited outside of the footprint ?

- At the time of the compliance inspection there was no evidence of wastes being deposited outside the footprint.

Is access to the site controlled ?

- Access to the site is regulated under Section 11 (2) of Regulation 347. Currently, the entrance to the site is controlled by a locked chain. No evidence of fencing around the perimeter of the approved site.

  Note: There is no need for site supervision, since waste pick-up and disposal is done by the municipality, with the site not being open to the public of the Village of Alfred.

Are wastes being adequately covered ?

- The waste was compacted and covered approximately 3 times a year when owned and operated by the previous owner of the site. This practice contravened Section 2 of the 1981 C of A that stipulates the waste be compacted and covered with 15 cm of cover material once a month between April 15th and November 15th. The current owner (Alfred and Plantagenet Township) ensures the site is covered as per instructions on the C of A. Cover material is imported to the site from a local sand pit. Windblown litter did not appear to be a concern at the time of the compliance inspection.

Is there evidence of burning ?

- The C of A stipulates burning of domestic waste is prohibited at the site. There was no evidence of open burning at the time of the compliance inspection.

Is there any obvious evidence of groundwater/surface water impact ?

- At the time of the compliance inspection, there was no obvious evidence of groundwater or surface water impacts, but to this date, no hydrogeological investigation has been performed to verify or deny an impact.

If a leachate control system is required for this site, is it operational ?

- It is currently impossible to determine if a leachate control system is required, since a full hydrogeological investigation has yet to be completed.

If a methane gas control system is required for this site, is it operational ?

- Currently impossible to determine if a methane gas control system is required, since a hydrogeological investigation has yet to be completed.

Is there evidence that wastes other than solid non-hazardous wastes are being deposited at the site?

- No evidence of waste other than solid non-hazardous wastes are being deposited at the site.

3.0 REVIEW OF OUTSTANDING ISSUES

- No complaints have been received by this Ministry pertaining to the operation of the site since the last Compliance Inspection report of 1994.

- A site inspection was completed in April 1998, by ministry staff, to assess the operating authority's compliance with the site's Certificate of Approval. The Cornwall Area Office then forwarded a letter on August 21, 1998, to the attention of Diane Thauvette (Clerk-Treasurer, Alfred and Plantagenet Township) outlining recommendations pertaining to waste management practices (Appendix "D"). The Township then forwarded a response on September 21, 1998, outlining their remedial plan to comply with the ministry's recommendations (Appendix "E").

4.0 SUMMARY OF INSPECTION FINDINGS (HEALTH/ENVIRONMENTAL IMPACT)

- Was there any indication of a known or anticipated human health impact during the inspection and/or review of relevant material, related to this Ministry's mandate ?

  Yes No ☒

- Was there any indication of a known or anticipated environmental impact during the inspection and/or review of relevant material ?

  Yes No ☒

- Was there any indication of a known or suspected violation of a legal requirement during the inspection and/or review of relevant material which could cause a human health impact or environmental impairment ?

  Yes ☒ No

  Specifics: The site is being operated using the area method of fill, but the CofA was issued to incorporate the trench method of fill.

- Was there any indication of a potential for environmental impairment during the inspection and/or the review of relevant material ?

  Yes ☒ No

  Specifics: The natural topography of the land surrounding and including the footprint would indicate a relatively high groundwater table and if so, there may be leachate concerns generated from wastes buried within the water table.

4.1 ACTION(S) REQUIRED

- The Municipality is to:

1) amend the existing C of A to incorporate the currently used area method of fill as opposed to the approved trench method;
2) retain the services of a competent consultant to conduct a complete hydrogeological assessment of the site;
3) retain the services of a competent consultant to complete the required Operation and Development Plan for the site;
4) develop a municipal plan, i.e. by-law, to deal with the disposal of waste appliances at the site that contain refrigerants. Enclosed (Appendix "F") is a copy of Ontario Regulation 189/94 entitled "Refrigerants". As was suggested, there appears to be two preferred ways to go with regard to an approved method of emptying these appliances of refrigerant. One would be to have the owner of the waste appliance retain the services of an Ozone Depletion Prevention (ODP) card member to come to the location where the appliance is stored and properly remove the refrigerant and then tag the appliance which would indicate the appliance as refrigerant free. The tagged appliance could then be disposed of at the local approved waste disposal site and stored with other white goods (stoves, etc.). The second method would involve the municipality accepting these refrigerant appliances, storing them in a separate secure area of the site and hiring an ODP card member to come to the waste disposal site to empty these units;
5) dispose of tires through a recycling company;
6) install an up-to-date sign at the entrance to the site that will denote the owner of the site, operator of the site, who is authorized to use the site, types of waste accepted, emergency telephone number, and any applicable local by-laws.

5.0 ACTION(S) REQUIRED

- The municipality is aware of the above inspection findings and is currently developing a strategy to deal with these situations. The municipality is to report, in writing, to the MOE Cornwall Area Office by February 25, 2000, of their intention as to the timing of these issues.

OCCURRENCE REPORT #: 9940002533 - to amend C of A.

PREPARED BY:

ENVIRONMENTAL OFFICER: Gerry Murphy
(Print)

(Signature)

Kingston/Cornwall Area Office
(District/Area Office)

January 21/2000
(Date)

REVIEWED BY:

DISTRICT SUPERVISOR: R.J. Robertson
(Print)

R.J. Robertson
(Signature)

Jan 21/00
(Date)

REPORT MAILED OUT ON: 21.I.00
(Date)

NOTE: "This inspection does not in any way suggest that there is or has been compliance with applicable legislation and regulations as they apply or may apply to this facility. It is, and remains, the responsibility of the owner and/or the operating authority to ensure compliance with all applicable legislative and regulatory requirements."

APPENDIX "A"

CERTIFICATE OF APPROVAL

issued August 11, 1977

Ontario
Ministry of the Environment

Provisional Certificate No.
A 470904

PROVISIONAL CERTIFICATE OF APPROVAL
FOR A
WASTE DISPOSAL SITE

MINISTRY OF THE ENVIRONMENT
CORNWALL

Under The Environmental Protection Act, 1971 and the regulations and subject to the limitations thereof, this Provisional Certificate of Approval is issued to:

Arthur N. Carriere
R. R. # 1
Alfred, Ontario

For the use, operation and establishment of a landfilling site all in accordance with Schedule "A".

Located on Part of W½ Lot 35, Concession 3
Alfred Township
Prescott County

THIS IS A TRUE COPY OF THE ORIGINAL CERTIFICATE MAILED

ON AUG 1 2 1977

P. L.
(Signed)

This Provisional Certificate expires on the 15th day of August, 19 82

Dated this 11th day of August, 19 77

D. P. Caplice
DIRECTOR, SECTION 3 (a) E.P.A.

SCHEDULE "A"

Provisional Certificate of Approval No. A 470904

1. Application and Supporting Information forms for the Waste Disposal Site dated November 24, 1976.

2. Document entitled "Description of Proposed Waste Disposal Site".

3. Aerial photography showing the proposed site and surrounding area.

4. Plan dated November 26, 1976 showing the proposed waste disposal site and adjacent property owners.

5. "Operative Plan of Mr. Arthur Carrier's Proposed Dump Site in the Township of Alfred" dated January 6, 1977 prepared by Andre F. Desjardins, P. Eng., Consulting Engineer.

APPENDIX "B"

CERTIFICATE OF APPROVAL

issued July 14, 1981

Ontario of the Environment

470904

PROVISIONAL CERTIFICATE OF APPROVAL
WASTE DISPOSAL SITE

Under The Environmental Protection Act, 1971 and the regulations and subject to the limitations thereof, this Provisional Certificate of Approval is issued to:

Arthur N. Carriere,
R.R. #1,
Alfred, Ontario.

for the use and operation of a 2.51 hectare landfilling site within a total site area of 37.4 hectares.

all in accordance with the following plans and specifications:
as per Schedule "A" (see attached)

Located: Part of West 1/2 of Lot 35, Concession 3,
Township of Alfred,
County of Prescott

which includes the use of the site only for the disposal of the following categories of waste (NOTE: Use of the site for additional categories of wastes requires a new application and amendments to the Provisional Certificate of Approval) 65% commercial, 30% domestic and 5% non-hazardous solid industrial waste.

and subject to the following conditions:

1. No waste shall be disposed of at the site until this Certificate including the reasons for this condition has been registered by the applicant as an instrument in the appropriate Land Registry Office against title to the site and a duplicate registered copy thereof has been returned by the applicant to the Director.

Registered ON TITLE as Instrument 48131

2. Wastes are to be deposited in an orderly manner in the fill area, compacted and adequately covered by 15 cm (6") of cover material once a month between April 15 and November 15, or as directed by the Director of the Southeastern Region of the Ministry of the Environment.

3. Burning of domestic waste is prohibited at the site.

THIS IS A TRUE COPY OF THE ORIGINAL CERTIFICATE MAILED ON 23.7.81

Dated this 14th day of July, 1981.

(Signed)

Director, Section 39,
The Environmental Protection Act, 1971

Jan 6, 1977.

Mr G.J. McKenna, P.Eng.,
District Officer,
Municipal and Private Abatement,
4 Montréal Road,
Second Floor,
Cornwall, Ontario.

[illegible] OF THE ENVIRONMENT

JAN 1 1977

[illegible]

Subject: Operational Plan of Mr Arthur N. Carrière's Proposed Dump Site in the Township of Alfred.

Dear Sir:

Mr Arthur N. Carrière, if his dump site is approved intends to operate in the following manner:

according to Mr. Carriere topsoil using the trench method in approx 1980 feet as method of landfill

1. The trenches will be dug to a maximum depth of 6 = 1.82m feet, starting at the northeast end of the dump site, excavating the trench parallel to the east property line and progressing gradually with the other trenches toward the west side of the dump with all trenches being parallel to one another.

2. Compaction of the garbage and coverage with 6 inches of fill material will be done at least once a month and more frequently if required.

3. The access gate to the dump will be locked when the dump is not being used and signs will be erected near the gate. The signs erected will indicate the following:
   a) No trespassing.
   b) Hours for dump opening (as per Village requirements)
   c) Materials accepted in the dump site.

4. A buffer zone of 150 feet will be observed from all neighboring properties. This 150 feet buffer zone will include 50 feet of screening from adjacent properties.

5. The garbage will be compacted and covered using a D-6 dozer. The gravel road to the dump site is private and will be maintained by Mr Carrière.

Yours truly,

André Desjardins

André E. Desjardins, P.ENG.

c.c. Mr Carrière.

614 THERIAULT STREET, HAWKESBURY, ONTARIO, K6A 1Z3 – TEL.: (613) 632-4271

SCHEDULE "A"

Provisional Certificate of Approval No. A 470904

1. Application and Supporting Information forms for the Waste Disposal Site dated November 24, 1976.

2. Document entitled "Description of Proposed Waste Disposal Site".

3. Aerial photography showing the proposed site and surrounding area.

4. Plan dated November 26, 1976 showing the proposed waste disposal site and adjacent property owners.

5. "Operative Plan of Mr. Arthur Carrier's Proposed Dump Site in the Township of Alfred" dated January 6, 1977 prepared by Andre F. Desjardins, P. Eng., Consulting Engineer.

Ontario

MINISTRY OF THE ENVIRONMENT

NOTICE

TO: Arthur N. Carriere,
R.R. #1,
Alfred, Ontario.

You are hereby notified that Provisional Certificate of Approval No. A 470904 has been issued to you subject to the conditions outlined therein.

The reasons for the imposition of these conditions are as follows:

1. A reason for the condition requiring registration of the Certificate is that Section 46 of The Environmental Protection Act, 1971 prohibits any use being made of the lands after they cease to be used for waste disposal purposes within a period of twenty-five years from the year in which such land ceased to be used unless the approval of the Minister for the proposed use has been given. The purpose of this prohibition is to protect future occupants of the site and the environment from any hazards which might occur as a result of waste being disposed of on the site. This prohibition and potential hazard should be drawn to the attention of future owners and occupants by the Certificate being registered on title.

2. The reason for the imposition of condition 2 is to ensure that the development of this landfilling site will be in an orderly and systematic manner and the landfilling operations will be in accordance with the provisions of The Environmental Protection Act, 1971 and Regulation 824 pursuant to that Act and the use and operation of the site without such a conditon may create a nuisance.

3. A reason for condition 3 is to ensure the health and safety of any person and the operations of the site without such a condition may create a nuisance.

You may by written notice served upon me and the Environmental Appeal Board within 15 days after receipt of this Notice, require a hearing by the Board.

This Notice should be served upon:

The Secretary
Environmental Appeal Board
1 St. Clair Avenue West
5th Floor
Toronto, Ontario
M4V 1K7

AND

The Director
Section 39, E.P.A.
Ministry of the Environment
133 Dalton Street, Box 820,
Kingston, Ontario
K7L 4X6

Dated at Toronto this 14th day of July, 1981.

Ministry of the Environment — Waste Management Branch

Ontario

FOR MINISTRY USE ONLY

File A —

SUPPORTING INFORMATION TO AN APPLICATION FOR APPROVAL OF A LANDFILL DISPOSAL SITE

APPLICANT TO COMPLETE ITEMS 1-4 INCLUSIVE

1. Site Details

APPLICANT: Arthur N. Carrière

SITE LOCATION: Pt W½ Lot 35 Concession 3

Alfred Township - Prescott County

TOTAL AREA OF SITE 92.5 65 ACRES	TOTAL AREA TO BE UTILIZED FOR WASTE DISPOSAL 6.2 ACRES
ANTICIPATED LIFETIME ____ YEARS	DISTANCE TO NEAREST WATERCOURSE N/A FT.
DISTANCE TO NEAREST POTABLE WELL WATER SUPPLY 900 FT.	DEPTH OF WELL NOTED AT LEFT 16 FT.
DISTANCE TO DWELLING 900 FT.	DISTANCE TO PUBLIC ROAD MEASURED FROM WORKING AREA 1,200 FT.
DISTANCE TO CEMETERY 14,000 FT.	DEPTH FROM ORIGINAL SURFACE TO BOTTOM OF WASTE 6 FT.
DEPTH FROM ORIGINAL SURFACE TO TOP OF FILL - FT.	

GROUND CONDITIONS ENCOUNTERED MEASURED FROM ORIGINAL SURFACE

Fine Sand FROM 0' TO 9'

FROM ____ TO ____

FROM ____ TO ____

FROM ____ TO ____

DEPTH TO WATERTABLE BELOW SURFACE None at 9 FT.	ON(DATE) August 23 1976

GENERAL DESCRIPTION OF SITE (LOCATION, TOPOGRAPHY, ETC.)

1200 feet south of Forced Road across W½ Lot 35 Concession 3 on topographically high area.

PROPOSED USE OF LAND AFTER SITE FULLY UTILIZED

2. Wastes to be disposed of

DOMESTIC 95

COMMERCIAL

INDUSTRIAL WASTE

HAULED LIQUID INDUSTRIAL WASTE

*DESCRIBE

ORIGIN (OTHER)

FOR REGIONAL OFFICE USE

Authorities consulted:	Comment	Approved
HEALTH UNIT	☐	☐
A.M.B.	☐	☐
MUNICIPALITY	☐	☐
CONSERVATION AUTHORITY	☐	☐
SANITARY ENGINEERING	☐	☐
INDUSTRIAL WASTES	☐	☐
WATER QUANTITY	☐	☐
OTHER ____	☐	☐
____	☐	☐

Inspection Record Forms attached Yes ☐ No ☐

Number of Forms ____

Regional Engineer's Report attached ☐

	REQUIRED	AVAILABLE
Ground Water monitoring	Yes ☐ No ☐	Yes ☐ No ☐
Surface Water monitoring	Yes ☐ No ☐	Yes ☐ No ☐

3. Quantities

TOTAL TONS PER DAY	TOTAL GALLONS PER DAY
1	Nil

ESTIMATED ☒ OR MEASURED ☐

SITE OPENED 5 DAYS FROM 9 AM TO 4 PM

POPULATION SERVED ~~1,000~~ 1350

NAMES OF MUNICIPALITIES SERVED

Village of Alfred

OFFICIAL PLAN ☐ N/A ZONING BY-LAW ☐ N/A

SITE LAND ZONED	ADJACENT LAND ZONED
Agricultural	Agricultural

EQUIPMENT OWNED ☐ RENTED ☐

Ontario Environment — Waste Management Branch

FOR MINISTRY USE ONLY

File A — [redacted]

APPLICATION FOR A CERTIFICATE OF APPROVAL FOR A WASTE DISPOSAL SITE

IMPORTANT NOTE: This form must be submitted through the office of the Regional Waste Management Engineer **See back of form for instructions for completing this form.**

1. Owner (Applicant) — Under the Environmental Protection Act and the Regulations, this application is made by:—

Arthur N. Carrière (Name)
RR 1
Alfred, Ontario. (Address)
Box 38

2. Type of disposal site — For the ~~Renewal~~ Issue of a Certificate of Approval for a

Landfilling Dump

3. Site location — Located

Pt W½ Lot 35 Concession 2
Alfred Township
Prescott County.

IF APPLICATION IS FOR REISSUE, COMPLETE SECTIONS 4 AND 5 (A OR B)

4. Previous Certificate details — ~~Certificate~~ / Provisional Certificate for this site was issued on:— of Approval:— No. N/A 197

5. Changes. (A) The following changes in use, operation or ownership (have occurred since the date of the original application) OR (are proposed)

N/A

(B)

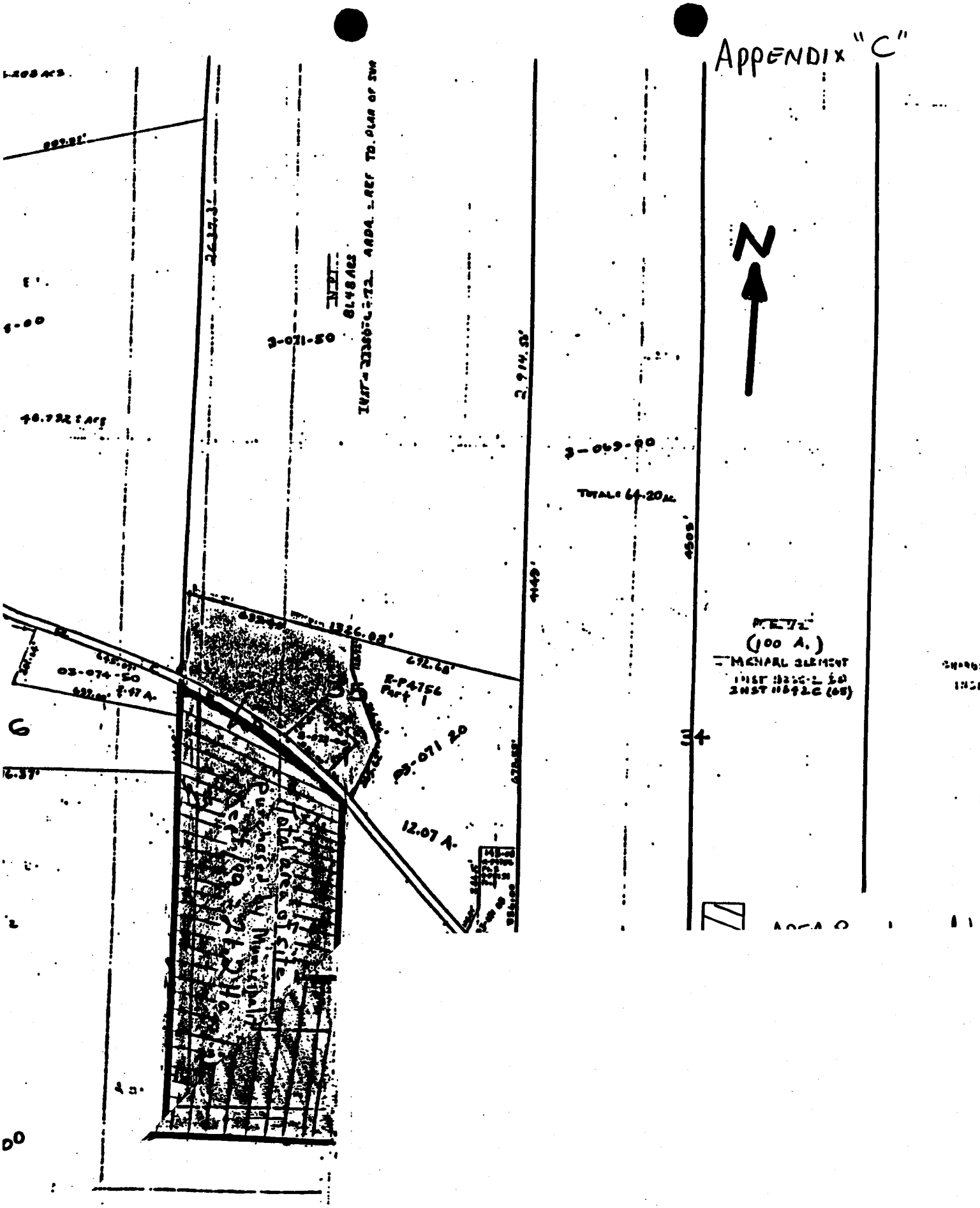
6. Operator

APPENDIX "C"

ASSESSMENT MAP

extracted from Official Plan 46R-6149

APPENDIX "C"


N
3-071-50
3-069-00
TOTAL 64.20 AC.
03-074-50
E-P4756 Part 1
39-071 20
12.07 A.
Proposed Site
Proposed Access
Proposed Tower
Proposed Equipment Shelter
Proposed Generator
Proposed Fuel Tank
Proposed Fence
Proposed Guy Anchor
Proposed Guy Wire
Proposed Utility Pole
Proposed Utility Line
Proposed Underground Utility Line
Proposed Overhead Utility Line
Proposed Utility Transformer
Proposed Utility Meter
Proposed Utility Box
Proposed Utility Pedestal
Proposed Utility Vault
Proposed Utility Manhole
Proposed Utility Handhole
Proposed Utility Cabinet
Proposed Utility Enclosure
Proposed Utility Shelter
Proposed Utility Building
Proposed Utility Structure
Proposed Utility Facility
Proposed Utility Equipment
Proposed Utility Material
Proposed Utility Work
Proposed Utility Project
Proposed Utility Plan
Proposed Utility Design
Proposed Utility Construction
Proposed Utility Maintenance
Proposed Utility Operation
Proposed Utility Management
Proposed Utility Administration
Proposed Utility Engineering
Proposed Utility Surveying
Proposed Utility Mapping
Proposed Utility Inspection
Proposed Utility Testing
Proposed Utility Commissioning
Proposed Utility Decommissioning
Proposed Utility Removal
Proposed Utility Relocation
Proposed Utility Upgrade
Proposed Utility Expansion
Proposed Utility Improvement
Proposed Utility Repair
Proposed Utility Replacement
Proposed Utility Modification
Proposed Utility Addition
Proposed Utility Deletion
Proposed Utility Change
Proposed Utility Update
Proposed Utility Revision
Proposed Utility Amendment
Proposed Utility Supplement
Proposed Utility Correction
Proposed Utility Clarification
Proposed Utility Interpretation
Proposed Utility Application
Proposed Utility Request
Proposed Utility Approval
Proposed Utility Permit
Proposed Utility License
Proposed Utility Agreement
Proposed Utility Contract
Proposed Utility Lease
Proposed Utility Easement
Proposed Utility Right-of-Way
Proposed Utility Corridor
Proposed Utility Boundary
Proposed Utility Limit
Proposed Utility Area
Proposed Utility Zone
Proposed Utility District
Proposed Utility Region
Proposed Utility Territory
Proposed Utility Jurisdiction
Proposed Utility Authority
Proposed Utility Agency
Proposed Utility Company
Proposed Utility Corporation
Proposed Utility Partnership
Proposed Utility Joint Venture
Proposed Utility Consortium
Proposed Utility Alliance
Proposed Utility Network
Proposed Utility System
Proposed Utility Grid
Proposed Utility Infrastructure
Proposed Utility Facility
Proposed Utility Equipment
Proposed Utility Material
Proposed Utility Work
Proposed Utility Project
Proposed Utility Plan
Proposed Utility Design
Proposed Utility Construction
Proposed Utility Maintenance
Proposed Utility Operation
Proposed Utility Management
Proposed Utility Administration
Proposed Utility Engineering
Proposed Utility Surveying
Proposed Utility Mapping
Proposed Utility Inspection
Proposed Utility Testing
Proposed Utility Commissioning
Proposed Utility Decommissioning
Proposed Utility Removal
Proposed Utility Relocation
Proposed Utility Upgrade
Proposed Utility Expansion
Proposed Utility Improvement
Proposed Utility Repair
Proposed Utility Replacement
Proposed Utility Modification
Proposed Utility Addition
Proposed Utility Deletion
Proposed Utility Change
Proposed Utility Update
Proposed Utility Revision
Proposed Utility Amendment
Proposed Utility Supplement
Proposed Utility Correction
Proposed Utility Clarification
Proposed Utility Interpretation
Proposed Utility Application
Proposed Utility Request
Proposed Utility Approval
Proposed Utility Permit
Proposed Utility License
Proposed Utility Agreement
Proposed Utility Contract
Proposed Utility Lease
Proposed Utility Easement
Proposed Utility Right-of-Way
Proposed Utility Corridor
Proposed Utility Boundary
Proposed Utility Limit
Proposed Utility Area
Proposed Utility Zone
Proposed Utility District
Proposed Utility Region
Proposed Utility Territory
Proposed Utility Jurisdiction
Proposed Utility Authority
Proposed Utility Agency
Proposed Utility Company
Proposed Utility Corporation
Proposed Utility Partnership
Proposed Utility Joint Venture
Proposed Utility Consortium
Proposed Utility Alliance
Proposed Utility Network
Proposed Utility System
Proposed Utility Grid
Proposed Utility Infrastructure

APPENDIX "D"

LETTER TO THE MUNICIPALITY RE: MOE ASSESSMENT OF OPERATING AUTHORITY'S COMPLIANCE WITH CERTIFICATE OF APPROVAL

dated August 21, 1998

CORPORATION DU CANTON DE TOWNSHIP OF ALFRED ET AND PLANTAGENET

C.P. / P.O. Box 350
205 Old Highway 17 / 205 vieille route 17
Plantagenet, Ontario
K0B 1L0

TÉL: (613) 673-4797
FAX: (613) 673-4812

File: 257-02

September 21st, 1998

Appendix "E"

Mr. R. J. Robertson, P. Eng., Area Supervisor
Ministry of the Environment
113 Amelia Street
Cornwall, Ontario
K6H 3P1

Dear Sir:

Re: Township of Alfred and Plantagenet – (Former Village of Alfred) Carrière Waste Disposal Site - Certificate of Approval Number A 470904

Your report of August 21st, 1998, listing some recommendations concerning the above mentioned site was brought to the attention of the public works committee on September 2nd, 1998.

The following is submitted in reply to the different recommendations brought forward:

1. "The frequency of covering waste is inadequate."
Effective September 9th, waste covering will be carried out monthly during the period from April 15th, to November 15th. Final grading and seeding will be done before October 15th.

2. "A litter control program should be implemented..."
Site will be inspected monthly to start a litter control program and then appropriate action will be carried out as required.

3. "The municipality should form a committee..."
A public works committee has recently been formed for our municipality and anything dealing with waste collection as well as the management of the waste disposal sites is reported to this committee by the public works superintendent who sits on that committee.

4. "The entrance sign should provide..."
All entrance signs of the different waste disposal sites will be redone as soon as the set fines are received from the Attorney General. The emergency telephone numbers will also be corrected at the same time.

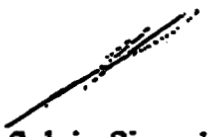
.../2

5. "Status reports regarding reserve capacity..."
Because of the recent restructuration of our municipality, council was not aware of the lack of reports for this site. As such a study was not budgeted, it is hereby requested that we postpone these reports for next year.

6. "To comply with regulation 189/94..."
There are presently no refrigerant equipment at this site and it is our intention to refuse all untagged refrigerant equipment at this particular site that is not opened to the public.

Hoping that the above answers your concerns, I remain.

Sincerely yours,



Sylvio Simard, Deputy Clerk

SS\ll

CORPORATION DU CANTON D' ALFRED ET DE PLANTAGENET
OF THE TOWNSHIP OF

C.P. / P.O. Box 350
205 Old Highway 17 / 205 vieille route 17
Plantagenet, Ontario
K0B 1L0

TÉL: (613) 673-4797
FAX: (613) 673-4812

File: 257-02

933-64.02

September 21st, 1998

Appendix "G"

Mr. R. J. Robertson, P. Eng., Area Supervisor
Ministry of the Environment
113 Amelia Street
Cornwall, Ontario
K6H 3P1

Dear Sir:

Re: Township of Alfred and Plantagenet - Ward 1 (former Alfred Township) Waste Disposal Site - Certificate of Approval Number A470903

Your report of August 21st, 1998, listing some recommendations concerning the above mentioned site was brought to the attention of the public works committee on September 2nd, 1998.

The following is submitted in reply to the different recommendations brought forward:

1. "The frequency of covering waste is inadequate".
Effective September 28th, waste will be covered monthly during the period of April 15th to November 15th. The required final cover and seeding will be done by October 15th, 1998.

2. "A buffer strip should be established..."
A buffer strip of 5 meters is being established between the disposal area and surrounding brush to minimise fire hazard and facilitate covering waste along the site boundaries.

3. "The municipality should form a committee..."
A public works committee has recently been formed for our new municipality and anything dealing with waste collection as well as the management of the waste disposal sites is reported to this committee by the public works superintendent who sits on that committee.

4. "The entrance sign should provide..."
All entrance signs of the different waste disposal sites will be redone as soon as the set fines are received from the Attorney General. The emergency telephone numbers will also be corrected at the same time.

.../2

5. "Status reports regarding reserve capacity..."
A report regarding reserve capacity, waste volumes, complaints, monitoring results prepared by McNeely Engineering Consultants Ltd. was sent to you in May 1997. Hydrogeological studies are being done by Golder Associates and will be sent to you when available.

6. "To comply with Regulation 189/94..."
Attached please find a copy of our waste collection By-law that deals with this matter as well as a copy of our 1998 Fall Clean-Up Bulk Waste Collection flyer that indicates what to do in case of items containing CFC.

In the hope that the above answers your concerns, I remain.

Sincerely yours

Sylvio Simard, Deputy Clerk

SS\ll

encl.

APPENDIX C

RECORD OF BOREHOLE SHEETS

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

Dynamic Penetration Resistance; N_d:
The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Piezo-Cone Penetration Test (CPT):
An electronic cone penetrometer with a 60° conical tip and a projected end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	N Blows/300 mm or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	c_u, s_u kPa	c_u, s_u psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	over 200	over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limit
w_l	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_S)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:
1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I GENERAL

π = 3.1416
ln x, natural logarithm of x
$\log_{10}$ x or log x, logarithm of x to base 10
g acceleration due to gravity
t time
F factor of safety
V volume
W weight

II. STRESS AND STRAIN

γ shear strain
Δ change in, e.g. in stress: $\Delta\sigma$
ε linear strain
ε_v volumetric strain
η coefficient of viscosity
ν Poisson's ratio
σ total stress
σ' effective stress ($\sigma' = \sigma - u$)
σ'_{vo} initial effective overburden stress
$\sigma_1,\sigma_2,\sigma_3$ principal stresses (major, intermediate, minor)
σ_{oct} mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ shear stress
u porewater pressure
E modulus of deformation
G shear modulus of deformation
K bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$ bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$ dry density (dry unit weight)
$\rho_w(\gamma_w)$ density (unit weight) of water
$\rho_s(\gamma_s)$ density (unit weight) of solid particles
γ' unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R relative density (specific gravity)of solid particles ($D_R = \rho_s/\rho_w$) (formerly G_s)
e void ratio
n porosity
S degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density x acceleration due to gravity)

(a) Index Properties (con't.)

w water content
w_l liquid limit
w_p plastic limit
I_P plasticity Index = $(w_l - w_p)$
w_S shrinkage limit
I_L liquidity index = $(w - w_p)/I_p$
I_C consistency index = $(w_l - w)/I_p$
e_{max} void ratio in loosest state
e_{min} void ratio in densest state
I_D density index = $(e_{max} - e)/(e_{max} - e_{min})$ (formerly relative density)

(c) Hydraulic Properties

h hydraulic head or potential
q rate of flow
v velocity of flow
i hydraulic gradient
k hydraulic conductivity (coefficient of permeability)
j seepage force per unit volume

(d) Consolidation (one-dimensional)

C_c compression index (normally consolidated range)
C_r recompression index (overconsolidated range)
C_S swelling index
C_α coefficient of secondary consolidation
m_v coefficient of volume change
c_v coefficient of consolidation
T_v time factor (vertical direction)
U degree of consolidation
σ'_p pre-consolidation pressure
OCR Overconsolidation ratio $= \sigma'_p/\sigma'_{vo}$

(e) Shear Strength

τ_p, τ_r peak and residual shear strength
ϕ' effective angle of internal friction
δ angle of interface friction
μ coefficient of friction = tan δ
c' effective cohesion
c_u, s_u undrained shear strength ($\phi = 0$ analysis)
p mean total stress $(\sigma_1 + \sigma_3)/2$
p' mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q $(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u compressive strength $(\sigma_1 - \sigma_3)$
S_t sensitivity

Notes: 1. $\tau = c' + \sigma' \tan \phi'$
2. Shear strength = (Compressive strength)/2

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-1

SHEET 1 OF 1

LOCATION:

BORING DATE: 20/07/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		99.18							
0	Power Auger 200mm DIAM. (Hollow Stem)	Loose, brown to green brown, fine SAND, trace to some silt, occasional clay silt layer		0.00							Monitor B on Nov. 27/00; Concrete Casing; Granular Filter; Bentonite Seal
1					1	50 DO	-				Monitor A on Nov. 27/00
2					2	50 DO	7				38mm PVC # 10 Slot Screen B; Granular Filter
				97.05							
		Loose to compact, grey stratified fine SAND, trace to some silt		2.13							
3					3	50 DO	9				
					4	50 DO	10				
				95.37							
4		Firm to soft, grey to grey and red brown with depth SILTY CLAY		3.81	5	50 DO	1				Native Backfill
5					6	50 DO	PM				
					7	50 DO	PM				
6					8	50 DO	PM				Bentonite Seal
7											Granular Filter
8					9	50 DO	PM				50mm PVC # 10 Slot Screen A
9											
					10	50 DO	PM				Top of pipe Elev. 99.97m (A), 100m (B)
				89.33							
10		END OF BOREHOLE		9.85							

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: GFM

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/13/01

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-2

SHEET 1 OF 1

LOCATION:

BORING DATE: 21/07/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		99.54							
0	Power Auger 200mm DIAM. (Hollow Stem)	Brown, fine sand with some municipal waste, plastics and organics (FILL)		0.00	1	50 DO					Protective Casing in Concrete; Monitor A & B ▽ on Nov. 27/00; Sand Backfill
1				98.47							Bentonite Seal
		Compact, grey-brown to grey at depth, stratified, very fine SAND, some silt		1.07	2	50 DO	13				38mm PVC # 10 Slot Screen B Granular Filter
2					3	50 DO	16				
3					4	50 DO	13				Bentonite Seal
4					5	50 DO	16				50mm PVC # 10 Slot Screen A Granular Filter
					6	50 DO	18				
5				94.30							
		Very soft, grey and red to brown SILTY CLAY		5.24	7	50 DO	WR				
6											Bentonite Seal
					8	50 DO	WR				
				92.83							
		END OF BOREHOLE		6.71							Top of pipe Elev. 100.33m (A), 100.38m (B)
7											
8											
9											
10											

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/13/01

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: GBM

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-3

SHEET 1 OF 1

LOCATION:

BORING DATE: 24/07/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		98.54							
0	Power Auger 200mm DIAM. (Hollow Stem)	Brown sand with municipal waste (FILL)		0.00							Concrete Casing Monitor B on Nov. 27/00 Native Backfill Monitor A on Nov. 27/00
				97.63							
1		Compact, brown to grey, stratified fine to very fine SAND, trace to some silt		0.91	1	50 DO	-				Bentonite Seal
2					2	50 DO	10				Granular Filter & Native Backfill
3					3	50 DO	11				38mm PVC # 10 Slot Screen B
				95.19	4	50 DO	8				
		Soft to firm, grey SILTY CLAY		3.35							
4					5	50 DO	WH				Bentonite Seal
											Granular Filter
5					6	50 DO	PM				
											50mm PVC # 10 Slot Screen A
6					7	50 DO	PM				
					8	50 DO	PM				Bentonite Seal
				91.83							
7		END OF BOREHOLE		6.71							Top of pipe Elev. 99.26m (A), 99.31m (B)
8											
9											
10											

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/13/01

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: GBM

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-4

SHEET 1 OF 1

LOCATION:

BORING DATE: 24/07/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		99.84							
0	Power Auger 200mm DIAM. (Hollow Stem)	Municipal waste in sand matrix (FILL)		0.00							Protective Casing in Concrete
1				98.62							Granular Filter Bentonite Seal Granular Filter Monitor A & B on Nov. 27/00 ▽
		Compact to loose, grey, fine SAND, trace to some silt		1.22	1	50 DO	10				
2					2	50 DO	9				38mm PVC # 10 Slot Screen B Granular Filter
3					3	50 DO	7				Bentonite Seal
4					4	50 DO	12				50mm PVC # 10 Slot Screen A Granular Filter
5				94.72	5	50 DO	13				
		Soft, grey SILTY CLAY		5.12	6	50 DO	-				
6					7	50 DO	PM				Bentonite Seal
				93.13							
		END OF BOREHOLE		6.71							
7											Top of pipe Elev. 100.77m (A), 100.79m (B)
8											
9											
10											

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/23/01

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: G.B.M.

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-5

SHEET 1 OF 1

LOCATION:

BORING DATE: 17/10/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		97.73									
0	Power Auger 200mm DIAM. (Hollow Stem)	TOPSOIL		0.00 / 97.49									Monitor A & B on Nov. 27/00 Concrete Casing
		Loose, grey-brown to grey, fine SAND, silty to some silt		0.24									Bentonite Seal
1					1	50 DO	8						
													38mm PVC # 10 Slot Screen B
2					2	50 DO	8						
													Granular Filter
													Bentonite Seal
3					3	50 DO	9						
													Granular Filter 50mm PVC # 10 Slot Screen A
					4	50 DO	8						
		Grey, SILTY CLAY		94.22 / 3.51									
4					5	50 DO	PM						
													Clay Bottom
5					6	50 DO	PM						
				92.55									
		END OF BOREHOLE		5.18									
6													Top of pipe Elev. 98.67m (A), 98.73m (B)
7													
8													
9													
10													

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/13/01

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: GBM

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-6

SHEET 1 OF 1

LOCATION:

BORING DATE: 18/10/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, 20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		97.97							
0	Power Auger 200mm DIAM. (Hollow Stem)	PEAT/ TOPSOIL		0.00 / 97.67							Monitor A & B on Nov. 27/00 Concrete Casing
		Loose, grey-brown to grey, fine SAND, some silt		0.30							Bentonite Seal
1					1	50 DO	-				38mm PVC # 10 Slot Screen B
					2	50 DO	9				Granular Filter
2											Bentonite Seal
					3	50 DO	8				
3											Granular Filter 50mm PVC # 10 Slot Screen A
				94.62	4	50 DO	3				
		Firm to soft grey, SILTY CLAY		3.35							
4					5	50 DO	PM				Clay Bottom
				93.40							
		END OF BOREHOLE		4.57							
5											
6											Top of pipe Elev. 98.78m (A), 98.71m (B)
7											
8											
9											
10											

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/13/01

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: GBM

PROJECT: 001-2749

RECORD OF BOREHOLE: 00-7

SHEET 1 OF 1

LOCATION:

BORING DATE: 17/10/2000

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - O) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		98.80							
0	Power Auger 200mm DIAM. (Hollow Stem)	TOPSOIL		0.00 / 98.50							on Nov. 27/00 ▽ Concrete Casing
		Loose, grey-brown to grey, fine SAND, some silt		0.30	1	50 DO	13				Bentonite Seal
1											Granular Filter
					2	50 DO	7				
2											50mm PVC # 10 Slot Screen
					3	50 DO	10				
3				95.66							
		Grey, SILTY CLAY		3.14	4	50 DO	2				
4											Clay Bottom
					5	50 DO	PM				
		END OF BOREHOLE		94.23 / 4.57							
5											
6											Top of pipe Elev. 99.76m
7											
8											
9											
10											

BOREHOLE 001-2749.GPJ GLDR_CAN.GDT 2/13/01

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: P.A.H.

CHECKED: GBM

PROJECT: 011-2825

RECORD OF BOREHOLE: 01-8

SHEET 1 OF 1

LOCATION: SEE SITE PLAN

BORING DATE: MAY 23-24, 2001

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		98.92			
0	POWER AUGER 200 mm Diam. (Hollow Stem)	Brown fine sand, trace plastic (FILL)		0.00			
		Dark brown sandy TOPSOIL		98.40 0.52			
		Very loose brown fine SAND, Trace silt		0.61			
1				97.85	1	50 DO	7
		Loose grey stratified SILTY fine SAND		1.07			
2					2	50 DO	5
					3	50 DO	4
3							
					4	50 DO	7
4					5	50 DO	13
				94.50			
		Loose grey fine SAND, occasional thin silty clay seam		4.42			
5				93.89	6	50 DO	7
		Grey SILTY CLAY, occasional sand seams		5.03			
					7	50 DO	WH
6							
					8	50 DO	WH
				92.21			
		END OF BOREHOLE		6.71			
7							
8							
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)

SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})

WATER CONTENT PERCENT Wp W Wl (10 20 30 40)

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

W.L. in screen B at elev 98.47 m on June 12, 2001

W.L. in screen A at elev. 98.45 m on June 12, 2001

Top of pipe elevation screen A 99.82 m and screen B 99.83 m

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: D.J.S.

CHECKED: MV

BOREHOLE 011-2825.GPJ GLDR_CAN.GDT 11/3/02 M.A.C.

PROJECT: 011-2825

RECORD OF BOREHOLE: 01-9

SHEET 1 OF 1

LOCATION: SEE SITE PLAN

BORING DATE: MAY 24, 2001

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (20 40 60 80); nat V. + Q - ●; rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp — W — Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		98.13									
0	POWER AUGER 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00									
		Brown fine SAND, trace silt		0.15									
				97.67									
		Loose grey stratified SILTY fine SAND		0.46									
1					1	50 DO	7						
2					2	50 DO	3						
3					3	50 DO	7						
4					4	50 DO	8						
4					5	50 DO	5						
				93.92									
		Grey SILTY CLAY		4.21									
5					6	50 DO	1						
					7	50 DO	PH						
				92.34									
6		END OF BOREHOLE		5.79									
7													
8													
9													
10													

Bentonite Seal

Native Backfill

38 mm PVC #10 Slot Screen B with well sock

Native and Caved Backfill

50 mm PVC #10 Slot Screen A with well sock

Clay Bottom

W.L. in screen B at elev. 97.93 m on June 12, 2001

W.L. in screen A at elev. 97.85 m on June 12, 2001

Top of pipe elevation screen A 98.92 m and screen B 98.95 m

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: D.J.S

CHECKED:

BOREHOLE 011-2825.GPJ GLDR_CAN.GDT 5/2/02 M.A.C.

PROJECT: 011-2825

RECORD OF BOREHOLE: 01-10

SHEET 1 OF 1

LOCATION: SEE SITE PLAN

BORING DATE: MAY 24, 2001

DATUM: Local

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80)	SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕; Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3})	WATER CONTENT PERCENT (Wp, W, Wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		98.36									
0	POWER AUGER 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00 / 98.12									
		Brown fine SAND, trace silt		0.24 / 97.81									
		Loose to compact brown to grey SILTY fine SAND, occasional fine sand seam		0.55	1	50 DO	5						
1													
					2	50 DO	5						
2													
					3	50 DO	11						
				95.46									
3		Grey SILTY CLAY, occasional fine sand seam		2.90									
					4	50 DO	1						
4					5	50 DO	1						
				93.94									
		END OF BOREHOLE		4.42									
5													
6													
7													
8													
9													
10													

Bentonite Seal

Sand and Caved Backfill

50 mm PVC #10 slot screen with well sock

Sand and caved backfill

Clay Bottom

W.L. in screen at elev. 98.17 m on June 12, 2001

Top of pipe at elevation 99.17 m

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: D.J.S

CHECKED:

BOREHOLE 011-2825.GPJ GLDR_CAN.GDT 11/3/02 M.A.C.

APPENDIX D

REPORTS OF ANALYSIS, ACCUTEST LABORATORIES LTD.

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

ient: Golder Associates Ltd.

T: Mr. Michael Venhuis

Report Number: 2106236
Date: 2001-07-11
Date Submitted: 2001-06-12
Date Collected: 2001-06-11
Project: 011-2825

P.O. Number:
Matrix: GROUNDWATER

PARAMETER	UNITS	MDL	129680	129681	129682	129683	129684
			S-1	S-2	S-3	S-4	S-5
			BH04-1A	DH04-1B	BH00-7	BH00-2A	BH00-2B
kalinity as CaCO3	mg/L	5	147	165	80	390	204
OD	mg/L	5	27	22	18	16	132
Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Al	mg/L	0.05	0.57	1.91	<0.05	<0.05	0.86
	mg/L	0.01	0.10	<0.01	<0.01	0.02	0.24
Ba	mg/L	0.01	0.01	<0.01	0.02	0.11	0.12
Be	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
a	mg/L	1	14	8	24	85	40
d	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/L	1	1	1	1	8	11
Co	mg/L	0.0002	0.0002	<0.0002	<0.0002	0.0002	0.0041
	mg/L	0.001	0.001	<0.001	<0.001	0.001	0.005
Cu	mg/L	0.001	<0.001	0.002	<0.001	<0.001	<0.001
DOC	mg/L	0.5	6.1	9.0	6.3	6.9	47.1
	mg/L	0.01	0.58	0.12	0.09	1.27	61.6
ardness as CaCO3	mg/L	1	60	32	89	336	129
Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mg	mg/L	1	6	3	6	30	7
n	mg/L	0.01	0.05	<0.01	0.05	0.42	1.47
Mo	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
NH3	mg/L	0.02	0.77	0.26	0.09	0.26	15.4
NO2	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
N-NO3	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
henols	mg/L	0.001	0.003	0.001	0.002	0.001	<0.001
	mg/L	1	6	19	4	5	12
Si	mg/L	0.01	5.89	1.43	7.37	8.67	3.70
Na	mg/L	2	60	32	3	18	32
	mg/L	0.003	0.069	0.032	0.053	0.316	0.123
O4	mg/L	1	39	15	8	15	39

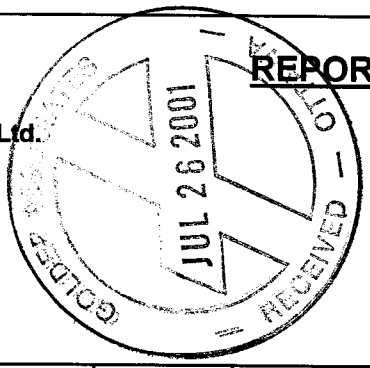
MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: _____

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.



REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2106236
Date: 2001-07-11
Date Submitted: 2001-06-12
Date Collected: 2001-06-11
Project: 011-2825

P.O. Number:
Matrix: GROUNDWATER

PARAMETER	UNITS	MDL	129680	129681	129682	129683	129684
			S-1 BH00-1A	S-2 BH00-1B	S-3 BH00-7	S-4 BH00-2A	S-5 BH00-2B
Tl	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	mg/L	0.01	0.03	0.01	<0.01	<0.01	0.01
TDS	mg/L	10	252	140	100	436	340
Total Kjeldahl Nitrogen	mg/L	0.05	0.89	0.41	0.13	0.41	17.9
Total P	mg/L	0.01	6.58	6.27	5.85	7.21	7.21
V	mg/L	0.001	0.002	0.028	<0.001	<0.001	0.006
Zn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	0.01

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

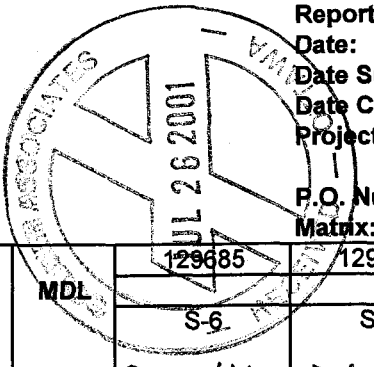
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis



Report Number: 2106236
Date: 2001-07-11
Date Submitted: 2001-06-12
Date Collected: 2001-06-11
Project: 011-2825
P.O. Number:
Matrix: GROUNDWATER

PARAMETER	UNITS	MDL	129685	129686	129687	129688	129689
			S-6 BH00-4A	S-7 BH00-4B	S-8 BH00-3A	S-9 DUPLICATE BH00-3A	S-10 BH00-3B
Alkalinity as CaCO3	mg/L	5	330	611	113	113	567
COD	mg/L	5	16	149	<5	<5	55
Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Al	mg/L	0.05	<0.05	0.40	<0.05	<0.05	<0.05
As	mg/L	0.01	0.07	0.11	0.03	0.03	0.14
Ba	mg/L	0.01	0.14	1.11	0.03	0.03	0.10
Be	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ca	mg/L	1	72	94	48	48	454
Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/L	1	12	3	2	2	79
Co	mg/L	0.0002	0.0025	0.0099	<0.0002	<0.0002	0.0025
Cr	mg/L	0.001	0.001	0.009	<0.001	<0.001	0.003
Cu	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
DOC	mg/L	0.5	7.5	70.8	3.3	3.1	13.4
Fe	mg/L	0.01	10.4	138	0.13	0.03	10.8
Hardness as CaCO3	mg/L	1	262	309	194	194	1560
Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mg	mg/L	1	20	18	18	18	103
Mn	mg/L	0.01	0.25	2.20	0.04	0.04	1.85
Mo	mg/L	0.01	<0.01	<0.01	0.03	<0.01	<0.01
Ni	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N-NH3	mg/L	0.02	0.63	40.2	0.28	0.45	0.65
N-NO2	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
N-NO3	mg/L	0.10	<0.10	<0.10	0.29	0.41	<0.10
Phenols	mg/L	0.001	0.003	0.002	0.001	0.003	<0.001
K	mg/L	1	5	71	6	6	5
Si	mg/L	0.01	12.2	6.54	5.81	5.83	9.93
Na	mg/L	2	33	43	102	103	23
Sr	mg/L	0.003	0.291	0.642	0.270	0.286	0.629
SO4	mg/L	1	15	21	300	285	907

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: _____

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2106236
Date: 2001-07-11
Date Submitted: 2001-06-12
Date Collected: 2001-06-11
Project: 011-2825

P.O. Number:
Matrix: GROUNDWATER

PARAMETER	UNITS	MDL	129685	129686	129687	129688	129689
			S-6 BH00-4A	S-7 BH00-4B	S-8 BH00-3A	S-9 DUPLICATE BH00-3A	S-10 BH00-3B
Tl	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TDS	mg/L	10	376	776	552	580	2220
Total Kjeldahl Nitrogen	mg/L	0.05	0.87	43.0	0.43	0.45	1.28
Total P	mg/L	0.01	3.15	0.02	0.84	0.84	1.59
V	mg/L	0.001	<0.001	0.007	<0.001	<0.001	<0.001
Zn	mg/L	0.01	<0.01	0.02	<0.01	<0.01	<0.01

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

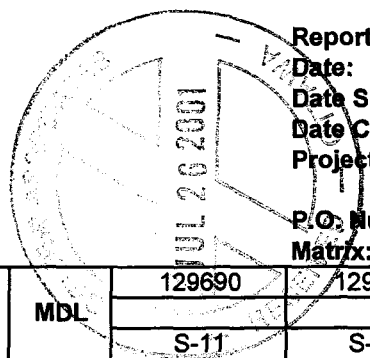
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

[redacted]ient: Golder Associates Ltd.

[redacted]T: Mr. Michael Venhuis



Report Number: 2106236
Date: 2001-07-11
Date Submitted: 2001-06-12
Date Collected: 2001-06-11
Project: 011-2825
P.O. Number:
Matrix: GROUNDWATER

PARAMETER	UNITS	MDL	129690	129691			
			S-11	S-12			
			BH00-5A	BH00-5B			
[redacted]kalinity as CaCO3	mg/L	5	100	108			
[redacted]OD	mg/L	5	5	5			
Ag	mg/L	0.0001	<0.0001	<0.0001			
[redacted]	mg/L	0.05	<0.05	<0.05			
[redacted]	mg/L	0.01	0.01	<0.01			
Ba	mg/L	0.01	0.01	0.03			
Be	mg/L	0.002	<0.002	<0.002			
[redacted]a	mg/L	1	23	27			
[redacted]d	mg/L	0.0001	<0.0001	<0.0001			
Cl	mg/L	1	1	<1			
[redacted]o	mg/L	0.0002	<0.0002	<0.0002			
[redacted]	mg/L	0.001	<0.001	<0.001			
Cu	mg/L	0.001	<0.001	<0.001			
DOC	mg/L	0.5	1.2	1.1			
[redacted]e	mg/L	0.01	0.07	0.02			
[redacted]ardness as CaCO3	mg/L	1	90	105			
Pb	mg/L	0.001	<0.001	<0.001			
[redacted]g	mg/L	1	8	9			
[redacted]n	mg/L	0.01	0.04	0.05			
[redacted]o	mg/L	0.01	<0.01	<0.01			
Ni	mg/L	0.01	<0.01	<0.01			
[redacted]NH3	mg/L	0.02	0.13	0.10			
[redacted]NO2	mg/L	0.10	<0.10	<0.10			
N-NO3	mg/L	0.10	<0.10	<0.10			
[redacted]henols	mg/L	0.001	0.002	<0.001			
[redacted]	mg/L	1	4	3			
[redacted]i	mg/L	0.01	6.20	6.62			
Na	mg/L	2	11	4			
[redacted]	mg/L	0.003	0.072	0.060			
[redacted]O4	mg/L	1	8	8			

MDL = Method Detection Limit INC = Incomplete

[redacted]omment:

APPROVAL: _____

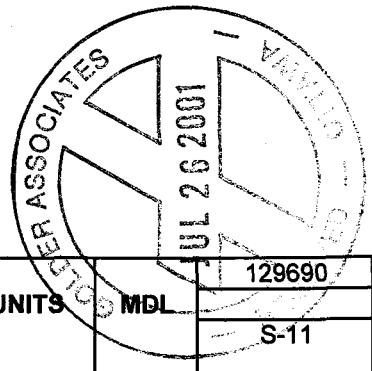
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis



Report Number: 2106236
Date: 2001-07-11
Date Submitted: 2001-06-12
Date Collected: 2001-06-11
Project: 011-2825

P.O. Number:
Matrix: GROUNDWATER

PARAMETER	UNITS	MDL	129690	129691			
			S-11 BH00-5A	S-12 BH00-5B			
Tl	mg/L	0.001	<0.001	<0.001			
Sn	mg/L	0.01	<0.01	<0.01			
Ti	mg/L	0.01	<0.01	<0.01			
TDS	mg/L	10	176	128			
Total Kjeldahl Nitrogen	mg/L	0.05	0.17	0.11			
Total P	mg/L	0.01	1.33	2.18			
V	mg/L	0.001	<0.001	<0.001			
Zn	mg/L	0.01	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete

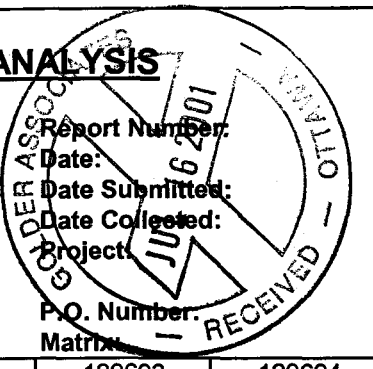
Comment:

APPROVAL:

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS



Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2106237
Date: 2001-07-05
Date Submitted: 2001-06-12
Date Collected: 2001-06-12
Project: 011-2825
P.O. Number:
Matrix: Groundwater

PARAMETER	UNITS	MDL	129692	129693	129694	129695	129696
			S-13 BH01-8A	S-14 BH01-8B	S-15 BH01-10	S-16 BH01-9A	S-17 BH01-9B
Alkalinity as CaCO3	mg/L	5	560	352	234	207	177
COD	mg/L	5	41	27	33	27	11
Ag	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	mg/L	0.05	<0.05	<0.05	0.75	<0.05	<0.05
	mg/L	0.01	<0.01	0.04	0.04	0.01	<0.01
Ba	mg/L	0.01	0.15	0.13	0.07	0.08	0.05
Be	mg/L	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ca	mg/L	1	152	90	93	54	48
Cd	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cl	mg/L	1	36	4	11	2	3
Cr	mg/L	0.0002	0.0015	0.0024	0.0026	<0.0002	<0.0002
F	mg/L	0.001	0.002	0.001	0.002	0.001	<0.001
Cu	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001
DOC	mg/L	0.5	15.6	9.3	9.5	10.1	5.0
Fe	mg/L	0.01	2.65	7.67	9.33	2.17	1.72
Hardness as CaCO3	mg/L	1	615	279	311	197	174
Pb	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mg	mg/L	1	57	13	19	15	13
Mn	mg/L	0.01	0.85	3.25	0.66	0.28	0.39
Mo	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ni	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
N-NH3	mg/L	0.02	0.24	1.40	0.21	0.28	0.11
N-NO2	mg/L	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
N-NO3	mg/L	0.10	0.11	0.27	<0.10	<0.10	<0.10
Phenols	mg/L	0.001	<0.001	0.002	<0.001	<0.001	<0.001
	mg/L	1	6	13	2	3	2
Si	mg/L	0.01	8.45	12.9	10.3	11.8	10.2
Na	mg/L	2	14	56	12	9	5
	mg/L	0.003	0.400	0.402	0.202	0.146	0.127
SO4	mg/L	1	47	79	109	6	7

MDL = Method Detection Limit INC = Incomplete

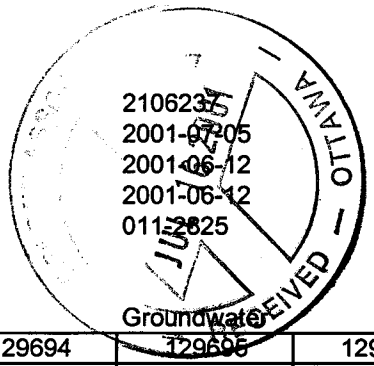
Comment:

APPROVAL:

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS



Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2106237
Date: 2001-07-05
Date Submitted: 2001-06-12
Date Collected: 2001-06-12
Project: 011-2825

P.O. Number:
Matrix: Groundwater

PARAMETER	UNITS	MDL	129692	129693	129694	129695	129696
			S-13 BH01-8A	S-14 BH01-8B	S-15 BH01-10	S-16 BH01-9A	S-17 BH01-9B
Tl	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	mg/L	0.01	<0.01	<0.01	0.02	<0.01	<0.01
TDS	mg/L	10	728	500	444	264	216
Total Kjeldahl Nitrogen	mg/L	0.05	0.60	1.41	0.52	0.56	0.22
Total P	mg/L	0.01	0.58	1.44	2.03	1.74	0.74
V	mg/L	0.001	<0.001	<0.001	0.001	0.002	<0.001
Zn	mg/L	0.01	<0.01	0.01	0.01	<0.01	<0.01

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

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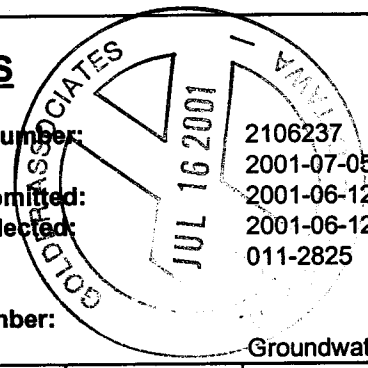
ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS



Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2106237
Date: 2001-07-05
Date Submitted: 2001-06-12
Date Collected: 2001-06-12
Project: 011-2825

P.O. Number:
Matrix: Groundwater

PARAMETER	UNITS	MDL	129697	129698			
			S-18 BH00-6A	S-19 BH00-6B			
Alkalinity as CaCO3	mg/L	5	294	316			
COD	mg/L	5	38	137			
Ag	mg/L	0.0001	<0.0001	<0.0001			
[redacted]	mg/L	0.05	<0.05	0.50			
[redacted]	mg/L	0.01	0.03	0.08			
Ba	mg/L	0.01	0.14	0.13			
Be	mg/L	0.002	<0.002	<0.002			
[redacted]a	mg/L	1	80	111			
[redacted]d	mg/L	0.0001	<0.0001	<0.0001			
Cl	mg/L	1	10	24			
[redacted]o	mg/L	0.0002	<0.0002	0.0006			
[redacted]	mg/L	0.001	<0.001	0.002			
Cu	mg/L	0.001	<0.001	<0.001			
DOC	mg/L	0.5	14.7	53.7			
[redacted]e	mg/L	0.01	4.58	6.34			
[redacted]ardness as CaCO3	mg/L	1	303	401			
Pb	mg/L	0.001	<0.001	<0.001			
[redacted]g	mg/L	1	25	30			
[redacted]n	mg/L	0.01	0.55	0.82			
Mo	mg/L	0.01	<0.01	<0.01			
Ni	mg/L	0.01	<0.01	<0.01			
[redacted]-NH3	mg/L	0.02	0.27	0.25			
[redacted]-NO2	mg/L	0.10	<0.10	<0.10			
N-NO3	mg/L	0.10	<0.10	<0.10			
[redacted]henols	mg/L	0.001	0.007	<0.001			
[redacted]	mg/L	1	4	3			
Si	mg/L	0.01	10.3	6.45			
Na	mg/L	2	25	72			
[redacted]	mg/L	0.003	0.211	0.184			
[redacted]O4	mg/L	1	64	235			

MDL = Method Detection Limit INC = Incomplete

Comment:

APPROVAL: _____

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2106237
Date: 2001-07-05
Date Submitted: 2001-06-12
Date Collected: 2001-06-12
Project: 011-2825

P.O. Number:
Matrix: Groundwater

PARAMETER	UNITS	MDL	129697	129698			
			S-18 BH00-6A	S-19 BH00-6B			
Tl	mg/L	0.001	<0.001	<0.001			
Sn	mg/L	0.01	<0.01	<0.01			
Ti	mg/L	0.01	<0.01	<0.01			
TDS	mg/L	10	388	368			
Total Kjeldahl Nitrogen	mg/L	0.05	0.72	1.27			
Total P	mg/L	0.01	3.74	6.54			
V	mg/L	0.001	0.001	0.004			
Zn	mg/L	0.01	<0.01	<0.01			

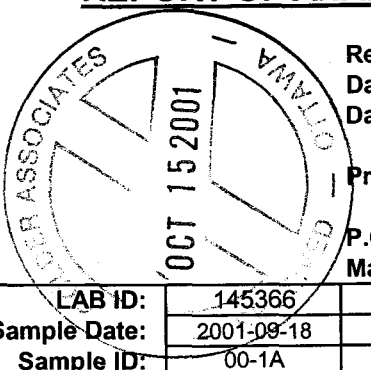
MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL:

146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS



Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19
Project: 011-2825
P.O. Number: 210137
Matrix: Groundwater

			LAB ID:	145366	145367	145368	145369	145370
			Sample Date:	2001-09-18	2001-09-18	2001-09-18	2001-09-18	2001-09-18
			Sample ID:	00-1A	00-2A	00-2C DUPLICATE BH00-2A	00-3A	00-3B
PARAMETER	UNITS	MDL						
Alkalinity as CaCO3	mg/L	5		125	372	335	112	814
COD	mg/L	5		11	27	21	<5	69
g	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05
B	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	0.01
Ba	mg/L	0.01		<0.01	0.11	0.10	0.02	0.10
e	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002
a	mg/L	1		15	77	68	34	558
Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	mg/L	1		1	8	6	2	116
o	mg/L	0.0002		<0.0002	0.0004	0.0004	<0.0002	0.0007
Cr	mg/L	0.001		0.001	0.006	0.005	0.001	0.022
Cu	mg/L	0.001		<0.001	<0.001	<0.001	0.001	0.001	
OC	mg/L	0.5		5.2	6.2	5.7	2.4	22.8
e	mg/L	0.01		<0.01	1.34	1.29	<0.01	22.3
Hardness as CaCO3	mg/L	1		62	304	269	143	1940
o	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
g	mg/L	1		6	27	24	14	132
Mn	mg/L	0.01		<0.01	0.37	0.36	<0.01	1.63
Mo	mg/L	0.01		<0.01	<0.01	<0.01	0.03	<0.01
	mg/L	0.01		<0.01	<0.01	0.001	<0.01	<0.01
-NH3	mg/L	0.02		0.67	0.27	0.24	0.09	0.56
N-NO2	mg/L	0.10		<0.10	<0.10	<0.10	<0.10	<0.10
-NO3	mg/L	0.10		<0.10	<0.10	<0.10	0.31	<0.10
henols	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
K	mg/L	1		3	5	4	5	7
Si	mg/L	0.01		6.23	10.4	10.5	6.70	20.2
a	mg/L	2		54	23	24	93	31
r	mg/L	0.003		0.091	0.210	0.188	0.261	0.891
SO4	mg/L	1		43	12	12	251	1230

MDL = Method Detection Limit INC = Incomplete

omment:

APPROVAL: _____

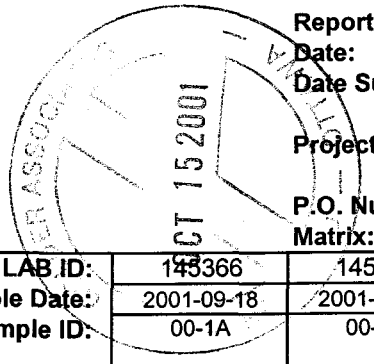
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis



Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

			LAB ID:	145366	145367	145368	145369	145370
			Sample Date:	2001-09-18	2001-09-18	2001-09-18	2001-09-18	2001-09-18
			Sample ID:	00-1A	00-2A	00-2C DUPLICATE OF 00-2A	00-3A	00-3B
PARAMETER	**UNITS**	**MDL**						
Tl	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
Ti	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
TDS	mg/L	10		244	420	376	492	2800
Total Kjeldahl Nitrogen	mg/L	0.05		0.70	0.57	0.28	0.25	1.61
Total P	mg/L	0.01		8.35	5.29	2.17	0.44	0.18
V	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	0.005
Zn	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

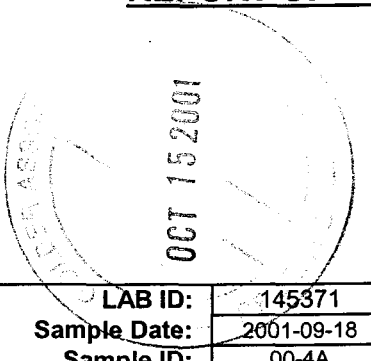
146 Colonnade Road, Unit 8, Nepean, Ontario, K2E 7Y1 Tel:(613)727-5692 Fax:(613)727-5222

ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

[redacted]ient: Golder Associates Ltd.

[redacted]TT: Mr. Michael Venhuis



Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

			LAB ID:	145371	145372	145373	145374	145375
			Sample Date:	2001-09-18	2001-09-18	2001-09-18	2001-09-18	2001-09-18
			Sample ID:	00-4A	00-4C DUPLICATE BH00-4A	00-5A	00-5B	00-6A
PARAMETER	UNITS	MDL						
[redacted]kalinity as CaCO3	mg/L	5		341	355	112	828	110
COD	mg/L	5		16	11	11	75	11
[redacted]g	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
[redacted]	mg/L	0.05		<0.05	<0.05	<0.05	<0.05	<0.05
[redacted]B	mg/L	0.01		0.06	0.06	<0.01	0.01	<0.01
Ba	mg/L	0.01		0.20	0.21	0.02	0.10	0.02
[redacted]e	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002
[redacted]a	mg/L	1		76	78	34	558	37
Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
[redacted]l	mg/L	1		11	11	1	111	1
[redacted]o	mg/L	0.0002		0.0046	0.0043	<0.0002	0.0006	<0.0002
Cr	mg/L	0.001		0.009	0.008	0.002	0.016	0.002
Cu	mg/L	0.001		<0.001	<0.001	<0.001	0.001	<0.001
[redacted]OC	mg/L	0.5		4.1	3.7	2.9	21.1	2.7
[redacted]e	mg/L	0.01		24.0	19.6	<0.01	24.9	<0.01
Hardness as CaCO3	mg/L	1		268	273	143	1920	150
[redacted]b	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
[redacted]g	mg/L	1		19	19	14	128	14
Mn	mg/L	0.01		0.23	0.23	<0.01	1.64	<0.01
Mo	mg/L	0.01		<0.01	<0.01	0.03	<0.01	0.03
[redacted]i	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
[redacted]-NH3	mg/L	0.02		0.36	0.51	0.10	0.48	0.08
N-NO2	mg/L	0.10		<0.10	<0.10	<0.10	<0.10	<0.10
[redacted]-NO3	mg/L	0.10		<0.10	<0.10	0.22	<0.10	0.27
[redacted]henols	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
[redacted]K	mg/L	1		7	6	5	7	5
Si	mg/L	0.01		31.3	26.9	6.72	22.3	6.77
[redacted]a	mg/L	2		31	32	88	33	85
[redacted]r	mg/L	0.003		0.339	0.330	0.264	0.875	0.266
SO4	mg/L	1		8	10	237	1180	256

[redacted]MDL = Method Detection Limit INC = Incomplete
[redacted]omment:

APPROVAL: _____

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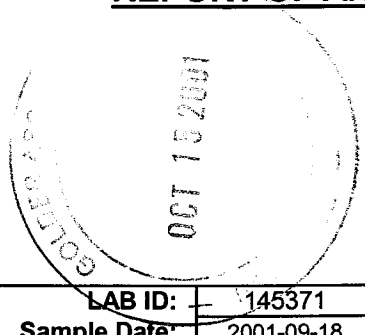
ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis



Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

	LAB ID:	145371	145372	145373	145374	145375
	Sample Date:	2001-09-18	2001-09-18	2001-09-18	2001-09-18	2001-09-18
	Sample ID:	00-4A	00-4C DUPLICATE TH00-4A	00-5A	00-5B	00-6A
PARAMETER	**UNITS**	**MDL**					
Tl	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TDS	mg/L	10	420	392	476	2740	456
Total Kjeldahl Nitrogen	mg/L	0.05	0.57	0.75	0.18	0.72	0.27
Total P	mg/L	0.01	0.80	1.28	0.42	1.13	0.36
V	mg/L	0.001	0.001	0.001	<0.001	0.003	<0.001
Zn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

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ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

			LAB ID:	145376	145377	145378	145379	145380
			Sample Date:	2001-09-18	2001-09-18	2001-09-18	2001-09-18	2001-09-18
			Sample ID:	00-6B	00-7	01-8A	01-8B	01-9A
PARAMETER	**UNITS**	**MDL**						
Alkalinity as CaCO3	mg/L	5		797	123	122	100	370
COD	mg/L	5		75	16	11	32	16
[illegible]g	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
[illegible]	mg/L	0.05		<0.05	<0.05	<0.05	0.28	<0.05
B	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	0.03
[illegible]a	mg/L	0.01		0.11	<0.01	<0.01	0.01	0.15
[illegible]e	mg/L	0.002		<0.002	<0.002	<0.002	<0.002	<0.002
[illegible]a	mg/L	1		563	15	14	19	76
Cd	mg/L	0.0001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
[illegible]	mg/L	1		111	2	1	3	11
[illegible]o	mg/L	0.0002		0.0005	<0.0002	<0.0002	<0.0002	0.0026
Cr	mg/L	0.001		0.015	<0.001	<0.001	<0.001	0.005
[illegible]u	mg/L	0.001		0.001	<0.001	<0.001	0.002	<0.001
[illegible]OC	mg/L	0.5		20.2	3.6	2.4	7.8	5.2
[illegible]e	mg/L	0.01		21.9	<0.01	<0.01	0.01	7.70
Hardness as CaCO3	mg/L	1		2000	58	56	48	276
[illegible]b	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
[illegible]g	mg/L	1		144	5	5	<1	21
Mn	mg/L	0.01		1.65	<0.01	<0.01	<0.01	0.18
Mo	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
[illegible]i	mg/L	0.01		<0.01	<0.01	<0.01	<0.01	<0.01
[illegible]-NH3	mg/L	0.02		1.29	0.51	0.42	0.23	2.54
N-NO2	mg/L	0.10		<0.10	<0.10	<0.10	<0.10	<0.10
[illegible]-NO3	mg/L	0.10		<0.10	0.10	<0.10	<0.10	<0.10
[illegible]henols	mg/L	0.001		<0.001	<0.001	<0.001	<0.001	<0.001
K	mg/L	1		7	3	3	15	8
Si	mg/L	0.01		19.9	6.05	6.00	1.84	24.0
[illegible]a	mg/L	2		32	44	43	24	28
[illegible]r	mg/L	0.003		0.883	0.089	0.088	0.079	0.256
SO4	mg/L	1		1180	38	36	17	9

[illegible]DL = Method Detection Limit INC = Incomplete

[illegible]omment:

APPROVAL: _____

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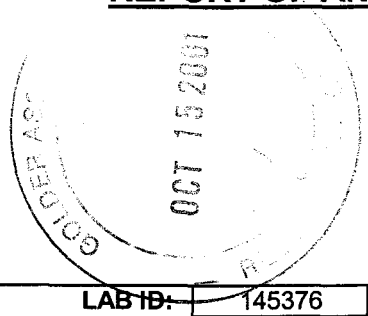
REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis



Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

	LAB ID:	145376	145377	145378	145379	145380
	Sample Date:	2001-09-18	2001-09-18	2001-09-18	2001-09-18	2001-09-18
	Sample ID:	00-6B	00-7	01-8A	01-8B	01-9A
PARAMETER	**UNITS**	**MDL**				
Tl	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ti	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TDS	mg/L	10	2710	208	188	144	388
Total Kjeldahl Nitrogen	mg/L	0.05	2.60	0.81	0.74	0.54	3.00
Total P	mg/L	0.01	2.89	4.53	2.82	6.99	2.71
V	mg/L	0.001	0.003	<0.001	<0.001	0.015	<0.001
Zn	mg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL: _____

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ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

ATT: Mr. Michael Venhuis

Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

	LAB ID:	145381	145382			
	Sample Date:	2001-09-18	2001-09-18			
	Sample ID:	01-9B	01-10			
PARAMETER	**UNITS**	**MDL**				
Alkalinity as CaCO3	mg/L	5	372	205			
COD	mg/L	5	11	16			
[redacted]	mg/L	0.0001	<0.0001	<0.0001			
[redacted]	mg/L	0.05	<0.05	<0.05			
B	mg/L	0.01	0.04	<0.01			
[redacted]	mg/L	0.01	0.17	0.04			
[redacted]	mg/L	0.002	<0.002	<0.002			
[redacted]	mg/L	1	89	59			
Cd	mg/L	0.0001	<0.0001	<0.0001			
[redacted]	mg/L	1	11	9			
[redacted]	mg/L	0.0002	0.0031	0.0003			
Cr	mg/L	0.001	0.005	0.003			
[redacted]	mg/L	0.001	0.002	<0.001			
[redacted]OC	mg/L	0.5	4.5	5.5			
[redacted]	mg/L	0.01	8.53	0.99			
Hardness as CaCO3	mg/L	1	305	213			
[redacted]	mg/L	0.001	<0.001	<0.001			
[redacted]	mg/L	1	20	16			
Mn	mg/L	0.01	0.19	0.36			
[redacted]	mg/L	0.01	<0.01	<0.01			
[redacted]	mg/L	0.01	<0.01	<0.01			
[redacted]-NH3	mg/L	0.02	1.70	0.15			
N-NO2	mg/L	0.10	<0.10	<0.10			
[redacted]-NO3	mg/L	0.10	<0.10	<0.10			
[redacted]henols	mg/L	0.001	<0.001	<0.001			
K	mg/L	1	8	2			
[redacted]	mg/L	0.01	24.0	23.4			
[redacted]	mg/L	2	29	18			
[redacted]	mg/L	0.003	0.279	0.114			
SO4	mg/L	1	8	44			

[redacted]DL = Method Detection Limit INC = Incomplete

[redacted]omment:

APPROVAL: _____

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ACCUTEST LABORATORIES LTD.

REPORT OF ANALYSIS

Client: Golder Associates Ltd.

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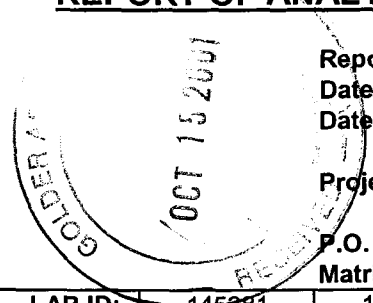

Report Number: 2110654
Date: 2001-10-09
Date Submitted: 2001-09-19

Project: 011-2825

P.O. Number: 210137
Matrix: Groundwater

		LAB ID:	145381	145382			
		Sample Date:	01-9B	01-10			
		Sample ID:	01-9B	01-10			
PARAMETER	**UNITS**	**MDL**					
Tl	mg/L	0.001	<0.001	<0.001			
Sn	mg/L	0.01	<0.01	<0.01			
Ti	mg/L	0.01	<0.01	<0.01			
TDS	mg/L	10	420	304			
Total Kjeldahl Nitrogen	mg/L	0.05	1.97	0.34			
Total P	mg/L	0.01	2.28	2.34			
V	mg/L	0.001	<0.001	<0.001			
Zn	mg/L	0.01	<0.01	<0.01			

MDL = Method Detection Limit INC = Incomplete
Comment:

APPROVAL:

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APPENDIX E

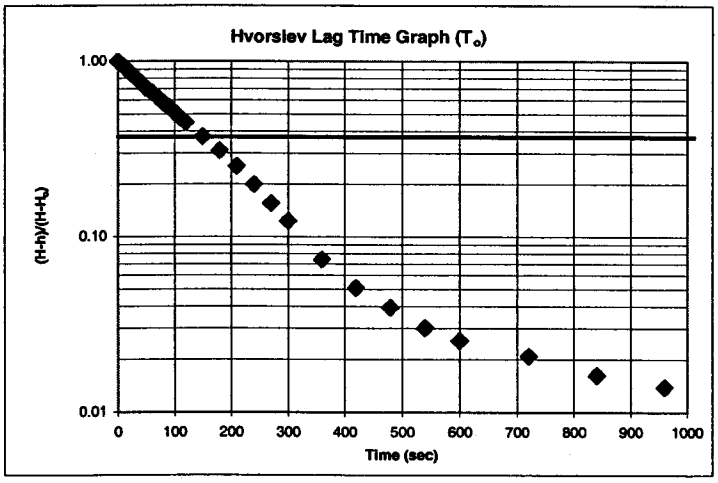
IN-SITU HYDRAULIC CONDUCTIVITY DATA (2001)

Hvorslev Calculation
(for Hydraulic Conductivity from Response Tests)

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Well Name =	**BH01-10**	
Well Depth =	2.74 m	
Initial WL (H_o) =	1.00 m	
Radius of pipe (r) =	0.025 m	(2inch diameter)
Radius of hole (R) =	0.102 m	(8inch diameter)
Length of screen (L) =	1.830 m	(5 feet)
$H-H_o$ =	2.160 m	
Lag time (T_o) =	146 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**3.49E-06 m/s** **3.49E-04 cm/s**	

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.16	2.16	1.00
10	3.02	2.02	0.94
20	2.89	1.89	0.87
30	2.76	1.76	0.81
40	2.64	1.64	0.76
50	2.52	1.52	0.70
60	2.44	1.44	0.66
70	2.34	1.34	0.62
80	2.26	1.26	0.58
90	2.19	1.19	0.55
100	2.11	1.11	0.51
110	2.03	1.03	0.48
120	1.97	0.97	0.45
150	1.81	0.81	0.37
180	1.67	0.67	0.31
210	1.55	0.55	0.25
240	1.43	0.43	0.20
270	1.34	0.34	0.16
300	1.27	0.27	0.12
360	1.16	0.16	0.07
420	1.11	0.11	0.05
480	1.09	0.09	0.04
540	1.07	0.06	0.03
600	1.06	0.05	0.03
720	1.05	0.04	0.02
840	1.04	0.03	0.02
960	1.03	0.03	0.01
1080	1.03	0.02	0.01
1200	1.03	0.02	0.01
1320	1.02	0.02	0.01



Prepared by: MAV
Checked by: JO

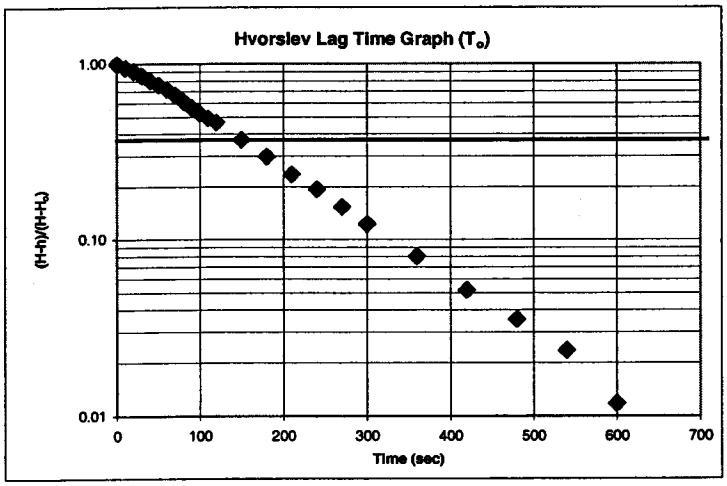
Hvorslev Calculation
(for Hydraulic Conductivity from Response Tests)

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Well Name =	**BH01-9B**	
Well Depth =	2.44 m	
Initial WL (H_o) =	1.02 m	
Radius of pipe (r) =	0.019 m	(1.5inch diameter)
Radius of hole (R) =	0.102 m	(8inch diameter)
Length of screen (L) =	1.680 m	(5 feet)
$H-H_o$ =	2.120 m	
Lag time (T_o) =	150 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)

Hydraulic Cond.(K) = 2.02E-06 m/s
2.02E-04 cm/s

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.14	2.12	1.00
10	3.04	2.02	0.95
20	2.95	1.93	0.91
30	2.84	1.82	0.86
40	2.72	1.70	0.80
50	2.63	1.61	0.76
60	2.54	1.52	0.72
70	2.43	1.41	0.67
80	2.32	1.30	0.61
90	2.22	1.20	0.57
100	2.13	1.11	0.52
110	2.06	1.04	0.49
120	2.01	0.99	0.46
150	1.81	0.79	0.37
180	1.65	0.63	0.30
210	1.52	0.50	0.24
240	1.43	0.41	0.19
270	1.35	0.33	0.15
300	1.28	0.26	0.12
360	1.19	0.17	0.08
420	1.13	0.11	0.05
480	1.10	0.08	0.04
540	1.07	0.05	0.02
600	1.05	0.02	0.01
720	1.04	0.01	0.01
840	1.03	0.01	0.00



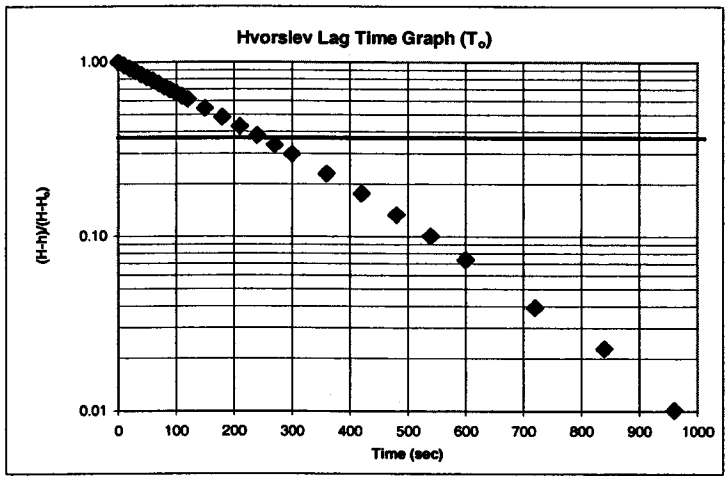
Prepared by: MAV
Checked by: JO

Hvorslev Calculation
(for Hydraulic Conductivity from Response Tests)

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Well Name =	**BH01-9A**	
Well Depth =	4.57 m	
Initial WL (H_o) =	1.07 m	
Radius of pipe (r) =	0.025 m	(2inch diameter)
Radius of hole (R) =	0.102 m	(8inch diameter)
Length of screen (L) =	2.000 m	
$H-H_o$ =	3.940 m	
Lag time (T_o) =	247 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**1.95E-06 m/s** **1.95E-04 cm/s**	

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	5.01	3.94	1.00
10	4.85	3.78	0.96
20	4.70	3.63	0.92
30	4.56	3.49	0.89
40	4.42	3.35	0.85
50	4.28	3.21	0.81
60	4.16	3.09	0.78
70	4.04	2.97	0.75
80	3.92	2.85	0.72
90	3.81	2.74	0.69
100	3.70	2.63	0.67
110	3.58	2.51	0.64
120	3.49	2.42	0.61
150	3.21	2.14	0.54
180	2.97	1.90	0.48
210	2.76	1.69	0.43
240	2.57	1.50	0.38
270	2.39	1.32	0.34
300	2.24	1.17	0.30
360	1.98	0.91	0.23
420	1.77	0.70	0.18
480	1.60	0.53	0.13
540	1.47	0.40	0.10
600	1.36	0.29	0.07
720	1.23	0.16	0.04
840	1.16	0.09	0.02
960	1.11	0.04	0.01
1080	1.10	0.02	0.01
1200	1.09	0.01	0.00



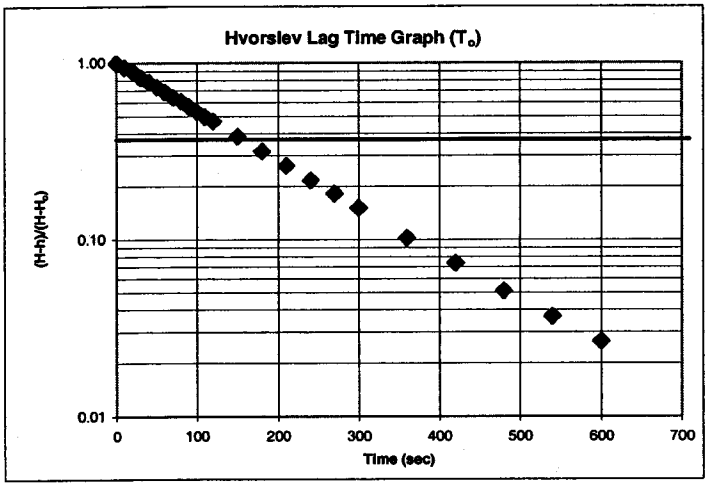
Prepared by: MAV
Checked by: JO

Hvorslev Calculation
(for Hydraulic Conductivity from Response Tests)

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Well Name =	**BH01-8B**	
Well Depth =	3.08 m	
Initial WL (H_o) =	1.36 m	
Radius of pipe (r) =	0.019 m	(1.5inch diameter)
Radius of hole (R) =	0.102 m	(8inch diameter)
Length of screen (L) =	1.710 m	
$H-H_o$ =	2.450 m	
Lag time (T_o) =	156 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**1.92E-06 m/s**	
	1.92E-04 cm/s	

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	3.81	2.45	1.00
10	3.67	2.31	0.94
20	3.56	2.20	0.90
30	3.39	2.03	0.83
40	3.28	1.92	0.78
50	3.16	1.80	0.73
60	3.04	1.68	0.69
70	2.93	1.57	0.64
80	2.85	1.49	0.61
90	2.75	1.39	0.57
100	2.66	1.30	0.53
110	2.58	1.22	0.50
120	2.51	1.15	0.47
150	2.30	0.94	0.38
180	2.14	0.78	0.32
210	2.00	0.64	0.26
240	1.89	0.53	0.22
270	1.81	0.45	0.18
300	1.73	0.37	0.15
360	1.61	0.25	0.10
420	1.54	0.18	0.07
480	1.49	0.13	0.05
540	1.45	0.09	0.04
600	1.43	0.06	0.03
720	1.40	0.03	0.01
840	1.38	0.02	0.01
960	1.375	0.01	0.01
1080	1.37	0.01	0.00

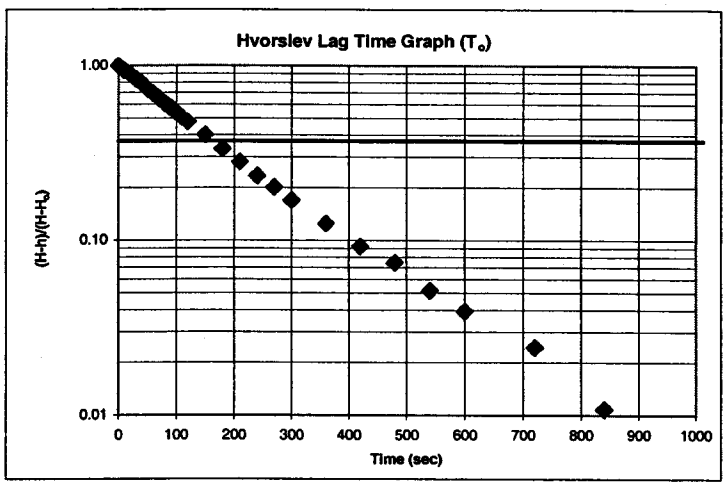


Hvorslev Calculation
(for Hydraulic Conductivity from Response Tests)

Hvorslev Formula: $K = [r^2 \ln(L/R)] / [2LT_o]$

Well Name =	**BH01-8A**	
Well Depth =	5.03 m	
Initial WL (H_o) =	1.37 m	
Radius of pipe (r) =	0.025 m	(2inch diameter)
Radius of hole (R) =	0.102 m	(8inch diameter)
Length of screen (L) =	1.620 m	
$H-H_o$ =	3.690 m	
Lag time (T_o) =	163 sec	(time at $(H-h)/(H-H_o)$ = 0.37 on graph)
Hydraulic Cond.(K) =	**3.38E-06 m/s** **3.38E-04 cm/s**	

Time (sec)	WL (m)	H-h (m)	$(H-h)/(H-H_o)$
0	5.06	3.69	1.00
10	4.83	3.46	0.94
20	4.66	3.29	0.89
30	4.45	3.08	0.83
40	4.29	2.92	0.79
50	4.08	2.71	0.73
60	3.92	2.55	0.69
70	3.77	2.40	0.65
80	3.61	2.24	0.61
90	3.49	2.12	0.57
100	3.35	1.98	0.54
110	3.23	1.86	0.50
120	3.12	1.75	0.47
150	2.85	1.48	0.40
180	2.60	1.23	0.33
210	2.41	1.04	0.28
240	2.23	0.86	0.23
270	2.11	0.74	0.20
300	2.00	0.63	0.17
360	1.83	0.46	0.12
420	1.71	0.34	0.09
480	1.65	0.28	0.07
540	1.56	0.19	0.05
600	1.52	0.15	0.04
720	1.46	0.09	0.02
840	1.41	0.04	0.01
960	1.40	0.02	0.01



Prepared by: MAV
Checked by: JO

APPENDIX F

GROUNDWATER CHEMICAL DATA

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-1A**

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	156	147	125
Aluminum	0.1	3.780	0.570	<0.050
Ammonia (as N)		1.40	0.77	0.67
Barium	1	0.040	0.010	<0.010
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.090	0.100	<0.010
Cadmium	0.005	<0.00500	<0.00010	<0.00010
Calcium		32.0	14.0	15.0
Chloride	250	5.0	1.0	1.0
Chromium	0.05	<0.010	0.001	0.001
Cobalt		<0.0100	0.0002	<0.0002
COD		68	27	11
Conductivity (uS/cm)		420	400	325
Copper	1	0.0100	<0.0010	<0.0010
DOC	5	13.1	6.1	5.2
Hardness (CaCO3)	80-100	121	60	62
Iron	0.3	3.46	0.58	<0.01
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		10.00	6.00	6.00
Manganese	0.05	0.140	0.050	<0.010
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.4	8.0	7.3
Phenols		<0.001	0.003	<0.001
Phosphorus (total)		0.21	6.58	8.35
Potassium		7.0	6.0	3.0
Silicon		7.79	5.89	6.23
Silver		<0.0100	<0.0001	<0.0001
Sodium	200	59.0	60.0	54.0
Strontium		0.171	0.069	0.091
Sulphate	500	99.0	39.0	43.0
Sulphur		31		
TDS	500	380	252	244
Temperature (C)	15	8.0	8.0	10.0
Thallium		<0.20000	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.170	0.030	<0.010
TKN		1.40	0.89	0.70
Vanadium		<0.0100	0.0020	<0.0010
Zinc	5	0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-1B** Sheet: 1

Parameter	ODWS/O	Date Sampled: 19-Aug-2000	11-Jun-2001	18-Sep-2001
Alkalinity (CaCO3)	30-500	166	165	WELL DRY
Aluminum	0.1	1.180	1.910	
Ammonia (as N)		0.49	0.26	
Barium	1	0.050	<0.010	
Beryllium		<0.002	<0.002	
Boron	5	0.010	<0.010	
Cadmium	0.005	<0.00500	<0.00010	
Calcium		34.0	8.0	
Chloride	250	2.0	1.0	
Chromium	0.05	<0.010	<0.001	
Cobalt		<0.0100	<0.0002	
COD		58	22	
Conductivity (uS/cm)		400	420	
Copper	1	<0.0100	0.0020	
DOC	5	20.1	9.0	
Hardness (CaCO3)	80-100	118	32	
Iron	0.3	0.92	0.12	
Lead	0.01	<0.0010	<0.0010	
Magnesium		8.00	3.00	
Manganese	0.05	0.110	<0.010	
Molybdenum		<0.010	<0.010	
Nickel		<0.010	<0.010	
Nitrate (as N)	10	<0.10	<0.10	
Nitrite (as N)	1		<0.10	
pH (pH units)	6.5-8.5	7.1	7.3	
Phenols		<0.001	0.001	
Phosphorus (total)		0.06	6.27	
Potassium		7.0	19.0	
Silicon		4.22	1.43	
Silver		<0.0100	<0.0001	
Sodium	200	31.0	32.0	
Strontium		0.144	0.032	
Sulphate	500	39.0	15.0	
Sulphur		12		
TDS	500	300	140	
Temperature (C)	15	9.0	10.0	
Thallium		<0.20000	<0.00100	
Tin		<0.010	<0.010	
Titanium		0.060	0.010	
TKN		0.69	0.41	
Vanadium		<0.0100	0.0280	
Zinc	5	<0.010	<0.010	

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-2A**

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	408	390	372
Aluminum	0.1	1.580	<0.050	<0.050
Ammonia (as N)		0.49	0.26	0.27
Barium	1	0.140	0.110	0.110
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.020	0.020	<0.010
Cadmium	0.005	<0.00500	<0.00010	<0.00010
Calcium		86.0	85.0	77.0
Chloride	250	10.0	8.0	8.0
Chromium	0.05	<0.010	0.001	0.006
Cobalt		<0.0100	0.0002	0.0004
COD		33	16	27
Conductivity (uS/cm)		500	610	500
Copper	1	<0.0100	<0.0010	<0.0010
DOC	5	9.3	6.9	6.2
Hardness (CaCO3)	80-100	351	336	304
Iron	0.3	2.58	1.27	1.34
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		33.00	30.00	27.00
Manganese	0.05	0.460	0.420	0.370
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.5	7.5	7.4
Phenols		<0.001	0.001	<0.001
Phosphorus (total)		<0.01	7.21	5.29
Potassium		5.0	5.0	5.0
Silicon		10.30	8.67	10.40
Silver		<0.0100	<0.0001	<0.0001
Sodium	200	25.0	18.0	23.0
Strontium		0.405	0.316	0.210
Sulphate	500	30.0	15.0	12.0
Sulphur		10		
TDS	500	496	436	420
Temperature (C)	15	7.0	9.0	9.0
Thallium		<0.20000	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.070	<0.010	<0.010
TKN		0.80	0.41	0.57
Vanadium		<0.0100	<0.0010	<0.0010
Zinc	5	0.090	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-2B** Sheet: 1

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	349	204	I.S.
Aluminum	0.1	1.050	0.860	
Ammonia (as N)		15.50	15.40	
Barium	1	0.200	0.120	
Beryllium		<0.002	<0.002	
Boron	5	<0.010	0.240	
Cadmium	0.005	<0.00500	<0.00010	
Calcium		70.0	40.0	
Chloride	250	7.0	11.0	
Chromium	0.05	<0.010	0.005	
Cobalt		<0.0100	0.0041	
COD		375	132	
Conductivity (uS/cm)		600	550	
Copper	1	<0.0100	<0.0010	
DOC	5	140.0	47.1	
Hardness (CaCO3)	80-100	233	129	
Iron	0.3	24.30	61.60	
Lead	0.01	<0.0010	<0.0010	
Magnesium		14.00	7.00	
Manganese	0.05	2.090	1.470	
Molybdenum		<0.010	<0.010	
Nickel		<0.010	<0.010	
Nitrate (as N)	10	<0.10	<0.10	
Nitrite (as N)	1		<0.10	
pH (pH units)	6.5-8.5	7.2	7.2	
Phenols		<0.001	<0.001	
Phosphorus (total)		0.40	7.21	
Potassium		13.0	12.0	
Silicon		5.83	3.70	
Silver		<0.0100	<0.0001	
Sodium	200	39.0	32.0	
Strontium		0.276	0.123	
Sulphate	500	41.0	39.0	
Sulphur		13		
TDS	500	528	340	
Temperature (C)	15	9.0	11.0	
Thallium		<0.20000	<0.00100	
Tin		<0.010	<0.010	
Titanium		0.030	0.010	
TKN		15.50	17.90	
Vanadium		0.0100	0.0060	
Zinc	5	<0.010	0.010	

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-3A**

Sheet: 1

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	122	113	112
Aluminum	0.1	1.140	<0.050	<0.050
Ammonia (as N)		0.73	0.28	0.09
Barium	1	0.080	0.030	0.020
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.030	0.030	<0.010
Cadmium	0.005	<0.00500	<0.00010	<0.00010
Calcium		48.0	48.0	34.0
Chloride	250	8.0	2.0	2.0
Chromium	0.05	<0.010	<0.001	0.001
Cobalt		<0.0100	<0.0002	<0.0002
COD		28	<5	<5
Conductivity (uS/cm)		800	750	700
Copper	1	<0.0100	<0.0010	0.0010
DOC	5	5.8	3.3	2.4
Hardness (CaCO3)	80-100	190	194	143
Iron	0.3	1.02	0.13	<0.01
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		17.00	18.00	14.00
Manganese	0.05	0.070	0.040	<0.010
Molybdenum		0.020	0.030	0.030
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	6.94	0.29	0.31
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.2	7.1	7.3
Phenols		<0.001	0.001	<0.001
Phosphorus (total)		0.41	0.84	0.44
Potassium		6.0	6.0	5.0
Silicon		5.51	5.81	6.70
Silver		<0.0100	<0.0001	<0.0001
Sodium	200	149.0	102.0	93.0
Strontium		0.318	0.270	0.261
Sulphate	500	365.0	300.0	251.0
Sulphur		120		
TDS	500	768	552	492
Temperature (C)	15	8.0	8.0	8.5
Thallium		<0.20000	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.050	<0.010	<0.010
TKN		0.82	0.43	0.25
Vanadium		<0.0100	<0.0010	<0.0010
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-3B** Sheet: 1

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	438	567	814
Aluminum	0.1	0.410	<0.050	<0.050
Ammonia (as N)		0.66	0.65	0.56
Barium	1	0.160	0.100	0.100
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.120	0.140	0.010
Cadmium	0.005	<0.00500	<0.00010	<0.00010
Calcium		369.0	454.0	558.0
Chloride	250	73.0	79.0	116.0
Chromium	0.05	<0.010	0.003	0.022
Cobalt		<0.0100	0.0025	0.0007
COD		50	55	69
Conductivity (uS/cm)		1600	1400	2700
Copper	1	0.0100	<0.0010	0.0010
DOC	5	14.3	13.4	22.8
Hardness (CaCO3)	80-100	1310	1560	1940
Iron	0.3	10.00	10.80	22.30
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		93.00	103.00	132.00
Manganese	0.05	1.810	1.850	1.630
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.0	7.1	7.4
Phenols		<0.001	<0.001	<0.001
Phosphorus (total)		0.10	1.59	0.18
Potassium		6.0	5.0	7.0
Silicon		11.20	9.93	20.20
Silver		<0.0100	<0.0001	<0.0001
Sodium	200	43.0	23.0	31.0
Strontium		0.683	0.629	0.891
Sulphate	500	865.0	907.0	1230.0
Sulphur		239		
TDS	500	1872	2220	2800
Temperature (C)	15	9.0	12.0	9.0
Thallium		<0.20000	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.020	<0.010	<0.010
TKN		1.49	1.28	1.61
Vanadium		<0.0100	<0.0010	0.0050
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-4A**

Sheet: 1

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	397	330	341
Aluminum	0.1	0.430	<0.050	<0.050
Ammonia (as N)		0.97	0.63	0.36
Barium	1	0.180	0.140	0.200
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.090	0.070	0.060
Cadmium	0.005	<0.00500	<0.00010	<0.00010
Calcium		92.0	72.0	76.0
Chloride	250	13.0	12.0	11.0
Chromium	0.05	<0.010	0.001	0.009
Cobalt		<0.0100	0.0025	0.0046
COD		35	16	16
Conductivity (uS/cm)		600	560	600
Copper	1	<0.0100	<0.0010	<0.0010
DOC	5	8.4	7.5	4.1
Hardness (CaCO3)	80-100	321	262	268
Iron	0.3	12.10	10.40	24.00
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		22.00	20.00	19.00
Manganese	0.05	0.370	0.250	0.230
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.4	7.1	7.3
Phenols		<0.001	0.003	<0.001
Phosphorus (total)		0.02	3.15	0.80
Potassium		7.0	5.0	7.0
Silicon		14.90	12.20	31.30
Silver		<0.0100	<0.0001	<0.0001
Sodium	200	30.0	33.0	31.0
Strontium		0.427	0.291	0.339
Sulphate	500	26.0	15.0	8.0
Sulphur		10		
TDS	500	460	376	420
Temperature (C)	15	8.0	9.0	8.5
Thallium		<0.20000	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.020	<0.010	<0.010
TKN		1.28	0.87	0.57
Vanadium		<0.0100	<0.0010	0.0010
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-4B** Sheet: 1

Date Sampled:		19-Aug-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	397	611	I.S.
Aluminum	0.1	0.560	0.400	
Ammonia (as N)		5.47	40.20	
Barium	1	0.350	1.110	
Beryllium		<0.002	<0.002	
Boron	5	0.110	0.110	
Cadmium	0.005	<0.00500	<0.00010	
Calcium		127.0	94.0	
Chloride	250	20.0	3.0	
Chromium	0.05	<0.010	0.009	
Cobalt		<0.0100	0.0099	
COD		90	149	
Conductivity (uS/cm)		800	830	
Copper	1	0.0100	<0.0010	
DOC	5	28.0	70.8	
Hardness (CaCO3)	80-100	441	309	
Iron	0.3	20.80	138.00	
Lead	0.01	<0.0010	<0.0010	
Magnesium		30.00	18.00	
Manganese	0.05	1.420	2.200	
Molybdenum		0.010	<0.010	
Nickel		<0.010	<0.010	
Nitrate (as N)	10	<0.10	<0.10	
Nitrite (as N)	1		<0.10	
pH (pH units)	6.5-8.5	7.1	6.3	
Phenols		<0.001	0.002	
Phosphorus (total)		0.03	0.02	
Potassium		19.0	71.0	
Silicon		10.30	6.54	
Silver		<0.0100	<0.0001	
Sodium	200	66.0	43.0	
Strontium		0.885	0.642	
Sulphate	500	79.0	21.0	
Sulphur		25		
TDS	500	736	776	
Temperature (C)	15	10.0	12.0	
Thallium		<0.20000	<0.00100	
Tin		<0.010	<0.010	
Titanium		0.040	<0.010	
TKN		5.93	43.00	
Vanadium		<0.0100	0.0070	
Zinc	5	<0.010	0.020	

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-5A**

Sheet: 1

Date Sampled:		29-Nov-2000	12-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	98	100	112
Aluminum	0.1	0.730	<0.050	<0.050
Ammonia (as N)		0.22	0.13	0.10
Barium	1	0.030	0.010	0.020
Beryllium		<0.002	<0.002	<0.002
Boron	5	<0.010	0.010	<0.010
Cadmium	0.005	<0.00010	<0.00010	<0.00010
Calcium		19.0	23.0	34.0
Chloride	250	1.0	1.0	1.0
Chromium	0.05	<0.010	<0.001	0.002
Cobalt		0.0007	<0.0002	<0.0002
COD		<4	5	11
Conductivity (uS/cm)		160	160	675
Copper	1	0.0020	<0.0010	<0.0010
DOC	5	2.0	1.2	2.9
Hardness (CaCO3)	80-100	85	90	143
Iron	0.3	0.93	0.07	<0.01
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		9.00	8.00	14.00
Manganese	0.05	0.060	0.040	<0.010
Molybdenum		<0.010	<0.010	0.030
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	0.22
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	8.2	7.3	7.4
Phenols		<0.001	0.002	<0.001
Phosphorus (total)		3.48	1.33	0.42
Potassium		4.0	4.0	5.0
Silicon		8.26	6.20	6.72
Silver		<0.0001	<0.0001	<0.0001
Sodium	200	11.0	11.0	88.0
Strontium		0.080	0.072	0.264
Sulphate	500	8.0	8.0	237.0
TDS	500	112	176	476
Temperature (C)	15	7.0	9.0	9.0
Thallium		<0.00100	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.040	<0.010	<0.010
TKN		0.23	0.17	0.18
Vanadium		0.0020	<0.0010	<0.0010
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-5B** Sheet: 1

Date Sampled:		29-Nov-2000	12-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	119	108	828
Aluminum	0.1	0.290	<0.050	<0.050
Ammonia (as N)		0.15	0.10	0.48
Barium	1	0.040	0.030	0.100
Beryllium		<0.002	<0.002	<0.002
Boron	5	<0.010	<0.010	0.010
Cadmium	0.005	<0.00010	<0.00010	<0.00010
Calcium		27.0	27.0	558.0
Chloride	250	1.0	<1.0	111.0
Chromium	0.05	<0.010	<0.001	0.016
Cobalt		0.0006	<0.0002	0.0006
COD		8	5	75
Conductivity (uS/cm)		190	120	2650
Copper	1	0.0080	<0.0010	0.0010
DOC	5	3.2	1.1	21.1
Hardness (CaCO3)	80-100	109	105	1920
Iron	0.3	0.30	0.02	24.90
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		10.00	9.00	128.00
Manganese	0.05	0.050	0.050	1.640
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.4	7.5	7.5
Phenols		<0.001	<0.001	<0.001
Phosphorus (total)		2.75	2.18	1.13
Potassium		3.0	3.0	7.0
Silicon		8.02	6.62	22.30
Silver		<0.0001	<0.0001	<0.0001
Sodium	200	6.0	4.0	33.0
Strontium		0.082	0.060	0.875
Sulphate	500	8.0	8.0	1180.0
TDS	500	136	128	2740
Temperature (C)	15	7.0	11.0	7.5
Thallium		<0.00100	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.020	<0.010	<0.010
TKN		0.23	0.11	0.72
Vanadium		0.0030	<0.0010	0.0030
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-6A**

Sheet: 1

Date Sampled:		29-Nov-2000	12-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	245	294	110
Aluminum	0.1	0.170	<0.050	<0.050
Ammonia (as N)		0.36	0.27	0.08
Barium	1	0.110	0.140	0.020
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.010	0.030	<0.010
Cadmium	0.005	<0.00010	<0.00010	<0.00010
Calcium		54.0	80.0	37.0
Chloride	250	4.0	10.0	1.0
Chromium	0.05	<0.010	<0.001	0.002
Cobalt		0.0003	<0.0002	<0.0002
COD		35	38	11
Conductivity (uS/cm)		320	540	700
Copper	1	0.0020	<0.0010	<0.0010
DOC	5	14.9	14.7	2.7
Hardness (CaCO3)	80-100	213	303	150
Iron	0.3	2.25	4.58	<0.01
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		19.00	25.00	14.00
Manganese	0.05	0.340	0.550	<0.010
Molybdenum		<0.010	<0.010	0.030
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	0.27
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.6	7.3	7.3
Phenols		0.003	0.007	<0.001
Phosphorus (total)		15.40	3.74	0.36
Potassium		5.0	4.0	5.0
Silicon		13.40	10.30	6.77
Silver		<0.0001	<0.0001	<0.0001
Sodium	200	17.0	25.0	85.0
Strontium		0.203	0.211	0.266
Sulphate	500	12.0	64.0	256.0
TDS	500	300	388	456
Temperature (C)	15	8.0	9.0	8.0
Thallium		<0.00100	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		<0.010	<0.010	<0.010
TKN		0.60	0.72	0.27
Vanadium		0.0030	0.0010	<0.0010
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-6B** Sheet: 1

Date Sampled:		29-Nov-2000	12-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	359	316	797
Aluminum	0.1	0.230	0.500	<0.050
Ammonia (as N)		0.16	0.25	1.29
Barium	1	0.160	0.130	0.110
Beryllium		<0.002	<0.002	<0.002
Boron	5	0.030	0.080	<0.010
Cadmium	0.005	<0.00010	<0.00010	<0.00010
Calcium		144.0	111.0	563.0
Chloride	250	23.0	24.0	111.0
Chromium	0.05	<0.010	0.002	0.015
Cobalt		0.0015	0.0006	0.0005
COD		141	137	75
Conductivity (uS/cm)		850	840	2700
Copper	1	0.0030	<0.0010	0.0010
DOC	5	71.7	53.7	20.2
Hardness (CaCO3)	80-100	512	401	2000
Iron	0.3	6.75	6.34	21.90
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		37.00	30.00	144.00
Manganese	0.05	1.350	0.820	1.650
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10	<0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	6.8	6.7	7.2
Phenols		0.006	<0.001	<0.001
Phosphorus (total)		3.76	6.54	2.89
Potassium		4.0	3.0	7.0
Silicon		10.60	6.45	19.90
Silver		<0.0001	<0.0001	<0.0001
Sodium	200	29.0	72.0	32.0
Strontium		0.302	0.184	0.883
Sulphate	500	199.0	235.0	1180.0
TDS	500	720	368	2710
Temperature (C)	15	5.0	10.0	7.5
Thallium		<0.00100	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		<0.010	<0.010	<0.010
TKN		1.23	1.27	2.60
Vanadium		0.0060	0.0040	0.0030
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 00-7**

Sheet: 1

Date Sampled:		29-Nov-2000	11-Jun-2001	18-Sep-2001
Parameter	ODWS/O			
Alkalinity (CaCO3)	30-500	97	80	123
Aluminum	0.1	0.460	<0.050	<0.050
Ammonia (as N)		0.14	0.09	0.51
Barium	1	0.030	0.020	<0.010
Beryllium		<0.002	<0.002	<0.002
Boron	5	<0.010	<0.010	<0.010
Cadmium	0.005	<0.00010	<0.00010	<0.00010
Calcium		25.0	24.0	15.0
Chloride	250	3.0	1.0	2.0
Chromium	0.05	<0.010	<0.001	<0.001
Cobalt		0.0005	<0.0002	<0.0002
COD		14	18	16
Conductivity (uS/cm)		140	150	430
Copper	1	0.0020	<0.0010	<0.0010
DOC	5	4.6	6.3	3.6
Hardness (CaCO3)	80-100	100	89	58
Iron	0.3	0.81	0.09	<0.01
Lead	0.01	<0.0010	<0.0010	<0.0010
Magnesium		9.00	6.00	5.00
Manganese	0.05	0.080	0.050	<0.010
Molybdenum		<0.010	<0.010	<0.010
Nickel		<0.010	<0.010	<0.010
Nitrate (as N)	10	0.11	<0.10	0.10
Nitrite (as N)	1		<0.10	<0.10
pH (pH units)	6.5-8.5	7.7	7.3	7.4
Phenols		0.002	0.002	<0.001
Phosphorus (total)		3.53	5.85	4.53
Potassium		3.0	4.0	3.0
Silicon		8.48	7.37	6.05
Silver		<0.0001	<0.0001	<0.0001
Sodium	200	4.0	3.0	44.0
Strontium		0.073	0.053	0.089
Sulphate	500	7.0	8.0	38.0
TDS	500	124	100	208
Temperature (C)	15	7.0	8.0	10.0
Thallium		<0.00100	<0.00100	<0.00100
Tin		<0.010	<0.010	<0.010
Titanium		0.020	<0.010	<0.010
TKN		0.19	0.13	0.81
Vanadium		0.0020	<0.0010	<0.0010
Zinc	5	<0.010	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 01-8A** Sheet: 1

Parameter	ODWS/O	Date Sampled: 12-Jun-2001	18-Sep-2001
Alkalinity (CaCO3)	30-500	560	122
Aluminum	0.1	<0.050	<0.050
Ammonia (as N)		0.24	0.42
Barium	1	0.150	<0.010
Beryllium		<0.002	<0.002
Boron	5	<0.010	<0.010
Cadmium	0.005	<0.00010	<0.00010
Calcium		152.0	14.0
Chloride	250	36.0	1.0
Chromium	0.05	0.002	<0.001
Cobalt		0.0015	<0.0002
COD		41	11
Conductivity (uS/cm)		880	430
Copper	1	0.0010	<0.0010
DOC	5	15.6	2.4
Hardness (CaCO3)	80-100	615	56
Iron	0.3	2.65	<0.01
Lead	0.01	<0.0010	<0.0010
Magnesium		57.00	5.00
Manganese	0.05	0.850	<0.010
Molybdenum		<0.010	<0.010
Nickel		<0.010	<0.010
Nitrate (as N)	10	0.11	<0.10
Nitrite (as N)	1	<0.10	<0.10
pH (pH units)	6.5-8.5	7.0	7.3
Phenols		<0.001	<0.001
Phosphorus (total)		0.58	2.82
Potassium		6.0	3.0
Silicon		8.45	6.00
Silver		<0.0001	<0.0001
Sodium	200	14.0	43.0
Strontium		0.400	0.088
Sulphate	500	47.0	36.0
TDS	500	728	188
Temperature (C)	15	8.0	7.5
Thallium		<0.00100	<0.00100
Tin		<0.010	<0.010
Titanium		<0.010	<0.010
TKN		0.60	0.74
Vanadium		<0.0010	<0.0010
Zinc	5	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 01-8B**

Sheet: 1

Parameter	ODWS/O	Date Sampled: 12-Jun-2001	18-Sep-2001
Alkalinity (CaCO3)	30-500	352	100
Aluminum	0.1	<0.050	0.280
Ammonia (as N)		1.40	0.23
Barium	1	0.130	0.010
Beryllium		<0.002	<0.002
Boron	5	0.040	<0.010
Cadmium	0.005	<0.00010	<0.00010
Calcium		90.0	19.0
Chloride	250	4.0	3.0
Chromium	0.05	0.001	<0.001
Cobalt		0.0024	<0.0002
COD		27	32
Conductivity (uS/cm)		580	280
Copper	1	<0.0010	0.0020
DOC	5	9.3	7.8
Hardness (CaCO3)	80-100	279	48
Iron	0.3	7.67	0.01
Lead	0.01	<0.0010	<0.0010
Magnesium		13.00	<1.00
Manganese	0.05	3.250	<0.010
Molybdenum		<0.010	<0.010
Nickel		<0.010	<0.010
Nitrate (as N)	10	0.27	<0.10
Nitrite (as N)	1	<0.10	<0.10
pH (pH units)	6.5-8.5	6.8	7.4
Phenols		0.002	<0.001
Phosphorus (total)		1.44	6.99
Potassium		13.0	15.0
Silicon		12.90	1.84
Silver		<0.0001	<0.0001
Sodium	200	56.0	24.0
Strontium		0.402	0.079
Sulphate	500	79.0	17.0
TDS	500	500	144
Temperature (C)	15	11.0	8.0
Thallium		<0.00100	<0.00100
Tin		<0.010	<0.010
Titanium		<0.010	<0.010
TKN		1.41	0.54
Vanadium		<0.0010	0.0150
Zinc	5	0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 01-9A** Sheet: 1

Parameter	ODWS/O	Date Sampled: 12-Jun-2001	18-Sep-2001
Alkalinity (CaCO3)	30-500	207	370
Aluminum	0.1	<0.050	<0.050
Ammonia (as N)		0.28	2.54
Barium	1	0.080	0.150
Beryllium		<0.002	<0.002
Boron	5	0.010	0.030
Cadmium	0.005	<0.00010	<0.00010
Calcium		54.0	76.0
Chloride	250	2.0	11.0
Chromium	0.05	0.001	0.005
Cobalt		<0.0002	0.0026
COD		27	16
Conductivity (uS/cm)		320	600
Copper	1	<0.0010	<0.0010
DOC	5	10.1	5.2
Hardness (CaCO3)	80-100	197	276
Iron	0.3	2.17	7.70
Lead	0.01	<0.0010	<0.0010
Magnesium		15.00	21.00
Manganese	0.05	0.280	0.180
Molybdenum		<0.010	<0.010
Nickel		<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10
pH (pH units)	6.5-8.5	7.2	7.3
Phenols		<0.001	<0.001
Phosphorus (total)		1.74	2.71
Potassium		3.0	8.0
Silicon		11.80	24.00
Silver		<0.0001	<0.0001
Sodium	200	9.0	28.0
Strontium		0.146	0.256
Sulphate	500	6.0	9.0
TDS	500	264	388
Temperature (C)	15	8.0	8.5
Thallium		<0.00100	<0.00100
Tin		<0.010	<0.010
Titanium		<0.010	<0.010
TKN		0.56	3.00
Vanadium		0.0020	<0.0010
Zinc	5	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 01-9B**

Sheet: 1

Date Sampled:		12-Jun-2001	18-Sep-2001
Parameter	ODWS/O		
Alkalinity (CaCO3)	30-500	177	372
Aluminum	0.1	<0.050	<0.050
Ammonia (as N)		0.11	1.70
Barium	1	0.050	0.170
Beryllium		<0.002	<0.002
Boron	5	<0.010	0.040
Cadmium	0.005	<0.00010	<0.00010
Calcium		48.0	89.0
Chloride	250	3.0	11.0
Chromium	0.05	<0.001	0.005
Cobalt		<0.0002	0.0031
COD		11	11
Conductivity (uS/cm)		280	575
Copper	1	<0.0010	0.0020
DOC	5	5.0	4.5
Hardness (CaCO3)	80-100	174	305
Iron	0.3	1.72	8.53
Lead	0.01	<0.0010	<0.0010
Magnesium		13.00	20.00
Manganese	0.05	0.390	0.190
Molybdenum		<0.010	<0.010
Nickel		<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10
pH (pH units)	6.5-8.5	6.9	7.3
Phenols		<0.001	<0.001
Phosphorus (total)		0.74	2.28
Potassium		2.0	8.0
Silicon		10.20	24.00
Silver		<0.0001	<0.0001
Sodium	200	5.0	29.0
Strontium		0.127	0.279
Sulphate	500	7.0	8.0
TDS	500	216	420
Temperature (C)	15	11.0	8.0
Thallium		<0.00100	<0.00100
Tin		<0.010	<0.010
Titanium		<0.010	<0.010
TKN		0.22	1.97
Vanadium		<0.0010	<0.0010
Zinc	5	<0.010	<0.010

All values reported in mg/L unless otherwise noted.

Golder Associates

WARD 3 LANDFILL (CARRIERE) - REPORT OF MONITORING RESULTS **Project: 011-2825**

Sample Source: **BH 01-10** Sheet: 1

Parameter	ODWS/O	Date Sampled: 12-Jun-2001	18-Sep-2001
Alkalinity (CaCO3)	30-500	234	205
Aluminum	0.1	0.750	<0.050
Ammonia (as N)		0.21	0.15
Barium	1	0.070	0.040
Beryllium		<0.002	<0.002
Boron	5	0.040	<0.010
Cadmium	0.005	<0.00010	<0.00010
Calcium		93.0	59.0
Chloride	250	11.0	9.0
Chromium	0.05	0.002	0.003
Cobalt		0.0026	0.0003
COD		33	16
Conductivity (uS/cm)		540	425
Copper	1	<0.0010	<0.0010
DOC	5	9.5	5.5
Hardness (CaCO3)	80-100	311	213
Iron	0.3	9.33	0.99
Lead	0.01	<0.0010	<0.0010
Magnesium		19.00	16.00
Manganese	0.05	0.660	0.360
Molybdenum		<0.010	<0.010
Nickel		<0.010	<0.010
Nitrate (as N)	10	<0.10	<0.10
Nitrite (as N)	1	<0.10	<0.10
pH (pH units)	6.5-8.5	6.5	7.5
Phenols		<0.001	<0.001
Phosphorus (total)		2.03	2.34
Potassium		2.0	2.0
Silicon		10.30	23.40
Silver		<0.0001	<0.0001
Sodium	200	12.0	18.0
Strontium		0.202	0.114
Sulphate	500	109.0	44.0
TDS	500	444	304
Temperature (C)	15	10.0	7.5
Thallium		<0.00100	<0.00100
Tin		<0.010	<0.010
Titanium		0.020	<0.010
TKN		0.52	0.34
Vanadium		0.0010	<0.0010
Zinc	5	0.010	<0.010

All values reported in mg/L unless otherwise noted.